MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

Petro Mohyla Black Sea National University

Medical Institute

Department of medical biology, microbiology, histology, physiology and pathophysiology

«APPROVED»
The first-vice rector
Ishchenko N.M. _____
«___» _____ 2021

THE WORKING EDUCATIONAL PROGRAM IN THE DISCIPLINE

«PHYSIOLOGY»

in the field of knowledge 22 «Health care»

in the specialty 222 «Medicine»

Developer	Hilmutdinova M.Sh.
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1. Discription of the educational discipline (annotation)

Title of indices	Characterization of educational discipline	
	«Physiology»	
Field of knowledge	22 «Health care»	
Specialty	222 «Medicine»	
Educational program	Master of Medicine	
Higher education level	Master	
Status of discipline	Normative	
Curriculum	2	
Academic year	2021/2022	
Semester number	Full-time	External form of education
	3 - 4	-
Total ECTS credits / hours	7,5 (3,5/4) / 225	
Course structure: – lectures – seminars (practical) – hours of students independent work	Full-time	External form of education
	36 (15/21) 108 (45/63) 81 (30/51)	–
Percentage of classroom load	64 %	
Language of instruction	english	
Interim control form (if there is)	–	
Form of final control	4 semester – exam	

2. Purpose, tasks and results of studying the discipline

Purpose: the purpose of teaching the discipline "Physiology" is to study the function of various cells, tissues, organs and systems in general in order to use the acquired knowledge in the study of the following medical disciplines and in future professional activities. There is an understanding of the concept of health, healthy lifestyle and prevention of dysfunction in the process of life.

Tasks of physiology as a science are:

- a systematic approach to the study of the essence of physiological processes, functions of individual organs, systems and the whole organism;
- study of nervous and endocrine regulation of the body, its organs and systems;
- disclosure of physiological mechanisms of interaction of organs and their systems;
- study of the mechanisms of pharmacological correction of physiological processes of the organism;
- formation of practical skills of definition and an estimation of functional features of an organism in students;
- expanding ideas about the role of studying human physiology for other medical disciplines;
- the ability to draw conclusions about the state of physiological functions of the organism, its systems and organs;
- analysis of age features of body functions and their regulation;
- to analyze the regulated parameters and draw conclusions about the mechanisms of nervous and humoral regulation of physiological functions of the organism and its systems;
- analysis of human health under different conditions on the basis of physiological criteria;
- interpretation of mechanisms and patterns of functioning of excitatory structures of an organism;
- analysis of the state of sensory processes in ensuring human life;
- explanation of physiological bases of methods of research of functions of an organism;
- explanation of the mechanisms of integrative activity of the organism.

Prerequisites for studying the discipline (interdisciplinary connections). The discipline provides training of masters-doctors who have a significant amount of theoretical and practical knowledge about the structural and functional features of the organism at different levels of its organization:

a) is based on the study by students of medical biology, medical and biological physics, medical chemistry, biological and bioorganic chemistry, morphological disciplines and is integrated with these disciplines;

b) lays the foundations for the study of students of pathophysiology and propaedeutics of clinical disciplines, which involves the integration of teaching with these disciplines and the formation of skills to apply knowledge of physiology in the process of further study and professional activities;

c) lays the foundations of a healthy lifestyle and prevention of dysfunction in the process of life.

Expected learning outcomes. As a result of studying the discipline, students have to:

- understand the essence of physiological processes, functions of individual organs, systems and the whole organism; basic provisions of nervous and endocrine regulation of the body, its organs and systems;
- reveal the physiological mechanisms of interaction of organs and their systems; to characterize the mechanisms of pharmacological correction of physiological processes of the organism;
- understand the importance of physiology for medicine and the health care system, its place in the system of medical knowledge, have an idea of its formation, the main stages of development;
- be able to combine the achievements of clinical research and modern experimental approaches in solving current problems of medicine, to have an idea of clinical physiology as a modern direction of development of physiological science;
- understand the role of the experimental method in the study of physiological processes;
- use knowledge of physiology to analyze and assess the state of the organism, disorders of its organs and systems in order to further plan diagnostic tests, treatment and prevention measures.

According to the requirements of the educational and professional program, students must:

a) know:

- basic concepts about the state of physiological functions of the organism, its systems and organs;
- age features of body functions and their regulation;
- regulated parameters and draw conclusions about the mechanisms of nervous and humoral regulation of physiological functions of the organism and its systems;
- the state of human health under different conditions on the basis of physiological criteria;
- mechanisms and patterns of functioning of excitable structures of the body;
- the state of sensory processes in ensuring human life;
- physiological bases of methods of research of functions of an organism;
- mechanisms of integrative activity of the organism;

b) be able to:

- solve situational problems with determining the state of physiological functions of the organism, its systems and organs;
- schematically reflect the mechanisms of nervous and humoral regulation of physiological functions of the organism and its systems;
- analyze and interpret the results of blood, urine, lipidogram, electrocardiograms, spirogram, immunogram, hormonal background;
- on the basis of the results of laboratory and instrumental research to assess the state of functioning of organs and systems of the body;
- analyze the age characteristics of body functions and their regulation;
- explain the physiological basis of methods for studying the functions of the body;
- be able to identify and record the leading typical physiological process, its main link and clinical signs;

- make an informed decision for the appointment of laboratory and / or instrumental examination;

c) have the competencies:

- on the application of knowledge of physiology to promote a healthy lifestyle, as well as to prevent the occurrence and development of diseases;
- about the main perspective directions of physiology development.

The developed program corresponds to the ***educational-professional program*** (EPP) and is focused on the formation of ***competencies:***

General (GC) – GC1 EPP:

- ability to abstract thinking, analysis and synthesis, ability to learn and be modernly trained;

Professional (PC) – PC 2; 3; 5; 14 EPP:

- ability to determine the necessary list of laboratory and instrumental studies and evaluate their results;
- ability to establish a preliminary and clinical diagnosis of the disease;
- the ability to determine the nature of nutrition in the treatment of diseases;
- ability to carry out sanitary and hygienic and preventive measures.

According to the educational-professional program, the **expected program learning outcomes** (PLO) include the skills of **PLO1, PLO4, PLO12 EPP**:

- know the methods of analysis, synthesis and further modern learning. Be able to analyze information, make informed decisions, be able to acquire modern knowledge. Establish appropriate connections to achieve goals. Be responsible for the timely acquisition of modern knowledge;
- know the types and methods of adaptation, principles of action in a new situation. To be able to apply means of self-regulation, to be able to adapt to new situations (circumstances) of life and activity. Establish appropriate connections to achieve results. Be responsible for the timely use of self-regulatory methods;
- to evaluate the information on the diagnosis in the conditions of the health care institution, its subdivision, applying the standard procedure, using the knowledge about the person, his organs and systems, on the basis of the results of laboratory and instrumental researches (according to list 4).

3. Program of the discipline

The educational process is organized under the European Credit Transfer and Accumulation System (ECTS).

The discipline program consists of two blocks:

Block 1. «General physiology and higher integrative functions»

Sections:

1. Introduction to physiology.
2. Physiology of excitable structures.
3. Biological regulation of body functions.
4. Nervous regulation of motor functions.
5. Humoral regulation of visceral functions.
6. Physiology of sensory systems.
7. Physiological basis of behavior.
8. Physiological bases of higher nervous activity of the person.

Block 2. «Physiology of visceral systems»

Sections:

9. Blood system.
10. Circulatory system
11. Respiratory system.
12. Energy exchange.
13. Thermoregulation.
14. Digestive system.
15. Excretory system.
16. Physiology of labor and sports.

Contents of the academic discipline

BLOCK 1. «GENERAL PHYSIOLOGY AND HIGHER INTEGRATIVE FUNCTIONS»

Section 1. Introduction to physiology

Topic 1. Subject and tasks of physiology. Methods of physiological research

The subject and tasks of physiology, its place among other sciences. Connection of physiology with other sciences. The role of physiology in the theory and practice of medicine, in pedagogy and psychology. Physiology and philosophy. General sections of physiology. Methods of physiological research. Acute and chronic experiments. Operative-surgical method. Methods of registration of physiological processes. Historical sketch of the development of physiology. Domestic physiological schools.

The main properties of living things: metabolism, excitability, growth, development, self-reproduction, adaptation. Levels of structural organization of living things: molecular, cellular, tissue, organ, systemic, organismic. The body and the external environment. Physiological functions, ideas about their regulation. Neuron as a morphological unit of the nervous system. Reflex, reflex arc and its components. Excitation and inhibition - the main acts of reflex activity. Unconditioned and conditioned reflexes. Nervous and humoral integration of functions and integrity of an organism. Somatic and autonomic nervous systems.

Section 2: Physiology of excitable structures

Topic 2. Functions of the cell membrane. Mechanisms of transport of substances across a membrane. Membrane potentials. Resting potential and action potential.

Excitable tissues and their properties. Electrical phenomena in excitable tissues. The nature of the resting membrane potential. Ionic asymmetry. Donan's balance. Nernst-Goldman equation. Sodium-potassium pump and its mechanisms. Representation of sodium, potassium and calcium channels. Action potential and its structure. Changes in the permeability of the membrane of excitable cells during the development of the action potential. Membrane resting potential and secretory cell action potential. Changes in resistance and excitability of the membrane during excitation. Absolute and relative refractory period. Irritation of excitable cells by electric current. Nerve fiber excitation. Membrane excitation theory. Laws of excitation on a nerve fiber. Local excitation and propagating excitation. Features and speed of propagation of excitation on myelinated and unmyelinated nerve fibers. Saltator theory.

Topic 3. Transmission of excitation along nerve fibers and through the neuromuscular synapse.

Synaptic transmission of excitation. Structure and physiological properties of synapses. Vvedensky's doctrine of parabiosis. Optimum and pessimum. Electrical and chemical theory of excitation transmission. Types of neurotransmitters. Cholino- and adrenoreceptors of the postsynaptic membrane, their agonists and antagonists.

Topic 4. Classification of stimuli by their strength.

Adequate and inadequate stimuli. Nerve cell membrane and its fibers. Its structure, properties and role in the excitation process.

Topic 5. Properties of skeletal muscles and mechanisms of their contraction.

Development of the muscular system in animals. Structure of striated muscle fiber. Molecular mechanism of muscle contraction. Contractile proteins (actin, myosin, troponin). The role of calcium ions in the excitation and contraction of muscle fiber. Characteristics and types of muscle contraction. Energy and biochemistry of muscle contraction. Heat production during muscle contraction.

Topic 6. Determining the strength of the muscles of the wrist.

Muscle strength and function. Ergography. Active rest (by Sechenov). Fatigue, its theories and mechanisms. Muscle performance. The law of optimal loads and rhythm. Dynamic and static muscle work. Unstriated muscles. Structure, localization, structural and physiological features of unstriated muscle fibers. Mechanisms of tonic and phase contractions of unstriated muscles.

Topic 7. Practical skills in the physiology of excitable structures.

Section 3. The biological regulation of functions.

Topic 8. Contours of biological regulation. Reflex principle of the central nervous system (CNS).

Biological regulation, its types, contours of biological regulation, regulated parameters, the role of feedback connection in the contour of biological regulation. Nervous regulation of functions. Neuron as a structural and functional unit of the CNS. Types of neurons, their functions. The neuron' chains. Reflex, reflex arch, functions of its links, mechanisms of coding of information and transmission information by links of the reflex arch. The role of receptors. Nervous centers and their physiological properties. Principles of reflexes coordination. Types of reflexes, their physiological significance.

Topic 9. Synapses of the central nervous system. The processes of excitation and inhibition in the central nervous system

Synapses of CNS, their structure, information transfer mechanisms. Neurotransmitters (acetylcholine, norepinephrine, dopamine, glycine, GABA, glutamate, serotonin, nitric oxide, others) and neuromodulators (neuro peptides, neurosteroids, others). The processes of excitation and inhibition in the central nervous system. Excitatory synapses, their neurotransmitters, cytoreceptors, development of excitatory postsynaptic potential (EPSP), it's parameters, physiological role. Inhibitory synapses, their neurotransmitters. Postsynaptic inhibition, development of inhibitory postsynaptic potential (IPSP). Presynaptic inhibition, mechanisms of it development. Central inhibition (by Sechenov). Processes of summation in central synapses: spatial summation, temporal summation. Summation of excitation and inhibition of neurons in the central nervous

system. The level of the central nervous system, their interaction in providing adaptive reactions of the body.

Section 4. Nervous regulation of motor functions.

Topic 10. The role of the spinal cord in the regulation of motor functions

The analysis of sensory information of the spinal cord. The motor systems of the spinal cord, their organization and mechanisms of coordination (convergence, divergence, types of inhibition of motor neurons - reverse, reciprocal). Physiological characteristics of proprioceptors. Muscle spindles or stretch receptors, their structure and function. Stretching reflexes (myotactic), their reflectory arches, functions of the gamma system. Activation of alpha- and gamma-motoneurons in the motor centers of spinal cord. The role of stretching reflexes in tone regulation (tonic myotatic reflexes) and muscle length (phase myotatic reflexes). Clinical significance of the study of myotatic reflexes. Golgi tendon receptors, their functions, tendon receptor reflexes, their reflex arcs, physiological significance. Flexor and extensor skin-muscle reflexes. The functionality of an isolated spinal cord. Cross section of spinal cord and spinal shock. Conductive function of the spinal cord, its role in the regulation of motor functions.

Topic 11. Human spinal cord reflexes.

Topic 12. The role of the brainstem in the regulation of motor functions

The role of the hindbrain in the regulation of motor functions. Descending motor pathways, their role in regulation of alpha- and gamma- motor neuron activity. The role of the brain in the posture of antigravity (vestibular nuclei and reticular formation), mechanisms of decerebrate rigidity. Tonic labyrinthine reflexes. Vestibular receptors, their role in the regulation of tone and posture. Tonic cervical reflexes.

The role of the midbrain in the regulation of motor functions. Motor reflexes of the midbrain: static and stato-kinetic. Reflexes of straightening (labyrinthine, cervical). Head rotations and receptors of semilunar channels, their physiological role in maintaining balance of equilibrium during accelerated movement. The vestibular mechanisms of stabilization of eyeballs. The role of the midbrain in the regulation of stereotypical involuntary movements. Indicative reflexes.

The role of reticular formation in the regulation of motor functions. Descending and ascending pathways, influences of the reticular formation on brain stem.

Topic 13. The role of the forebrain and cerebellum in the regulation of motor functions. Regulation of the systemic activity of the body.

The role of thalamus and hypothalamus in the regulation of motor functions.

Functional characteristics of the thalamus nuclei and hypothalamus (lateral nuclei, field of Forel) in the regulation of motor functions.

The role of basal nuclei in the regulation of motor functions. Functional organization and communication of basal nuclei. The role of basal nuclei in the regulation of muscle tone and complex motor acts, in the organization and implementation of motor programs. Their interaction with the subtalamic nucleus and the substantia nigra, other structures. Neurotransmitters in the system of basal nuclei, their physiological role. Clinical manifestations of damage to the basal nuclei, their physiological mechanisms.

The role of the motor cortex in the regulation of motor functions. The primary motor zone of the cortex (field 4), it's functional organization and role in the regulation of motor functions. Pre-motor and additional motor areas of the cortex, their organization and role

in the regulation of motor functions. Afferent connections of the motor cortex. Descending pathways and their role in the regulation of the functions of the muscles of the axial skeleton, proximal and distal limbs. Human locomotion, their regulation. Programming movements. The functional structure of voluntary movements. Age-related changes in motor functions.

The role of the cerebellum in the regulation of motor functions. The functional-structural organization of the cerebellum, it's afferent and efferent connections, their physiological role. The functional organization of cerebellar cortex. Interaction between brain cortex and vestibular nuclei. The role of the cerebellum in the programming, initiation and control of movements. The cerebellum and training. The consequences of removing or damaging the cerebellum, arising in humans, their mechanisms.

The role of the cerebral cortex in the formation of systemic activity of the organism. Physiological anatomy of the cerebral cortex. Modern ideas about the localization of functions in the cortex and its organization. Functional connections of the cerebral cortex with the structures of the central nervous system. Functions of individual fields of the cortex (associative, sensory, and motor). The role of the cortex in the formation of the systemic activity of the organism. Electrophysiological methods for studying the functions of the cerebral cortex: electroencephalography (EEG), registration of evoked potentials, impulse activity of neurons. Maintaining the activity of the cerebral cortex. Ascending activating effects of reticular formation of the brain stem. Neuro-humoral monitoring of brain activity (noradrenergic, dopaminergic, serotoninergic effects). Neuro-humoral systems of the brain.

The role of the limbic system in the formation of systemic activity of the organism. Limbic system, its organization, functions, the leading role of the hypothalamus. Features of the functions of the neurons of the hypothalamus. The role of the hypothalamus in the regulation of visceral functions, the integration of somatic, autonomous and endocrine mechanisms in the regulation of homeostasis, the formation of motivations, emotions, non-specific adaptation of the organism, biological rhythms. Specific functions of other structures of the limbic system - the hippocampus, amygdala, limbic cortex.

Topic 14. Research of the hindbrain and midbrain.

The hindbrain and pons. Connections of the pons with cerebellum. The nuclei of the pons. The role of the pneumotaxic center in the regulation of respiration. The cerebellum, its structure and connections with other parts of the CNS. Consequences of removal and damage of the cerebellum in various animals and humans. Cerebellar regulation of skeletal muscle tone and coordination of tonic movements.

The midbrain, its evolution. Functions of the four-humped body in lower and higher vertebrates. The red nucleus, its ligaments, and involvement in maintaining posture and skeletal muscle tone. Decerebral rigidity. Black substance. Cranial nerves, their nuclei and functions.

Topic 15. Research of mechanisms of nervous regulation of visceral functions.

Structural and functional organization of the autonomic nervous system. The sympathetic, parasympathetic and metasympathetic divisions, their role in the regulation of visceral functions. Autonomic reflexes, structural features of the efferent link of their reflex arcs. Autonomic ganglion, their functions. Mechanisms of transmission of excitation in the ganglion and neuro-organ synapses of the sympathetic and parasympathetic systems. Neurotransmitters of the autonomic nervous system. Types of

cytoreceptors (cholinergic, adrenergic, serotonergic and others). Blockers of transferring of excitation in synapses. Influences of the sympathetic, parasympathetic and metasympathetic divisions on the functions of organs. Central regulation of visceral functions. Integrative centers regulation of visceral functions. The role of the brain stem. Hypothalamus, its afferent and efferent connections. Functions of the hypothalamus in the regulation of visceral functions.

Topic 16. Practical skills in the physiology of nervous regulation of visceral functions of the body.

Section 5. Humoral regulation of visceral functions.

Topic 17. The humoral regulation, its factors, mechanism action of hormones on target cells, regulation of hormones secretion

Factors of humoral regulation, their characteristics and classification. Contour of humoral regulation, the role of feedback in regulation. Interconnection of nervous and humoral regulation. Structural and functional organization of the endocrine system. Endocrine glands, endocrine cells, their hormones and their significance. The main mechanisms action of hormones. Membrane and intracellular receptors, G-proteins, secondary intermediates (cAMP, cGMP, Ca2 +, NO etc.), their role. Regulation of secretion of hormones. Hypothalamic-pituitary system. Functional connection of the hypothalamus with the pituitary gland. Neurosecrets of the hypothalamus. The role of liberins and statins.

Topic 18. The role of hormones in the regulation of processes of mental, physical development and linear growth of the body

Adenohypophysis, its hormones, their effects. The role of somatotropin (STH) and somatomedins (insulin-like growth factor I: IGF-I, insulin-like growth factor II: IGF-II) in providing growth and development. The contour regulation of synthesis and secretion of somatotropin, circadian rhythms. Metabolic effects of somatotropin. Thyroid gland, its hormones (iodthyronin). Mechanisms of action of iodthyronines on target cells, mental functions, processes of growth and development, metabolic processes, state of visceral systems, etc. Contour regulation of synthesis and secretion of thyroxin (T4) and triiodothyronine (T3). The role of other hormones that influence the growth processes (insulin, steroid hormones, cortisol).

Topic 19. The role of hormones in regulating the body's adaptation to stress factors.

The hormones of the adrenal medulla (catecholamines), their role in the body, regulation of their secretion. The hormones of the adrenal cortex, the contours of the regulation of their secretion, circadian rhythms of secretion of the glucocorticoids, their effects and mechanisms of action on target cells. Types of adaptation of the organism. The concept of stress and stress factors. General adaptation syndrome (by Selye). The role of the sympathoadrenal system in adaptation. The role of adrenal cortex hormones (glucocorticoids, mineralocorticoids), hypothalamus, pituitary, thyroid hormones (thyroxine, triiodothyronine), vago-insular system in providing nonspecific adaptation of the organism to stress factors.

Topic 20. Practical skills in the physiology of humoral regulation of visceral functions of the body.

Section 6. Physiology of sensory systems.

Topic 21. General characteristics of sensory systems. Somatosensory system. Physiological bases of pain and anesthesia.

The concept of sensory systems or analyzers. The value of sensory systems in the knowledge of the world. System of perception. Structural and functional organization of the sensory system. Receptors: classification, basic properties, mechanisms of excitation, functional lability. Regulation of receptor function. The concept of a receptive field and reflexogenic zones. Methods of study of receptor excitability. Conductive department of the sensory system. Pathways: specific and non-specific channels of information transfer. The involvement of the structures of the spinal cord, brainstem, thalamus in the conduction and processing of afferent excitations. Thalamus as a collector of afferent pathways. Functional characteristics of specific (relay, associative) and non-specific nuclei of the thalamus. Cortical division of the sensory system. Localization of afferent functions in the cortex. The processes of higher cortical analysis and synthesis of afferent excitations. The interaction of sensory systems. Encoding information and processing it in different parts of the sensory system. Physiological basis of methods for the study of sensory systems. Age-related changes in sensory systems.

Structural and functional organization of the somatosensory system (skin and proprioceptive sensitivity). Physiological basis of pain. Nociception, physiological characteristics and classification of nociceptors (C. Sherrington). Nociceptive or pain system, its structural and functional organization, pathways and levels of information processing. The physiological significance of pain. Antinociceptive or analgesic system, its structural and functional organization, opiate and non-opiate mechanisms, physiological role. Physiological basis of anesthesia.

Topic 22. Visual sensory system.

Structural and functional organization of the visual sensory system, the main and auxiliary structures. Receptor apparatus: sticks and cones. Photochemical processes in receptors (rods and cones) when exposed to light, receptor potential. Line of sight. Refraction and accommodation. Conductive and cortical divisions of the visual sensory system. Analysis of information at different levels. Formation of the visual image. Modern concepts of color perception. The main forms of color perception disorders. The main visual functions and physiological basis of their research methods.

Topic 23. Auditory sensory system.

Structural and functional organization of the auditory sensory system, the main and additional structures. Sound-conducting, perceiving and analyzing structures. Conductive and cortical parts of the auditory sensory system. Central mechanisms of analysis of sound information. Theory of perception of sounds. Binaural hearing.

Topic 24. Practical skills in the physiology of sensory systems.

Section 7. Physiological basis of behavior.

Topic 25. Physiological basis of behavior. Innate reflexes and instincts. Physiological bases of the acquired behavior.

The concept of higher integrative functions of the nervous system, methods of its research. The contribution of I. Sechenov, I. Pavlov to the development of scientific research on HNA. Neurophysiological basis of behavior. Internal needs of the body. Biological motivation. Motivational excitation. Congenital (unconditionally reflex) forms

of behavior. Instincts, their importance for the adaptive activity of the organism. Acquired (conditioned-reflex) forms of behavior, their significance for the adaptive activity of the organism. Neurophysiological mechanisms of temporal communication. Modern mechanisms of memory and learning.

Emotions, their types, neurophysiological mechanisms of formation, biological role. Theories of emotion: the central theory of William Kennon, the information theory of P.V. Simonov. The development of emotions. The limbic system and the effect of prolonged emotional stress under the action of stress factors on the state of the visceral systems of the body.

Section 8. Physiological bases of higher nervous activity of the person.

Topic 26. Types of HNA. The first and second signaling systems. Speech and modern mechanisms of its development. Features of asymmetry of the cerebral hemispheres.

Types of higher nervous activity, their classification, physiological bases, research methods. The first and second signaling systems. Speech, its functions. Modern mechanisms of speech formation. Functional asymmetry of the cerebral cortex, the concept of the dominant hemisphere, the functions of the non-dominant hemisphere, the interaction of the hemispheres. Thinking, consciousness and self-awareness.

Topic 27. Localization of functions in the cortex.

Interaction between the first and second signaling systems. Speech centers.

Topic 28. Practical skills in physiology of higher integrative functions of the nervous system.

Block 2. «Physiology of visceral systems»

Section 9. Blood system.

Topic 1. Blood system. Blood functions, physical and chemical properties.

The concept of the blood system. The main functions of blood. The composition and volume of blood in humans. Hematocrit index. The main physiological constants of blood, the mechanisms of their regulation. Plasma, its composition, the role of plasma proteins. Osmotic and oncotic pressure. Regulation of the constancy of osmotic pressure. Acid-alkaline blood condition, the role of buffer systems in the regulation of its constancy.

Topic 2. Erythrocyte physiology.

Erythrocytes, structure, quantity, function. Hemoglobin, its structure, properties and types of compounds. The amount of hemoglobin. Criteria of erythrocyte saturation with hemoglobin: average concentration, color index. Hemolysis, its types. Erythrocyte sedimentation rate (ESR), factors affecting it. The concept of erythron as a physiological system, the regulation of the number of red blood cells in the blood.

Topic 3. Defensive blood functions. Leukocyte physiology. Blood groups.

Leukocytes, their number, types. Leukocytosis and leucopenia. Leukocyte formula. Functions of various types of leukocytes. Regulation of the number of leukocytes. The concept of immunity, its types. Blood groups: AB0, CDE systems, others. Methods for the determination of blood groups. Physiological basis of blood transfusion. Blood substitutes.

Topic 4. Types and physiological mechanisms of hemostasis. Physiology of platelets.

Hemostasis, its types. Vascular-platelet hemostasis, its role. Coagulation hemostasis, its phases, mechanisms, values. Modern ideas about the main factors that are involved in coagulation hemostasis - coagulants. Anticoagulants, their types, mechanisms of action, value. Plasmin and fibrinolysis, its mechanisms, meaning. The role of the vascular wall in the regulation of hemostasis and fibrinolysis. Regulation of blood coagulation. Physiological basis of methods for studying the state of hemostasis. Age-related changes in the hemostatic system. Platelets, their number, function. Mechanisms to maintain the liquid state of the blood. Blood formation and its regulation. Age-related changes in the blood system. Extra vascular fluids of the body, their role in ensuring the vital activity of the cells of the body.

Topic 5. Practical skills in the physiology of the blood system.

Section 10. Circulatory system

Topic 6. General characteristics of the circulatory system. Physiological properties of the heart muscle.

General characteristics of the circulatory system, its role in the body. The structure of the heart, its function. Heart muscle, its structure, function. Physiological properties of the myocardium and their features. Heart automatism. The action potential of atypical cardiomyocytes. The pacemaker of the heart is a sino-atrial node. The conductive system, its functional features, the speed signal transmission by the conductive structures of the heart. The action potential of typical cardiomyocytes. Refractory period. Mechanisms of contraction and relaxation of cardiomyocytes. Dynamics of excitation in the heart.

Topic 7. Physiological basis of electrocardiography.

Physiological basis of electrocardiography. Normal ECG.

Topic 8. Pumping function of the heart, its role in hemodynamics, methods of researching.

Cardiac cycle, its phase structure. Blood pressure in the cavities of the heart and the valve apparatus during cardiac activity. Systolic and minute blood volumes, cardiac index. The work of the heart. Physiological basis of research methods: electrocardiography, phonocardiography, echocardiography, others.

Topic 9. Regulation of the cardiac activity.

Regulation of cardiac activity: myogenic, nervous, humoral. Dependence of the force of heart contraction on the length of cardiomyocytes (the Frank-Starling heart law), heart rate (Bowdich ladder) and resistance to blood expulsion (Anrep phenomenon). Mechanisms of influence of parasympathetic and sympathetic nerves on the physiological properties of the heart muscle. Mechanisms of influence of the ionic composition of blood plasma on the activity of the heart. Mechanisms of the effect of hormones on the activity of the heart: catecholamines, thyroxine and triiodothyronine, glucagon, and others.

Topic 10. Systemic blood flow, the laws of hemodynamic, the role of blood vessels in the blood circulation.

Systemic blood flow. Basic laws of hemodynamic. The mechanism of formation of vascular tone. Total peripheral vascular resistance. Factors that ensure the movement of blood through the vessels of high and low pressure. Linear and volumetric speeds of blood in different parts of the vascular bed. Full blood cycle time. Blood pressure: arterial (systolic, diastolic, pulse, medium), capillary, venous. Factors determining blood pressure. Physiological basis of measuring blood pressure in experiment and clinical practice.

Arterial pulse, its main parameters. Sphygmogram, its evaluation. Functional classification of blood vessels. Microcirculation. Morphological and functional characteristics of microvasculature vessels. The movement of blood in the capillaries, its features. Blood pressure in capillaries. Mechanisms of fluid and other substances exchanging between the blood and tissues. Physiological characteristics of capacitive vessels. Features of the venous movement of blood. Venous pulse. The turning blood to heart. The depot of blood.

Topic 11-12. The regulation of circulation.

Regulation of vascular tone. Features of the structure and function of vascular smooth muscle. Vascular tonus and its regulation, nervous and humoral mechanisms. Features of the regulatory mechanisms of microvasculature vessels. Regulation of local blood movement. The role of endothelium in the regulation of vascular tone.

Regulation of the systemic circulation. Regulation of blood pressure and its stages.

Cardiovascular center, its structure, afferent and efferent connections. The concept of a single hemodynamic center. The main reflexogenic zones, baroreceptors and chemoreceptors of the carotid sinus and aortic arch, their role. Reflexes from atrial receptors and large veins. Pressor and depressor reflexes. Interconnected mechanisms of nervous and humoral regulation of heart activity, vascular tone and circulating blood volume in various adaptive reactions. Physiological causes of blood pressure disorders. Nervous and humoral mechanisms of blood pressure regulation. Regulation of blood circulation during changing of the body position. Regulation of blood circulation during physical work. Age features of blood circulation and its regulation.

Topic 13. Regional blood circulation and its regulation.

Physiological features of regional blood circulation: pulmonary, coronary, cerebral, abdominal. Fetal blood circulation. Changes in blood circulation after birth.

Topic 14. Dynamics of lymph circulation.

Lymph, its composition, number, functions. Mechanisms of the formation and movement of lymph through lymphatic vessels.

Topic 15. Practical skills in the physiology of the circulatory system.

Section 11. Respiratory system.

Topic 16. General characteristics of the respiratory system. External respiration.

Structure and functions of the respiratory system. The value of respiration for the body. The main stages of the process of breathing. External breathing. Respiratory cycle. Physiological characteristics of respiratory tract, their functions. The value of ciliated epithelium. Biomechanics of respiration. Pressure in the pleural cavity, its changes during breathing. The elastic properties of the lungs and chest wall. Surface tension of the alveoli, its mechanisms. Surfactants, their meaning. Static and dynamic indicators of external respiration.

Topic 17. Gas exchange in the lungs.

The composition of the inhaled air, exhaled and alveolar. The relative constancy of the composition of the alveolar air. Tension of gases dissolved in the blood. The partial pressure of gases (PCO_2, PO_2) in the alveolar air. Mechanisms of exchange of exhaled air, inhaled and alveolar gas mixture, between the alveoli and blood in the pulmonary capillaries. Property of the pulmonary membrane. Diffusion capacity of the lungs. The

relationship between pulmonary circulation and lung ventilation. Anatomical and physiological "dead space".

Topic 18. Transportation of gases by blood.

Hemoglobin. Myoglobin. Oxyhemoglobin dissociation curve, factors affecting the formation and dissociation of oxyhemoglobin. The content of oxygen and carbon dioxide in arterial and venous blood. Oxygen capacity of blood. Formation and dissociation of bicarbonates and carbhemoglobin. The value of carbonic anhydrase. Gas exchange between blood and tissues. Tension of oxygen and carbon dioxide in the tissue fluid and cells.

Topic 19. Regulation of respiration.

CNS structures providing respiratory periodicals. The structures of the hindbrain: the dorsal respiratory group of neurons, its role in the generation of the main rhythm of breathing and regulation of inspiration; ventral respiratory group of neurons, its role. The role of the pneumotaxic center in inhibition of inspiration, regulation of the volume and frequency of respiration. Apneustic center, its role. The influence of the gas composition and pH of arterial blood on the frequency and depth of respiration. Central and peripheral chemoreceptors, their importance in providing gas homeostasis. Changes in lung ventilation during hypercapnia, hypoxia. Lung' stretch receptors, their importance in the regulation of respiration. Hering–Breuer's reflex. The role of other receptors in the regulation of respiration: irritant receptors, j-receptors, proprioceptors. Protective respiratory reflexes. Regulation of airway resistance. Voluntary regulation of breathing. Breathing during physical work, with high and low barometric pressure. Regulation of the first breath of a newborn baby. Age features of breathing.

Section 12-13. Energy exchange. Thermoregulation.

Topic 20. Energy exchange and methods of its research.

General concepts about the metabolism in the body. Metabolism between the organism and the external environment as the basic conditions of life and the preservation of homeostasis. The role of nutrients. The balance of the receipt and consumption of substances. Energy exchange. An organism as an open thermodynamic system. Energy balance of the body. Physical calorimetry. Caloric value of various nutrients (physical and physiological). Direct and indirect calorimetry (the study of energy consumption using a full and incomplete gas analysis). Caloric coefficient of one liter of oxygen. Respiratory rate. Basal exchange, value, conditions of his research. The specific dynamic effect of nutrients. Work exchange. Energy costs of the body in various types of labor. Age features of energy exchange in children. Physiological nutritional standards. The need for proteins, fats, carbohydrates, depending on age, type of work and state of the body (pregnancy, lactation period and others).

Topic 21. Body temperature and regulation of its constancy.

The constancy of the temperature of the internal environment as a necessary condition for the normal state of metabolic processes. Poikilothermy, homeothermy. The temperature of the human body, its daily fluctuations. The temperature of various skin areas and internal organs. Physical and chemical thermoregulation. Metabolism as a source of heat. The role of individual organs in heat production. Heat transfer. Ways of heat release from the body surface (radiation, conduction, convection, evaporation).

Physiological mechanisms of heat transfer (movement of blood in the vessels of the skin, sweating, and others). The center of thermoregulation. Peripheral and central thermoreceptors. Nervous and humoral mechanisms of thermoregulation. Regulation of body temperature with changes in environment temperature. Physiological basis of tempering. Age and sexual characteristics of thermoregulation.

Topic 22. Practical skills in the physiology of respiratory systems, energy metabolism and thermoregulation.

Section 14. Digestive system.

Topic 23. General characteristics and functions of the digestive system. Digestion in the oral cavity. The role of taste and olfactory sensory systems.

Structure and function of the digestive system. Digestive canal and digestive glands. The main functions of the digestive system: secretion, motility, absorption. Digestion its types (abdominal, membrane, intracellular), the main stages. Features of secretory cells, secretion mechanisms, the role of calcium ions and cellular mediators in the secretory process. The basic principles and mechanisms of regulation of digestion. Gastrointestinal hormones. Phases of secretion of head glands. Periodic activity of the digestive system. The motor of the digestive canal. Features of the structure and functions of smooth muscles of the digestive canal. Physiological bases of methods of investigation of functions of the digestive canal.

Digestion in the oral cavity. The role of the taste sensory system. The receptor, conductor and cortical divisions. Types of taste sensations, values for digestion. Interaction with the olfactory sensory system, the meaning of this in determining the nature of food. Mechanical and chemical processing of food. Salivation. Quantity, composition and properties of saliva, its importance in digestion, mechanisms of secretion (primary, secondary saliva). Regulation of secretion of saliva. Chewing, its features depending on the type of food, chewing regulation. Swallowing, its phases, regulation.

Topic 24. Digestion in the stomach.

Secretory activity of the gastric glands. Research methods. Structure and properties of gastric juice. Mechanisms of secretion of hydrochloric acid, enzymes, mucus and their regulation. Nervous and humoral regulation of secretion of the gastric glands, phases of regulation of secretion: cephalic, gastrointestinal, and intestinal. Adaptive changes in gastric secretion. The motor function of the stomach, its regulation.

Topic 25. Digestion in the duodenum.

Regulation of bile formation and its secretion into the duodenum.

Topic 26. The role of pancreatic juice and bile in digestive processes.

External secretory activity of the pancreas. Quantity, composition and properties of juice of the pancreas, its role in digestion. Nervous and humoral regulation of pancreatic secretion. Phases of regulation of secretion: cephalic, gastric, and intestinal. The role of the liver in digestion. Formation of bile, its composition and properties. Methods of researching. Liver and bladder bile. Participation of bile in digestion. Regulation of the formation of bile and its excretion in the duodenum.

Topic 27. Digestion in the intestines. Physiological bases of hunger and satiety.

Intestinal secretion, composition and properties of intestinal juice, its role in digestion. Methods of researching. Regulation of intestinal secretion. Cavity and membrane hydrolysis of nutrients. Motor activity of the small intestine, its role in

digestion. Types of motility, its regulation. The role of the metasympathetic system in regulation the secretory and motor functions of the intestines. Digestion in the colon. The role of gut microflora. The motility of the colon, its regulation. Act of defecation. The processes of absorption. Methods of researching. Absorption of substances in different parts of the digestive canal, its mechanisms. Features of the absorption of water, salts, carbohydrates, proteins, fats, vitamins and other substances. Regulation of absorption.

Physiological bases of hunger and satiety. Food motivation. The idea of a food center (center of hunger) and a saturation center. Short-term and long-term mechanisms for regulating food intake and maintaining body weight. The role of ghrelin ("hormones of hunger"), other hormones of the digestive canal, and hormones of adiposities - leptins in the regulation of food intake. The contour of regulation of the maintenance of the constancy of nutrient content in the environment, eating behavior and the constancy of body weight.

Section 15. Excretory system.

Topic 28. General characteristics of the excretory system.

The excretory system, its structure, functions. Organs of excretion (kidneys, skin, lungs, digestive canal), their participation in maintaining the homeostasis of the body. Kidneys as the main organs of the excretory system. Nephron as a structural and functional unit of the kidney. Blood circulation in the kidney, its features.

Topic 29. The role of the kidneys in the process of excretion, the mechanisms of urine formation.

The main processes of urination: filtration, reabsorption, secretion. Filtration mechanisms, the composition of the primary urine. Regulation of filtration rate. Tubular reabsorption, its mechanisms. Secretory processes in the proximal and distal tubules and collective ducts. The final urine, its composition, quantity. The coefficient of purification (clearance) and the determination of the rate of filtration, reabsorption, secretion, the magnitude of renal plasma flow and blood circulation.

Topic 30. The role of the kidneys in maintaining homeostasis.

Regulation of urination. The involvement of the kidneys in maintaining nitrogen balance, homeostasis parameters. Regulation of the constancy of the osmotic pressure of the internal environment, the role of vasopressin. Thirst mechanisms. Regulation of the constancy of the concentration of sodium ions, potassium, water volumes and circulating blood in the body with the participation of the kidneys the role of rennin - angiotensin-, atrial natriuretic hormone. Regulation of constancy of concentration of calcium ions and phosphates with the participation of the kidneys. The role of the kidneys in the regulation of the acid-base state of the internal environment. Urination and its regulation. Physiological bases of methods of research of function of kidneys. Age changes in urine formation and urination.

Topic 31. Practical skills in the physiology of digestive and excretory systems.

Section 16. Physiology of labor and sports.

Topic 32. Muscular and mental performance, their indicators and periods. Theories of fatigue development. Relationship between physical and mental work.

Labor activity. The physiological basis of labor. Features of physical and mental labor. Strength, endurance, performance. Muscular performance, its periods. Performance

indicators and their energy supply. Mechanisms of fatigue and recovery (the concept of Sechenov and the rules of Folbort). Methods for assessing fatigue and recovery during muscular work. Mental performance and its periods. Modern mechanisms of mental fatigue. The relationship of physical and mental labor. Trainings. Basics of sports physiology.

Structure of the discipline

Topics	total	th.	pr.	i.w.
BLOCK 1. "GENERAL PHYSIOLOGY AND HIGHER INTEGRATIVE FUNCTIONS"				
Section 1. Introduction to physiology				
Topic 1. Subject and tasks of physiology. Methods of physiological research	4	2	-	2
Together	**4**	**2**	**-**	**2**
Section 2. Physiology of excitable structures				
Topic 2. Functions of the cell membrane. Mechanisms of transport of substances across a membrane. Membrane potentials. Resting potential and action potential	6	2	2	2
Topic 3. Conduction of excitation by nerve fibers and through the neuromuscular synapse	2	-	-	2
Topic 4. Classification of stimuli by their strength	2	-	-	2
Topic 5. Properties of skeletal muscles and mechanisms of their contraction	2	-	2	-
Topic 6. Determining the strength of the muscles of the wrist	2	-	2	-
Topic 7. Practical skills in the physiology of excitable structures	2	-	2	-
Together	**16**	**2**	**8**	**6**
Section 3. Biological regulation of body functions				
Topic 8. Contours of biological regulation of functions. Reflex principle of CNS activity	3	-	1	2
Topic 9. CNS synapses. Excitation and inhibition in the central nervous system	4	-	2	2
Together	**7**	**-**	**3**	**4**
Section 4. Nervous regulation of motor functions				
Topic 10. The role of the spinal cord in the regulation of motor functions	5	2	2	1

Topic 11. Human spinal cord reflexes	3	-	2	1
Topic 12. The role of the brainstem in the regulation of motor functions	2	-	2	-
Topic 13. The role of the forebrain and cerebellum in the regulation of motor functions of the body. Regulation of systemic activity of the organism	4	-	2	2
Topic 14. Research of the hindbrain and midbrain.	2	-	2	-
Topic 15. Research of mechanisms of nervous regulation of visceral functions	6	2	2	2
Topic 16. Practical skills in the physiology of the nervous system	2	-	2	-
Together	**24**	**4**	**14**	**6**
Section 5. Humoral regulation of visceral functions				
Topic 17. Humoral regulation, its factors, mechanisms of action of hormones on target cells, regulation of hormone secretion	4	2	2	-
Topic 18. The role of hormones in the regulation of mental and physical development, linear growth of the body	2	-	2	-
Topic 19. The role of hormones in regulating the body's adaptation to stress factors	3	1	-	2
Topic 20. Practical skills in the physiology of nervous and humoral regulation of visceral functions of the body	2	-	2	-
Together	**11**	**3**	**6**	**2**
Section 6. Physiology of sensory systems				
Topic 21. General characteristics of sensory systems. Somatosensory system. Physiological bases of pain and anesthesia	4	2	2	-
Topic 22. Visual sensory system	4	-	2	2
Topic 23. Auditory sensory system	2	-	2	-
Topic 24. Practical skills in the physiology of sensory systems	2	-	2	-
Together	**12**	**2**	**8**	**2**
Section 7. Physiological bases of behavior				
Topic 25. Physiological basis of behavior. Innate reflexes and instincts. Physiological bases of the acquired behavior.	6	-	2	4

Together	**6**	**-**	**2**	**4**
Section 8. Physiological basis of higher human nervous activity				
Topic 26. Types of HNA. The first and second signaling systems. Language and modern mechanisms of its development. Features of asymmetry of the cerebral hemispheres	6	2	2	2
Topic 27. Localization of functions in the cortex.	2	-	-	2
Topic 28. Practical skills in physiology of higher integrative functions of the nervous system	2	-	2	-
Together	**10**	**2**	**4**	**4**
Total hours	**90**	**15**	**45**	**30**
BLOCK 2. "PHYSIOLOGY OF VISCERAL SYSTEMS"				
Section 9. Blood system				
Topic 1. General characteristics of the blood system. Blood functions, physicochemical properties of blood	5	2	2	1
Topic 2. Physiology of erythrocytes	2	-	2	-
Topic 3. Protective functions of the blood. Physiology of leukocytes. Blood groups	4	-	2	2
Topic 4. Types and mechanisms of hemostasis. Platelet physiology	6	2	2	2
Topic 5. Practical skills in the physiology of the blood system	4	-	2	2
Together	**21**	**4**	**9**	**7**
Section 10. The circulatory system				
Topic 6. General characteristics of the circulatory system. Physiological properties of the heart muscle. General characteristics of the circulatory system, its role in the body. Dynamics of cardiac excitation	7	2	2	3
Topic 7. Physiological basis of electrocardiography	3	-	3	-
Topic 8. Pumping function of the heart, its role in hemodynamics, physiological foundations of research methods	6	2	2	2
Topic 9. Regulation of the cardiac activity	4	-	2	2
Topic 10. Systemic circulation. Laws of hemodynamics, the role of blood vessels in blood circulation	2	2	-	-
Topic 11. Regulation of blood circulation	4	-	2	2

Topic 12. Regulation of blood circulation	2	-	2	-
Topic 13. Features of regional blood circulation and its regulation	4	-	2	2
Topic 14. Dynamics of lymph circulation	2	-	-	2
Topic 15. Practical skills in the physiology of the circulatory system	2	-	2	-
Together	**36**	**6**	**17**	**13**
Section 11. Respiratory system				
Topic 16. General characteristics of the respiratory system. External respiration	5	2	2	1
Topic 17. Gas exchange in the lungs	6	2	2	2
Topic 18. Transportation of gases by blood	2	-	2	-
Topic19. Regulation of respiration	4	-	2	2
Together	**17**	**4**	**8**	**5**
Sections: 12. Energy metabolism. 13. Thermoregulation				
Topic 20. Energy metabolism and methods of its research	6	2	2	2
Topic 21. Body temperature and regulation of its constancy	2	-	2	-
Topic 22. Practical skills in the physiology of the respiratory system, energy metabolism and thermoregulation	4	-	2	2
Together	**12**	**2**	**6**	**4**
Section 14. Digestive system				
Topic 23. General characteristics and functions of the digestive system. Digestion in the oral cavity. The role of taste and olfactory sensory systems	6	2	2	2
Topic 24. Digestion in the stomach	6	-	2	4
Topic 25. Digestion in the duodenum	4	-	2	2
Topic 26. The role of pancreatic juice and bile in digestive processes	4	-	2	2
Topic 27. Digestion in the intestines. Physiological bases of hunger and satiety	6	-	2	4
Together	**26**	**2**	**10**	**14**
Section 15. Excretory system				

Topic 28. Excretory system	6	2	2	2
Topic 30. The role of the kidneys in the processes of excretion, mechanisms of urine formation	2	-	2	-
Topic 31. The role of the kidneys in maintaining homeostasis	7	1	4	2
Topic 32. Practical skills in the physiology of the digestive and excretory systems	2	-	2	-
Together	**17**	**3**	**10**	**4**
Section 16. Physiological bases of labor activity and sports				
Topic 33. Muscular and mental performance, their indicators and periods. Theories of fatigue development. Relationship between physical and mental work.	6	-	2	4
Together	**6**	**-**	**2**	**4**
Final modular control (exam)	**-**	**-**	**2**	**-**
Total hours	**135**	**21**	**63**	**51**
TOGETHER	**225**	**36**	**108**	**81**

4. Content of the academic discipline

4.1. Plan of the lectures

№	Topic of class / plan	Number of hours
BLOCK 1. GENERAL PHYSIOLOGY AND HIGHER INTEGRATIVE FUNCTIONS		
1.	**Topic 1. Subject and tasks of physiology. Methods of physiological research.** 1. Physiology is a science that studies the objective laws of the functions of the human body and its structures (systems, organs, tissues, cells) in their unity and interaction of the organism with the external environment. 2. Methods of physiological research: observations, experiments, modeling. 3. Physiological characteristics of functions, their parameters. Relationship between structure and function. Age and gender features. 4. Functions of cells, tissues, organs, physiological systems of the body.	2

2.	**Topic 2. Conduction of excitation by nerve fibers and through the neuromuscular synapse.** 1. Physiological properties of nerve fibers. Mechanisms of nerve impulse conduction by myelin and myelin-free nerve fibers. Patterns of excitation. The rate of excitation, the factors on which it depends. Characteristics of nerve fibers of type A, B, C. 2. Neuromuscular synapse, its structure, functions. Mechanisms of chemical transmission of excitation through neuromuscular synapse. End plate potential. Physiological mechanisms of neuromuscular blockade.	2
3.	**Topic 3. The role of the spinal cord in the regulation of motor functions.** 1. Analysis of sensory information by the spinal cord. Motor systems of the spinal cord, their organization and coordination mechanisms (convergence, divergence, types of inhibition of motoneurons - reverse, reciprocal). 2. Physiological characteristics of proprioceptors. Muscle spindles or tension receptors, their structure and function. Stretching reflexes (myotatic), their reflex arcs, functions of the gamma system. Activation of alpha and gamma motoneurons by supraspinal motor centers. 3. The role of stretching reflexes in the regulation of tone (tonic myotatic reflexes) and muscle length (phase myotatic reflexes). 4. Clinical significance of the study of myotatic reflexes. Golgi tendon receptors, their functions, reflexes from tendon receptors, their reflex arcs, physiological significance. Flexion and extension of the skin and muscle reflexes. Functional capabilities of the isolated spinal cord. Spinal cord cross section and spinal shock. 5. Conductive function of the spinal cord, its role in the regulation of motor functions.	2
4.	**Topic 4. Research of mechanisms of nervous regulation of visceral functions.** 1. Autonomous reflexes, features of the structure of the efferent link of their reflex arcs. Autonomous ganglia, their functions. Mechanisms of excitation transmission in ganglionic and neuro-organ synapses of sympathetic and parasympathetic systems. 2. Neurotransmitters of the autonomic nervous system. Types of cytoreceptors (cholinergic, adrenergic, purinergic, serotonergic, etc.). Excitation transmission blockers at synapses. Influences of sympathetic, parasympathetic and metasympathetic departments on organ functions. 3. Central regulation of visceral functions. Integrative centers of regulation of visceral functions. The role of the brain stem. Hypothalamus, its afferent and efferent connections. Functions of the hypothalamus in the regulation of visceral functions.	2

5.	**Topic 5. Humoral regulation, its factors, mechanisms of action of hormones on target cells, regulation of hormone secretion.** 1. Factors of humoral regulation, their characteristics and classification. The contour of humoral regulation, the role of feedback in regulation. Relationship between nervous and humoral regulation. 2. Structural and functional organization of the endocrine system. Endocrine glands, endocrine cells, their hormones and significance. The main mechanisms of action of hormones. Membrane and intracellular receptors, G-proteins, secondary mediators, their role. Regulation of hormone secretion. Hypothalamic-pituitary system. Functional connection of the hypothalamus with the pituitary gland. Neurosecretes of the hypothalamus. The role of liberins and statins.	2
6.	**Topic 6. The role of hormones in regulating the body's adaptation to stress factors.** 1. Adenohypophysis, its hormones, their effects. The role of somatotropin (STG) and somatomedins (insulin-like growth factor I: IGF-I, insulin-like growth factor II: IGF-II) in ensuring growth and development. Contour of regulation of synthesis and secretion of somatotropin, circadian rhythms. Metabolic effects of somatotropin. 2. Thyroid gland, its hormones (iodothyronines). Mechanisms of action of iodothyronines on target cells, mental functions, growth and development processes, metabolic processes, state of visceral systems, etc. Contour of regulation of synthesis and secretion of thyroxine (T4) and triiodothyronine (T3). The role of other hormones that affect growth processes (insulin, gonadal steroid hormones, cortisol).	1
7.	**Topic 7. General characteristics of sensory systems. Somatosensory system. Physiological bases of pain and anesthesia.** 1. Structural and functional organization of the sensory system. Receptors: classification, basic properties, excitation mechanisms, functional lability. Regulation of receptor function. The concept of the receptive field and reflexogenic zones. Methods of research of receptor excitability. 2. Conducting department of the sensor system. Leading paths: specific and nonspecific channels of information transmission. Participation of structures of the spinal cord, brain stem, thalamus in the conduction and processing of afferent excitations. Thalamus as a collector of afferent pathways. Functional characteristics of specific (relay, associative) and nonspecific thalamic nuclei. 3. Cortical department of the sensory system. Localization of afferent functions in the cortex. Processes of higher cortical analysis and synthesis of afferent excitations. Interaction of sensory systems. Coding of information and its processing in different departments of the sensor system. Physiological bases of methods of research of sensory systems. Age-related changes in sensory systems.	2

8.	**Topic 8. Physiological bases of behavior.** 1. Types of higher nervous activity, their classification, physiological bases, research methods. The first and second signaling systems. 2. Speech, its functions. Modern mechanisms of speech formation. 3. Functional asymmetry of the cerebral cortex.	2
	Total hours	***15***
	BLOCK 2. PHYSIOLOGY OF VISCERAL SYSTEMS	
9.	**Topic 9. General characteristics of the blood system. Blood functions, physicochemical properties of blood.** 1. The concept of the blood system. Basic blood functions. The composition and volume of blood in humans. Hematocrit index. Basic physiological constants of blood, mechanisms of their regulation. 2. Plasma, its composition, the role of plasma proteins. Osmotic and oncotic pressures. Regulation of osmotic pressure constancy. Acid-base state of blood, the role of buffer systems in the regulation of its stability.	2
10.	**Topic 10. Physiology of blood cells. Protective functions of the blood.** 1. Hemostasis, its types. Vascular and platelet hemostasis, its role. Coagulation hemostasis, its phases, mechanisms, significance. Modern ideas about the main factors involved in coagulation hemostasis - coagulants. Anticoagulants, their types, mechanisms of action, significance. 2. Plasmins and fibrinolysis, its mechanisms, significance. The role of the vascular wall in the regulation of hemostasis and fibrinolysis. Regulation of blood clotting. Physiological bases of methods of research of a condition of a hemostasis. Age-related changes in the hemostasis system.	2
11.	**Topic 11. General characteristics of the circulatory system. Physiological properties of the heart muscle.** 1. The structure of the heart, its functions. Cardiac muscle, its structure, functions Physiological properties of the myocardium and their features. Automaticity of the heart. The action potential of atypical cardiomyocytes of the driver of the heart rhythm - sinoatrial node. Leading system, its functional features, the rate of excitation of the heart structures. The action potential of typical cardiomyocytes. Periods of refractoriness. Mechanisms of cardiomyocyte contraction and relaxation.	2
12.	**Topic 12. Pumping function of the heart, its role in hemodynamics, physiological basis of research methods. Regulation of heart activity.** 1. Cardiac cycle, its phase structure. Blood pressure in the heart cavities and the operation of the valvular apparatus during cardiac activity. Systolic and cardiac output, cardiac index. The work of the heart. Physiological bases of research methods: electrocardiography, phonocardiography, echocardiography, others.	2

13.	**Topic 13. Systemic circulation. Laws of hemodynamics, the role of blood vessels in blood circulation.** 1. Systemic circulation. Basic laws of hemodynamics. The mechanism of formation of vascular tone. Total peripheral vascular resistance. Factors that ensure the movement of blood through the vessels of high and low pressure. Linear and volumetric velocities of blood flow in different parts of the vascular bed. Time of complete blood circulation. 2. Blood pressure: arterial (systolic, diastolic, pulse, average), capillary, venous. Factors that determine the amount of blood pressure. Physiological basis of blood pressure measurement in experiment and clinical practice. Arterial pulse, its main parameters. Sphygmogram, its evaluation. 3. Functional classification of blood vessels. Physiological characteristics of vessels of compression, resistance.	2
14.	**Topic 14. General characteristics of the respiratory system. External respiration. Gas exchange in the lungs.** 1. Structure and functions of the respiratory system. The value of respiration for the body. The main stages of the respiratory process. External respiration. Respiratory cycle. Physiological characteristics of the respiratory tract, their functions. The value of the ciliated epithelium. Biomechanics of inhalation and exhalation.	2
15.	**Topic 15. Gas exchange in the lungs.** 1. The composition of inhaled, exhaled, alveolar air. Relative constancy of alveolar air composition. Tension of gases dissolved in the blood. Partial pressure of gases in alveolar air. Mechanisms of gas exchange between inhaled air and alveolar gas mixture, between alveoli and blood in pulmonary capillaries. 2. Hemoglobin. Myoglobin. Oxyhemoglobin dissociation curve, factors influencing oxyhemoglobin formation and dissociation. Oxygen and carbon dioxide content in arterial and venous blood. 3. Oxygen capacity of blood. Formation and dissociation of bicarbonates and carbhemoglobin. The value of carbonic anhydrase. Gas exchange between blood and tissues. The tension of oxygen and carbon dioxide in the tissue fluid and cells.	2
16.	**Topic 16. Energy metabolism and methods of its research.** 1. General concepts of metabolism in the body. Metabolism between the body and the environment as the basic conditions of life and preservation of homeostasis. Plastic and energy role of nutrients. Balance of income and expenditure of substances. 2. Energy metabolism. The body as an open thermodynamic system. Energy balance of the body. Physical calorimetry. Caloric value of various nutrients (physical and physiological). Direct and indirect calorimetry (study of energy consumption by means of the full and incomplete gas analysis).	2

17.	**Topic 17. General characteristics and functions of the digestive system. Digestion in the oral cavity. The role of taste and olfactory sensory systems Digestion in the stomach.** 1. Digestion: its types (cavity, membrane, intracellular), the main stages. Features of secretory cells, mechanisms of secretion, the role of calcium ions and cellular mediators in the secretory process. Basic principles and mechanisms of digestion regulation. 2. Digestion in the oral cavity. 3. The role of the taste sensory system. Receptor, conduction and cortical departments. Types of taste sensations, importance for digestion. Interaction with the olfactory sensory system, the importance of this in determining the nature of food. Mechanical and chemical processing of food. Salivation. The amount, composition and properties of saliva, its importance in digestion, mechanisms of secretion (primary, secondary saliva). Regulation of the secret. 3. Digestion in the intestines. Physiological bases of hunger and satiety.	2
18.	**Topic 18. Excretory system.** 1. Selection system, its structure, functions. Excretory organs (kidneys, skin, lungs, digestive tract), their participation in maintaining homeostasis. 2. Kidneys as the main organs of the excretory system. Nephron as a structural and functional unit of the kidney. Circulation in the kidney, its features. The main processes of urination: filtration, reabsorption, secretion. 3. Filtration mechanisms, composition of primary urine. Filtration speed regulation. Reabsorption in tubules, its mechanisms. Rotary-counterflow - multiple system, its role. Secretory processes in the proximal and distal tubules and collecting ducts.	2
19	**Topic 19: The role of the kidneys in maintaining homeostasis.** 1. Regulation of urination. Participation of the kidneys in maintaining nitrogen balance, homeostasis parameters. Regulation of the stability of the osmotic pressure of the internal environment, the role of vasopressin. Mechanisms of thirst. 2. Regulation of the stability of the concentration of sodium ions, potassium, water volumes and circulating blood in the body with the participation of the kidneys: the role of the renin-angiotensin-aldosterone system, atrial natriuretic hormone. Regulation of the stability of the concentration of calcium ions and phosphates with the participation of the kidneys. The role of the kidneys in the regulation of the acid-base state of the internal environment. Urination and its regulation. 3. Physiological bases of methods of research of function of kidneys. Age-related changes in urine formation and urination.	1
	Total hours	***21***

In all	***36***

4.2. Plan of the practical classes

№	Topic of class	Number of hours
BLOCK 1. GENERAL PHYSIOLOGY AND HIGHER INTEGRATIVE FUNCTIONS		
1.	Functions of the cell membrane. Mechanisms of transport of substances across a membrane. Membrane potentials. Resting potential and action potential.	2
2.	Properties of skeletal muscles and mechanisms of their contraction.	2
3.	Determining the strength of the muscles of the wrist.	2
4.	Practical skills in the physiology of excitable tissues.	2
5.	Contours of biological regulation of functions. Reflex principle of CNS activity.	1
6.	CNS synapses. Excitation and inhibition in the central nervous system.	2
7.	The role of the spinal cord in the regulation of motor functions.	2
8.	Human spinal cord reflexes.	2
9.	The role of the brainstem in the regulation of motor functions.	2
10.	Research of the hindbrain.	2
11.	The role of the forebrain and cerebellum in the regulation of motor functions of the body. Regulation of systemic activity of the organism.	2
12.	Research of mechanisms of nervous regulation of visceral functions of an organism.	2
13.	Practical skills in the physiology of nervous regulation of motor and visceral functions of the body.	2
14.	Humoral regulation, its factors, mechanisms of action of hormones on target cells, regulation of hormone secretion.	2
15.	The role of hormones in regulating the body's adaptation to stress factors.	2
16.	Practical skills in the physiology of humoral regulation of visceral functions of the body.	2
17.	General characteristics of sensory systems. Somatosensory system. Physiological bases of pain and anesthesia.	2
18.	Visual sensory system.	2

19.	Auditory sensory system.	2
20.	Practical skills in the physiology of sensory systems.	2
21.	Physiological basis of behavior. Innate reflexes and instincts. Physiological bases of the acquired behavior	2
22.	Types of HNA. The first and second signaling systems. Language and modern mechanisms of its development. Features of asymmetry of the cerebral hemispheres.	2
23.	Practical skills in the physiology of HNA.	***2***
	Total hours	***45***
BLOCK 2. PHYSIOLOGY OF VISCERAL SYSTEMS		
1.	General characteristics of the blood system. Blood functions, physicochemical properties of blood.	2
2.	Physiology of erythrocytes.	2
3.	Protective functions of the blood. Physiology of leukocytes. Blood groups.	2
4.	Types and mechanisms of hemostasis. Platelet physiology.	2
5.	Practical skills in the physiology of the blood system	2
6.	General characteristics of the circulatory system. Physiological properties of the heart muscle. General characteristics of the circulatory system, its role in the body.	2
7.	Pumping function of the heart, its role in hemodynamics, physiological foundations of research methods.	2
8.	Physiological basis of electrocardiography.	3
9.	Regulation of the cardiac activity.	2
10.	Regulation of blood circulation.	2
11.	Regulation of blood circulation.	2
12.	Features of regional blood circulation and its regulation.	2
13.	Practical skills in the physiology of the circulatory system.	2
14.	General characteristics of the respiratory system. External respiration.	2
15.	Gas exchange in the lungs.	2
16.	Transportation of gases by blood.	2
17.	Regulation of respiration.	2

18.	Energy metabolism and methods of its research.	2
19.	Body temperature and regulation of its constancy.	2
20.	Practical skills in the physiology of the respiratory system, energy metabolism and thermoregulation.	2
21.	General characteristics and functions of the digestive system. Digestion in the oral cavity. The role of taste and olfactory sensory systems.	2
22.	Digestion in the stomach.	2
23.	Digestion in the duodenum.	2
24.	The role of pancreatic juice and bile in digestive processes.	2
25.	Digestion in the intestines. Physiological bases of hunger and satiety.	2
26.	Excretory system.	2
27.	The role of the kidneys in the processes of excretion, mechanisms of urine formation.	2
28.	The role of the kidneys in maintaining homeostasis.	2
29.	Practical skills in the physiology of the digestive and excretory systems.	2
30.	Muscular and mental performance, their indicators and periods. Theories of fatigue development. Relationship between physical and mental work.	2
31.	***Final module control***	***2***
	Total hours	***63***
	In all	***108***

4.3. Tasks for independent work

№	Topic	Number of hours
Block 1. "General physiology and higher integrative functions"		
1	Preparation for practical classes (theoretical training, development of practical skills)	**5**
2	Online courses and online testing	**5**
3	Independent elaboration of topics that are not included in the classroom plan of Block 1 (list of analytical tasks)	**5**
4	Design of structural and logical schemes	**10**
5	Topics of search tasks (summary of the topic)	**5**

	TOGETHER	**30**
Block 2. "Physiology of visceral systems"		
1	Preparation for practical classes (theoretical training, development of practical skills)	**5**
2	Online courses and online testing	**5**
3	Independent elaboration of topics that are not included in the classroom plan of Block 2 (list of analytical tasks)	**11**
4	Design of structural and logical schemes	**20**
5	Preparation for the final test	**10**
	TOGETHER	**51**

Topics of analytical tasks

(analysis and generalization of theoretical material based on the study of modern educational, scientific and educational literature)

Topic: Synapses of the central nervous system. Processes of excitation and inhibition in the CNS.

1. Synapses of the CNS, their structure, mechanisms of information transmission.
2. Neurotransmitters (acetylcholine, norepinephrine, dopamine, glycine, GABA, glutamate, serotonin, nitric oxide, etc.) and neuromodulators (neuropeptides, neurosteroids, etc.).
3. Processes of excitation and inhibition in the CNS.
4. Excitatory synapses, their neurotransmitters, cytoreceptors, development of excitatory postsynaptic potential (ZPSP), its parameters, physiological role.
5. Inhibitory synapses, their neurotransmitters. Postsynaptic inhibition, development of inhibitory postsynaptic potential (GPSP). Presynaptic inhibition, mechanisms of development. Central braking (IM Sechenov).
6. Summation processes in central synapses: spatial summation, temporal summation. Summation of excitation and inhibition by CNS neurons.
7. Levels of the CNS, their interaction with the provision of adaptive responses of the body.

Topic: The role of the spinal cord in the regulation of motor functions.

1. Analysis of sensory information by the spinal cord.
2. Motor systems of the spinal cord, their organization and coordination mechanisms (convergence, divergence, types of inhibition of motoneurons - reverse, reciprocal).
3. Physiological characteristics of proprioceptors.
4. Stretching reflexes (myotatic), their reflex arcs, functions of the gamma system. Activation of alpha and gamma motoneurons by supraspinal motor centers.
5. The role of stretching reflexes in the regulation of tone (tonic myotatic reflexes) and muscle length (phase myotatic reflexes).

6. Clinical significance of the study of myotatic reflexes.

7. Tendon Golgi receptors, their functions, reflexes from tendon receptors, their reflex arcs, physiological significance.

8. Flexion and extension skin and muscle reflexes.

9. Functional capabilities of the isolated spinal cord. Spinal cord cross section and spinal shock.

Topic: Humoral regulation, its factors, mechanisms of action of hormones on target cells, regulation of hormone secretion.

1. Factors of humoral regulation, their characteristics and classification. The contour of humoral regulation, the role of feedback in regulation. Relationship between nervous and humoral regulation.

2. Structural and functional organization of the endocrine system. Endocrine glands, endocrine cells, their hormones and significance. The main mechanisms of action of hormones. Membrane and intracellular receptors, G-proteins, secondary mediators (cAMP, cGMP, Ca2 +, NO, etc.), their role. Regulation of hormone secretion.

3. Hypothalamic-pituitary system. Functional connection of the hypothalamus with the pituitary gland. Neurosecretes of the hypothalamus. The role of liberins and statins.

Topic: The role of hormones in the regulation of mental and physical development, linear body growth.

1. Adenohypophysis, its hormones, their effects. The role of somatotropin (STG) and somatomedins (insulin-like growth factor I: IGF-I, insulin-like growth factor II: IGF-II) in ensuring growth and development. Contour of regulation of synthesis and secretion of somatotropin, circadian rhythms. Metabolic effects of somatotropin.

2. Thyroid gland, its hormones (iodothyronines). Mechanisms of action of iodothyronines on target cells, mental functions, growth and development processes, metabolic processes, state of visceral systems, etc. Contour of regulation of synthesis and secretion of thyroxine (T4) and triiodothyronine (T3).

3. The role of other hormones that affect growth processes (insulin, gonadal steroid hormones, cortisol).

Topic: The role of hormones in the regulation of sexual function.

1. Gonads. Sexual differentiation, development and functions of the reproductive system. Puberty.

2. Male reproductive system, its structure and functions. Spermatogenesis. Endocrine function of the testes, regulation of testicular function, the regulation circuit with the participation of the hypothalamic-pituitary system. Erection and ejaculation, hormonal and nervous mechanisms of regulation.

3. Female reproductive system, its structure and functions. Ovarian hormones, their role, regulation of ovarian function. Lunar cycle. Pregnancy. Placental hormones. Lactation.

Topic: Physiology of erythrocytes.

1. Erythrocytes, structure, number, function.

2. Hemoglobin, its structure, properties, types, compounds. The amount of hemoglobin. Criteria for saturation of erythrocytes with hemoglobin: average concentration, color index.

3. Hemolysis, its types. Erythrocyte sedimentation rate (ESR), factors that affect it. The concept of erythron as a physiological system, regulation of the number of erythrocytes in the blood.

Topic: Types and physiological mechanisms of hemostasis in vascular wall damage. Platelet physiology.

1. Hemostasis, its types. Vascular and platelet hemostasis, its role. Coagulation hemostasis, its phases, mechanisms, significance.

2. Modern ideas about the main factors involved in coagulation hemostasis - coagulants. Anticoagulants, their types, mechanisms of action, significance. Plasmin and fibrinolysis, its mechanisms, significance.

3. The role of the vascular wall in the regulation of hemostasis and fibrinolysis. Regulation of blood clotting.

4. Physiological bases of methods of research of a condition of a hemostasis. Age-related changes in the hemostasis system.

5. Platelets, their number, function.

6. Mechanisms for maintaining the liquid state of the blood.

7. Hematopoiesis and its regulation. Age-related changes in the blood system.

8. Extravascular body fluids, their role in ensuring the viability of body cells.

Topic: Pumping function of the heart, its role in hemodynamics, physiological basis of research methods.

1. Cardiac cycle, its phase structure.

2. Blood pressure in the cavities of the heart and the operation of the valvular apparatus during cardiac activity.

3. Systolic and minute blood volumes, cardiac index.

4. The work of the heart. Physiological bases of research methods: electrocardiography, phonocardiography, echocardiography, others.

Topic: Systemic circulation, laws of hemodynamics, the role of blood vessels in blood circulation.

1. Systemic circulation. Basic laws of hemodynamics. The mechanism of formation of vascular tone. Total peripheral vascular resistance. Factors that ensure the movement of blood through the vessels of high and low pressure. Linear and volumetric velocities of blood flow in different parts of the vascular bed. Time of complete blood circulation.

2. Blood pressure: arterial (systolic, diastolic, pulse, average), capillary, venous. Factors that determine the amount of blood pressure. Physiological basis of blood pressure measurement in experiment and clinical practice. Arterial pulse, its main parameters. Sphygmogram, its evaluation.

3. Functional classification of blood vessels. Physiological characteristics of vessels of compression, resistance (resistive).

4. Microcirculation. Morpho-functional characteristics of microcirculatory vessels. The movement of blood in the capillaries, its features. Blood pressure in the capillaries. Mechanisms of fluid and other metabolism between blood and tissues.

5. Physiological characteristics of capacitive vessels. Features of venous blood flow. Venous pulse. Return of blood to the heart. Blood depot, its relativity.

Topic: Transportation of gases by blood.

1. Hemoglobin. Myoglobin. Oxyhemoglobin dissociation curve, factors influencing oxyhemoglobin formation and dissociation.

2. The content of oxygen and carbon dioxide in arterial and venous blood. Oxygen capacity of blood. Formation and dissociation of bicarbonates and carbohemoglobin.

Topic: The role of the kidneys in maintaining homeostasis.

1. Regulation of urination. Participation of the kidneys in maintaining nitrogen balance, homeostasis parameters. Regulation of the stability of the osmotic pressure of the internal environment, the role of vasopressin.

2. Mechanisms of thirst.

3. Regulation of the stability of the concentration of sodium ions, potassium, water volumes and circulating blood in the body with the participation of the kidneys: the role of the renin-angiotensin-aldosterone system, atrial natriuretic hormone.

4. Regulation of the stability of the concentration of calcium ions and phosphates with the participation of the kidneys.

5. The role of the kidneys in the regulation of the acid-base state of the internal environment.

6. Urination and its regulation.

7. Physiological bases of methods of research of function of kidneys.

8. Age-related changes in urination and urination.

Topic: General characteristics and functions of the digestive system.

1. Structure and functions of the digestive system. Digestive tract and digestive glands. The main functions of the digestive system: secretion, motility, absorption.

2. Digestion: its types (cavity, membrane, intracellular), the main stages.

3. Features of secretory cells, mechanisms of secretion, the role of calcium ions and cellular mediators in the secretory process.

4. Basic principles and mechanisms of digestion regulation.

5. Gastrointestinal hormones. Phases of secretion of the main digestive glands. Periodic activity of the digestive system.

6. Motility of the digestive tract. Features of the structure and function of smooth muscles of the digestive tract.

7. Digestion in the oral cavity. The role of taste and olfactory sensory systems.

8. Digestion in the stomach.

9. Digestion in the duodenum. The role of pancreatic juice and bile in digestive processes.

Topic: Body temperature and regulation of its constancy.

1. Constant temperature of the internal environment as a necessary condition for the normal state of metabolic processes. Poikilothermia, homoiothermia. Human body temperature, its daily fluctuations.

2. The temperature of various areas of skin and internal organs. Physical and chemical thermoregulation. Metabolism as a source of heat generation. The role of individual organs in heat production.

3. Heat transfer. Methods of heat transfer from the body surface (radiation, conduction, convection, evaporation.

Topic: Physiological basis of behavior.

1. The concept of higher integrative functions of the nervous system, methods of its study. The contribution of IM Sechenova, IP Pavlov in the development of GNI research.

2. Physiological basis of behavior. Internal needs of the body. Biological motivation. Motivational excitement.

3. Congenital (unconditionally reflex) forms of behavior. Instincts, their importance for the adaptive activity of the organism.

4. Acquired (conditioned-reflex) forms of behavior, their significance for the adaptive activity of the organism.

5. The mechanism of formation of a temporary connection.

6. Modern mechanisms of memory.

Topics of search tasks

(summary of the topic)

Topic: The role of the brainstem in the regulation of motor functions.

• The role of the hindbrain in the regulation of motor functions

1. Descending motor pathways, their role in regulating the activity of alpha and gamma motoneurons.

2. The role of the hindbrain in the provided postures of antigravity (vestibular nuclei and reticular formation), mechanisms of decerebration rigidity. Tonic labyrinthine reflexes.

3. Vestibular receptors of the sac and pistil, their role in the regulation of tone and posture. Tonic cervical reflexes.

• The role of the midbrain in the regulation of motor functions

4. Motor reflexes of the midbrain: static and stato-kinetic.

5. Straightening reflexes (labyrinthine, cervical).

6. Turns of the head and receptors of semicircular canals, their physiological role in maintaining the posture of balance during movement with acceleration.

Topic: The role of the forebrain and cerebellum in the regulation of motor functions. Regulation of systemic activity of the organism.

• The role of the thalamus and hypothalamus in the regulation of motor functions

1. Functional characteristics of the nuclei of the thalamus (specific: switching, associative, motor, nonspecific) and hypothalamus (lateral nuclei, Trout fields) in the regulation of motor functions.

• The role of basal ganglia in the regulation of motor functions

1. Functional organization and connections of basal ganglia (caudate nucleus, husk and pale sphere). The role of basal ganglia in the regulation of muscle tone and complex motor acts, in the organization and implementation of motor programs. Their interaction with the subthalamic nucleus and the substantia nigra, other structures.

2. Neurotransmitters in the system of basal ganglia, their physiological role. Cycles of husk and caudal body. Clinical manifestations of damaged basal ganglia, their physiological mechanisms.

• The role of motor areas of the cortex in the regulation of motor functions

1. Primary motor zone of the cortex (field 4), its functional organization and role in the regulation of motor functions. Premotor and additional motor areas of the cortex, their

organization and role in the regulation of motor functions. Afferent connections of the motor cortex.

2. Descending conductive pathways: cortico-nuclear, cortico-spinal - lateral, ventral, their role in the regulation of the functions of the muscles of the axial skeleton, proximal and distal extremities.

3. Human locomotions, their regulation. Motion programming. Functional structure of arbitrary movements. Age-related changes in motor functions.

• The role of the cerebellum in the regulation of motor functions

1. Functional and structural organization of the cerebellum, its afferent and efferent connections, their physiological role. Functional organization of the cerebellar cortex. Interaction between the cerebellar cortex and the cerebellar and vestibular nuclei.

2. The role of the cerebellum in programming, initiation and control of movements. Cerebellum and learning. Consequences of removal or damage to the cerebellum that occur in humans, their mechanisms.

• The role of the cerebral cortex in the formation of systemic activity of the organism

1. Physiological anatomy of the cerebral cortex. Modern ideas about the localization of functions in the cortex and its organization. Functional connections of the cerebral cortex with the structures of the CNS.

2. Functions of individual fields of the cortex (associative, sensory, motor). The role of the cortex in the formation of systemic activity of the organism Electrophysiological methods of studying the functions of the cerebral cortex: electroencephalography (EEG), registration of evoked potentials, impulse activity of neurons.

3. Maintaining the activity of the cerebral cortex. Ascending activating effects of reticular formation of the brainstem. Neuro-hormonal control of brain activity (noradrenergic, dopaminergic, serotonergic effects). Neuro-hormonal systems of the brain.

• The role of the limbic system in the formation of systemic activity of the organism

1. The limbic system, its organization, functions, the leading role of the hypothalamus. Features of the functions of neurons of the hypothalamus: neuroreception, neurosecretion.

2. The role of the hypothalamus in the regulation of visceral functions, integration of somatic, autonomic and endocrine mechanisms in the regulation of homeostasis, the formation of motivations, emotions, nonspecific adaptation of the organism, biological rhythms.

3. Specific functions of other structures of the limbic system - hippocampus, amygdala, limbic cortex.

Topic: General characteristics of sensory systems.

1. The concept of sensor systems or analyzers. The value of sensory systems in cognition of the world. Systemic nature of perception.

2. Structural and functional organization of the sensory system. Receptors: classification, basic properties, excitation mechanisms, functional lability. Regulation of receptor function. The concept of the receptive field and reflexogenic zones. Methods of research of receptor excitability.

3. Conducting department of the sensor system. Leading paths: specific and nonspecific channels of information transmission. Participation of structures of the spinal

cord, brain stem, thalamus in the conduction and processing of afferent excitations. Thalamus as a collector of afferent pathways. Functional characteristics of specific (relay, associative) and nonspecific thalamic nuclei.

4. Cortical department of the sensory system. Localization of afferent functions in the cortex. Processes of higher cortical analysis and synthesis of afferent excitations. Interaction of sensory systems. Coding of information and its processing in different departments of the sensor system. Physiological bases of methods of research of sensory systems. Age-related changes in sensory systems.

5. Structural and functional organization of the somato-sensory system (skin and proprioceptive sensitivities). Physiological basis of pain. Nociception, physiological characteristics and classification of nociceptors (C. Sherrington).

6. Nociceptive or pain system, its structural and functional organization, leading pathways and levels of information processing. Physiological significance of pain. Antinociceptive or analgesic system, its structural and functional organization, opiate and non-opiate mechanisms, physiological role. Physiological bases of anesthesia.

7. Structural and functional organization of the visual sensory system, main and auxiliary structures. Receptor apparatus: rods and cones. Photochemical processes in receptors (rods and cones) under the action of light, receptor potential. Sight. Refraction and accommodation. Conductive and cortical departments of the visual sensory system. Analysis of information at different levels.

8. Structural and functional organization of the auditory sensory system, main and auxiliary structures. Sound-conducting, perceptual and analytical structures. Conductive and cortical departments of the auditory sensory system. Central mechanisms of sound information analysis. Theory of sound perception. Binaural hearing.

9. Structural and functional organization of the vestibular sensory system. Receptor, conduction and cortical departments, central analysis of information at different levels. Perception of the position of the head in space and direction of movement.

10. Structural and functional organization of the taste sensory system. Receptor, conduction and cortical departments, central analysis of information at different levels. Physiological role of the taste sensory system.

11. Structural and functional organization of the olfactory sensory system. Receptor, conduction and cortical departments, central analysis of information at different levels. Classification of odors, theories of their perception.

Structural and logical schemes

(design of structurally logical schemes in the album of independent works)

1. Topic: Muscle physiology.
2. Topic: General physiology of the central nervous system.
3. Scheme of the structure of the reflex arc on the example of the arc of the flexural protective reflex.
4. Scheme explaining the mechanisms of excitation transmission through the central synapse.
5. Scheme of the autonomic nervous system.
6. Scheme of the main rhythms of the electroencephalogram.
7. Topic: Partial physiology of the central nervous system.
8. Topic: Physiology of sensory systems.

9. Topic: Physiological basis of higher nervous activity.
10. Scheme of the hypothalamic-pituitary system.
11. Mechanisms of action of hormones.
12. Neuro-humoral regulation of body functions.
13. Topic: Physiology of blood.
14. Cascade scheme of hemocoagulation.
15. General scheme of blood circulation.
16. Scheme of imposition of Stannius ligatures.
17. Scheme of the conduction system of the heart.
18. Topic: Physiology of the respiratory system.
19. The scheme of participation of kidneys in regulation of osmotic pressure of blood plasma.

4.4. Ensuring the educational process

Tools / equipment

Electrocardiograph. spirometer, prevmatohometer, dynamometer, tonometer, hemometer, set of dissecting instruments, isotonic Ringer's solution for cold-blooded (0.6% sodium chloride solution), board for fixing frogs, cotton wool, gauze napkins, threads, galvanic tweezers, prepack, cotton wool, Ringer's solution, electrical stimulator, electrodes, gauze wipes, saline, ether or alcohol.

Software

1. Basic and additional literature.
2. Training manual.
3. The list of questions for preparation and drawing up final module control (basic, intermediate, final level).
4. Block of questions for written answer to final module control.
5. Multimedia support of lecture materials and practical classes.
6. Blocks of situational tasks.
7. A set of scientific, educational and educational videos.
8. A set of computer training programs.

5. The final control

List of issues of final control

BLOCK 1. GENERAL PHYSIOLOGY AND HIGHER INTEGRATIVE FUNCTIONS

List of theoretical questions

Content module 1: Introduction to physiology

1. Physiology as a science. Function concept. Methods of physiological research.
2. The formation and development of physiology in the nineteenth century.
3. Contribution of works by Sechenov, Pavlov, Anokhin, Kostyuk to the development of world physiology.
4. Ukrainian Physiological School.

Content module 2: Physiology of excitatory structures

1. The resting potential, mechanisms of origin, its parameters, physiological role.

2. Action potential, mechanisms of origin, its parameters, physiological role.

3. Excitability. Critical level of depolarization, threshold of depolarization of the cell membrane.

4. Changes in the excitability of the cell in the development of a single action potential.

5. The value of the parameters of electrical stimuli for the excitation.

6. Mechanisms of excitation by nerve fibers.

7. Patterns of excitation by nerve fibers.

8. Mechanisms of transmission of excitation through the neuromuscular synapse.

9. The conjugation of excitation and reduction. Skeletal muscle contraction and relaxation mechanisms.

10. Types of muscle contractions: single and tetanic; isotonic and isometric.

Content module 3. Biological regulation of body functions

1. Biological regulation, its types and significance for the body. Outlines of biological regulation. The role of feedback in regulation.

2. The concept of reflex. The structure of the reflex arc and the function of its links.

3. Receptors, their classification, mechanisms of excitation.

4. Proprioceptors, their types, functions. The structure and functions of muscular spindles.

5. Mechanisms and regularities of excitation transfer at central synapses.

6. Types of central braking. Mechanisms of development of presynaptic and postsynaptic inhibition.

7. Sum of excitation and inhibition of CNS neurons.

Content module 4: Nervous regulation of locomotor functions

1. Motor reflexes of the spinal cord, their reflex arcs, physiological significance.

2. The conductive function of the spinal cord. Dependence of spinal reflexes on activity of brain centers. Spinal shock.

3. Motor reflexes of the hindbrain, decerebral rigidity.

4. Motor reflexes of the midbrain, their physiological significance.

5. The cerebellum, its functions, symptoms of defeat.

6. The thalamus, its functions.

7. Limbic system, hypothalamus, their functions.

8. Basal nuclei, their functions, symptoms of defeat.

9. Sensory, associative and motor areas of the cerebral cortex, their functions.

10. Interaction of different levels of CNS in regulation of motor functions. Locomotives, their regulation. Functional structure of arbitrary motions. Age-related changes in motor functions.

Content module 5: Nervous regulation of visceral functions

1. General plan for the structure of the autonomic nervous system. Autonomous reflexes, their reflex arcs.

2. Synapses of the autonomic nervous system, their mediators, cytoreceptors and blockers of excitation transmission in synapses.

3. Influence of sympathetic nervous system on visceral functions.

4. Influence of the parasympathetic nervous system on visceral functions.

5. The role of the metasympathetic system in the regulation of visceral functions.

6. The unity of sympathetic and parasympathetic systems in the regulation of functions.

Content module 6. Humoral regulation of visceral functions

1. Humoral regulation, its differences from nervous. Characteristics of factors of humoral regulation.

2. Properties of hormones, their main effects. The mechanism of action of hormones on target cells.

3. Outline of humoral regulation. Regulation of hormone secretion by endocrine glands.

4. The role of the hypothalamic-pituitary system in the regulation of endocrine glands function.

5. The role of somatotropin, thyroxine and triiodothyronine, insulin in the regulation of linear body growth, processes of physical and mental development of the body.

6. Role of calcitonin, parathormone, calcitriol in regulation of constancy of concentration of calcium ions and phosphates in blood.

7. The role of pancreatic hormones in the regulation of body functions.

8. Role of thyroid hormones (T3, T4) in the regulation of body functions.

9. Physiology of the female reproductive system, its function, the role of sex hormones.

10. Physiology of the male reproductive system, the role of sex hormones.

11. General idea of nonspecific adaptation of an organism to a stressful situation. The role of hormones in nonspecific adaptation.

12. The role of the sympatho-adrenal system in the regulation of nonspecific adaptation of the organism to stressful situations.

13. The role of the pituitary-adrenal system in the regulation of nonspecific adaptation of the organism to a stressful situation. The main effects of glucocorticoids and mineralocorticoids on the body.

Content module 7. Physiology of sensor systems

1. Sensor systems, their structure and functions.

2. Taste sensory system, its structure, functions, research methods.

3. The olfactory sensory system, its structure and functions.

4. Somatosensory system, its structure and functions.

5. Physiological mechanisms of pain.

6. Opiate and non-opiateantinociceptive systems of the body, their significance.

7. Physiological mechanisms of anesthesia.

8. Auditory sensory system, its structure and functions.

9. Functions of the outer and middle ear. Inner ear, frequency analysis of sound signals.

10. Visual sensory system, its structure and functions.

11. Basic visual functions and methods of their study.

Content module 8. Physiological bases of behavior

1. Biological behaviors. Needs and motivations, their role in shaping behavior.

2. Congenital behavior. Instincts, their physiological role.

3. Acquired behaviors. Mechanisms of formation of conditioned reflexes, their differences from unconditioned ones.

4. Memory: types and mechanisms of formation.

5. Emotions, mechanisms of formation. Biological and informational theory of emotions. Their role in shaping behavior

Content module 9. Physiological bases of the higher nervous activity of the person

1. Functions of a new cerebral cortex and higher nervous activity of the person.
2. Biological and informational theories of emotions, their role in shaping behavior.
3. Functional asymmetry of the cerebral cortex, its integrative function.
4. Language, its functions, physiological basis of formation.
5. Thinking. Development of abstract thinking in man. The role of brain structures in the thinking process.
6. Types of higher nervous activity of man. Temperatures and character.
7. Sleep, its types, phases, electrical activity of the cortex, physiological mechanisms.
8. Age aspects of higher nervous activity in humans.

List of practical tasks

1. Perform function parameter calculations and graphically display processes occurring in exciting structures.
2. Draw diagrams and explain the structure and mechanisms:

• contours of biological regulation, reflex arcs of motor reflexes;

• development of processes of excitation and inhibition in the CNS, processes of their summation and coordination of reflexes;

• reflex arcs of motor reflexes at all levels of the CNS and leading pathways that ensure the interaction of different levels of the CNS;

• reflex arcs of autonomous reflexes that provide regulation of visceral functions;

• effects of various hormones on target cells and regulation of their secretion, circuits of regulation of visceral functions involving hormones.

3. To evaluate the status of sensory systems on the basis of the study of their functions.
4. Draw diagrams of the structure of specific channels of information transmission in sensory systems and explain the mechanisms of formation of relevant sensations and images of external reality.
5. Draw diagrams that explain the formation of biological behaviors and interpret the mechanisms of each of its stages, the role of emotions in behavior.
6. To evaluate and interpret the results of studies characterizing the types of human higher nervous activity.

BLOCK 2. PHYSIOLOGY OF VISCERAL SYSTEMS

List of theoretical questions

Content module 10. Blood system

1. General characteristics of the blood system. Blood composition and function. The concept of homeostasis.
2. Blood plasma electrolytes. Osmotic blood pressure and its regulation.
3. Blood plasma proteins, their functional significance. Erythrocyte sedimentation rate (ESR).
4. Oncotic blood plasma pressure and its role.

5. Acid-base state of the blood, the role of the buffer blood systems in maintaining its constancy.

6. Erythrocytes, their functions. Regulation of erythropoiesis.

7. Types of hemoglobin and its compounds, their physiological role.

8. Leukocytes, their functions. Regulation of leukopoiesis. Physiological leukocytosis.

9. Platelets, their physiological role.

10. Vascular-platelet hemostasis, its mechanisms and physiological significance.

11. Coagulation hemostasis, its mechanisms and physiological significance.

12. Coagulants, anticoagulants, fibrinolysis factors, their physiological significance.

13. Physiological characteristics of the AB0 blood system. Donor and recipient blood compatibility conditions. Samples before blood transfusion.

14. Physiological characteristics of the rhesus blood system (CDE). The value of rhesus accessory in blood transfusion and pregnancy.

Content module 11. Circulatory system

1. General characteristics of the circulatory system. Factors that ensure blood circulation in the blood vessels, its orientation and continuity.

2. Heart automatism. The gradient of automatism. The Stanius Experience.

3. Potential action of atypical cardiomyocytesSino-atrial node, mechanisms of origin, physiological role.

4. The cardiac system. The sequence and speed of the excitation in the heart.

5. Potential action of typical ventricular cardiomyocytes, mechanisms of origin, physiological role. Ratio in PD time and single myocardial contraction.

6. Refractory periods during PD development of typical cardiomyocytes, their significance.

7. The conjugation of excitation and contraction in the myocardium. Mechanisms of contraction and relaxation of the myocardium.

8. Vector theory of ECG formation. Electrocardiographic leads. Origin of teeth, segments, ECG intervals.

9. Cardiac cycle, its phases, their physiological role.

10. Role of heart valves. Heart tones, mechanisms of their origin. FCG, its analysis.

11. The arterial pulse, its origin. SFG, its analysis.

12. Myogenic mechanisms of regulation of cardiac activity.

13. The nature and mechanisms of the effects of sympathetic nerves on cardiac activity. The role of sympathetic reflexes in the regulation of cardiac activity.

14. The nature and mechanisms of the effects of parasympathetic nerves on cardiac activity. Role of parasympathetic reflexes in regulation of cardiac activity.

15. Humoral regulation of heart activity. Dependence of the activity of the heart on changes in the ionic composition of the blood.

16. Features of structure and function of different departments of blood vessels. The basic law of hemodynamics.

17. The value of blood viscosity for blood circulation.

18. Linear and volumetric blood flow velocity in different areas of the vascular bed. Factors affecting their magnitude.

19. Blood pressure and changes in different sections of the vascular bed.

20. Blood pressure, factors that determine its value. Methods of blood pressure registration.

21. Circulation in capillaries. Mechanisms of fluid exchange between blood and tissues.

22. Circulation in the veins, the effect on it of gravity. Factors that determine the value of venous pressure.

23. Tone arterioles and venules, its value. Influence of vascular-motor nerves on the tone of vessels.

24. Myogenic and humoral regulation of vascular tone. The role of vascular endothelial secretion in the regulation of vascular tone.

25. Hemodynamic center. Reflex regulation of vascular tone. Press and reflex reflexes.

26. Reflex regulation of blood circulation when changing the position of the body in space (orthostatic test).

27. Regulation of blood circulation in muscular work.

28. Peculiarities of blood circulation in cerebral vessels and its regulation.

29. Features of blood circulation in the vessels of the heart and its regulation.

30. Features of pulmonary circulation and its regulation.

31. Mechanisms of lymph formation. Movement of lymph in vessels.

Content module 12. Respiratory system

1. General characteristics of the respiratory system. The main stages of breathing. Biomechanics of inhalation and exhalation.

2. Elastic pulmonary thrust, negative pressure in the pleural cleft.

3. External respiration. External respiratory indices and their evaluation.

4. Anatomical and physiological "dead space", its physiological role.

5. Diffusion of gases in the lungs. The diffusion capacity of the lungs and the factors on which it depends.

6. Oxygen transport by blood. Oxygen capacity of blood.

7. Oxyhemoglobin dissociation curve, factors affecting its course.

8. Transport of carbon dioxide by blood. The role of erythrocytes in the transport of carbon dioxide.

9. Physiological role of the respiratory tract, regulation of their lumen.

10. Respiratory center, its structure, regulation of breathing rhythm.

11. The mechanism of the first inhalation of a newborn baby.

12. Role of receptors of stretching lungs and afferent fibers of vagus nerves in regulation of respiration.

13. The role of central and peripheral chemoreceptors in the regulation of respiration. Blood components that stimulate external respiration.

14. Regulation of external respiration during exercise.

Content module 13. Energy exchange and thermoregulation

1. Sources and ways of using energy in the human body.

2. Methods for determining human energy consumption. Respiratory factor.

3. The main exchange and conditions of its definition, factors affecting its value.

4. Working exchange, the meaning of its definition.

Content module 14. Thermoregulation

1. Human body temperature, its daily fluctuations.

2. The physiological significance of homothermia. Center of thermoregulation, thermoreceptors.

3. Thermal formation in the body, its regulation.

4. Heat transfer in the body, its regulation.

5. Regulation of constancy of body temperature at different ambient temperatures.

6. Physiological basis of quenching.

Content module 15. Digestive system

1. General characteristics of the digestive system. Digestion in the oral cavity. Chewing, swallowing.

2. The composition of saliva, its role in digestion.

3. Mechanisms of saliva formation, primary and secondary saliva.

4. Regulation of salivation. Influence of irritant properties on saliva quantity and quality.

5. Methods of research of secretory function of a stomach at the person. The composition and properties of gastric juice. Mechanisms of hydrochloric acid secretion.

6. Complex reflex ("cephalic") phase of regulation of gastric secretion.

7. Neurohumoral ("gastric and intestinal") phase of regulation of gastric secretion. Enteral stimulants and inhibitors of gastric secretion.

8. Nervous and humoral mechanisms of inhibition of gastric secretion.

9. Gastric motor function and its regulation. Mechanisms of gastric contents transfer to the duodenum.

10. Methods of investigation of secretion of pancreatic juice in humans. The composition and properties of pancreatic juice.

11. Phases of regulation of the secretory function of the pancreas.

12. Methods of research of bile excretion at the person. Composition and properties of bile.

13. Regulation of bile formation and excretion. Mechanisms of bile flow into the duodenum.

14. The composition and properties of intestinal juice. Regulation of its secretion. Cavity and membrane digestion.

15. Absorption in the digestive canal. Mechanisms of absorption of sodium ions, water, carbohydrates, proteins, fats.

16. Intestinal motor function, types of contractions, their regulation.

17. Physiological mechanisms of hunger and satiation.

Content module 16. Excretory system

1. General characteristics of the selection system. The role of the kidneys in the processes of excretion. Features of blood supply to the kidney.

2. Mechanisms of urination. Filtering in the glomeruli and the factors on which it depends.

3. Reabsorption and secretion in nephrons, their physiological mechanisms.

4. Rotary-countercurrent-multiple system of nephrons, its physiological mechanisms and role.

5. Regulation of reabsorption of sodium and water ions in nephron tubules.

6. The role of the kidneys in providing iso-osmosis. Thirst mechanisms.

7. The role of the kidneys in providing isovolumia.

8. The role of the kidneys in ensuring the stability of the acid-base state of the blood.

9. Urination and its regulation.

Content module 17. Physiological bases of work and sports

1. Physiological basis of human labor activity.

2. Features of physical and mental work. Optimal modes of operation.

3. Physiological mechanisms of fatigue. Active rest and its mechanisms.

4. Age-related changes in human performance.

5. Physiological basis of sport. Principles of building optimal training regimes.

List of practical tasks

1. Determine the content of hemoglobin in the blood by the Sally method, evaluate the results.

2. Identify the blood group in the AB0 system and draw conclusions.

3. To calculate the color index of blood, to draw conclusions.

4. To determine the hematocrit index, to draw conclusions.

5. Determine the level of blood pressure under study, conclude.

6. To determine the duration of the period of tension of the ventricles of the heart based on the analysis of the polycardiogram, to conclude.

7. To determine the duration of the period of expulsion of blood from the ventricles of the heart based on the analysis of the polycardiogram, to conclude.

8. To determine the duration of total ventricular systole based on the analysis of the polycardiogram, to conclude.

9. To determine the duration of the phase of isometric contraction of the ventricles based on the analysis of the polycardiogram, to conclude.

10. Determine the direction and amplitude of the electrocardiogram teeth in standard leads. Draw conclusions.

11. Determine the duration of the cardiac cycle based on ECG analysis. Conclude.

12. Calculate on the basis of the ECG the duration of the P-Q interval. Conclude.

13. Calculate on the basis of ECG analysis the duration of the Q-T interval. Conclude.

14. Calculate on the basis of ECG analysis the duration of the QRS complex. Conclude.

15. Determine on the basis of the ECG analysis that is the driver of the heart rhythm. To reason the conclusion.

16. Calculate the respiratory volume, vital capacity of the lungs by spirogram. Conclude.

17. Calculate by spirogram the reserve volume of inhalation and exhalation. Conclude.

18. Spirogram to calculate the minute breathing volume. Conclude.

19. To calculate on the spirogram maximum ventilation of the lungs, to draw conclusions.

20. Calculate the respiratory reserve by spirogram. Conclude.

21. Determine by the spirograph of oxygen consumption investigated at rest and within the first minute after exercise, draw conclusions.

22. Determine according to the spirogram of oxygen consumption investigated at rest and within three minutes after loading, draw conclusions.

23. To calculate the main exchange of the investigated person, determining the oxygen consumption according to the spirogram registered under standard conditions, to make a conclusion.

24. Perform breathlessness tests. Conduct an analysis of the results.

25. How and why will salivation change after administration of human atropine?

26. Assess the secretory function of the stomach in humans.

27. Why in the increase of acidity of gastric juice recommend a dairy diet?

28. How and why will the secretion of pancreatic juice change with decreasing acidity of gastric juice?

29. What is the effect on the digestive process of reducing the bile acid content of bile? Why?

30. Suggest ways to increase the gut motor function. Give them physiological reasoning.

31. How and why will the amount and composition of gastric and pancreatic juices change upon admission to the duodenum of fats?

32. How and why will the amount and composition of gastric and pancreatic juices change upon admission to the stomach of cabbage juice?

33. Determine the filtration rate in the glomeruli, conclude.

34. Determine the amount of water reabsorption in the nephron. Conclude.

35. Evaluate the results of the study of kidney function by the Zymnitsky method.

36. To estimate a condition of an organism at physical activity on indicators of functions.

"0" test ticket form
Petro Mohyla Black Sea National University
Educational and qualification level - Master
Knowledge area: 22 Health care
specialty 222 Medicine

Discipline - PHYSIOLOGY
Variant № 0

1. Physiological properties of the myocardium and their features. Heart automaticity. Action potential of atypical cardiomyocytes of the heart rhythm driver (pacemakers) - sino-atrial node *(Scores 20 points)*.

2. Identify the blood group in the AB0 system and draw conclusions *(Scores 20 points).*

3. General characteristics of the digestive system. Digestion in the oral cavity. Chewing, swallowing *(Scores 20 points).*

Situational task.

Explain the main differences between conditional and unconditional reflexes. What reflexes are such reflexes as food, protective, sexual and parental? *(Scores 20 points)*

Approved at the meeting of the Department of "Medical Biology and Physics, Microbiology, Histology, Physiology and Pathophysiology", Protocol No. 1 of August 28, 2021.

Head of the Department Korolova O.V.
Examiner Hilmutdinova M.Sh.

Typical tasks to solve

Test tasks

Variant 1

1. A physiological system specialized in the reception, processing and storage of information about the environment and the internal environment of the organism is:

A) respiratory system
B) circulatory system
C) blood system
D) nervous system
E) digestive system

2. The afferent link of the reflex arc performs the functions of:

A) conduction of excitation from the nerve center to the executive structure
B) conduction of excitation from receptors to the nerve center
C) perceives the action of the stimulus, converts its energy into the receptor potential and encodes the properties of the stimuli
D) performs analysis and synthesis of information received, recoding of information and team development
E) coordinate effector activity

3. In the reflex arc, usually the greatest delay time of the excitation is carried out at:

A) the afferent link
B) the efferent link
C) the central link
D) the link of afferent afferentation
E) there is no right answer

4. When cutting the anterior roots of the spinal cord muscle tone:

A) will practically not change
B) extensor will increase
C) will decrease moderately
D) will virtually disappear
E) flexor will increase

5. The central link of the reflex arc performs the functions of:

A) conduction of excitation from the nerve center to the executive structure
B) conduction of excitation from receptors to the nerve center
C) perceives the energy of the stimulus, converts it into the receptor potential and encodes the properties of the stimuli
D) performs analysis and synthesis of information received, recoding of information and team development
E) perceives the receptor potential and converts it into action potential

Questions

1. What are the functions of the metencephalon?
2. What are the protective reflexes controlled by the medulla oblongata?
3. Describe the vestibular static reflexes of the metencephalon.
4. What is the conduction function of the medulla oblongata?
5. Define the concept of “reflex arc”.

Situational tasks

1. In the body of the animal began an acute purulent inflammatory process. What changes can be expected in a hemogram?

2. In the experiment, an alien protein was introduced into the animal's body. Which blood cells provide an immunological response?

3. In the blood test revealed a reduced content of hemoglobin. What function of blood will be broken thus?

4. A woman with Rh- blood is pregnant with Rh+ fetus. Pregnancy first. The baby was born healthy. A few months after giving birth, the woman's blood was transfused with single blood, but the patient died in the phenomenon of hemotransfusion shock. What could have been the cause of it?

An example of the final control work on block 2

Control work

1. The presence in the blood of antibodies and phagocytic activity of leukocytes causes:
A) trophic function
B) transport function
C) respiratory function
D) protective (immune) function
E) plastic function
2. The active reaction (pH) of arterial blood in a healthy person is:
A) 7.40 + / -0.04
B) 7.30 + / -0.04
C) 7.20 + / -0.04
D) 7.60 + / -0.04
E) 7.0 + / -0.04
3. The hematocrit is called the percentage ratio of:
A) the amount of hemoglobin to the volume of blood
B) the volume of formed elements (more precisely, erythrocytes) to the volume of blood
C) the volume of plasma to the volume of blood
D) the percentage of formed elements of blood
E) the number of leukocytes to the volume of blood
4. Most of the osmotic pressure of blood plasma is generated by ions:
A) sodium and chlorine
B) potassium and calcium
C) hydrocarbonate and phosphates
D) magnesium
E) hydrogen
5. The percentage of various forms of leukocytes is called:
A) color indicator
B) hematocrit number

C) leukocyte formula
D) nuclear index
E) osmotic resistance
And 45 more questions on various topics.

6. Evaluation criteria and tools for diagnosing learning outcomes

Control methods:

• survey (testing of theoretical knowledge and practical skills);

• test control;

• writing a review of scientific literature (abstracts), performing individual tasks, their defense.

Current control. Testing in practical classes of theoretical knowledge and mastery of practical skills, as well as the results of independent work of students. Supervised by teachers according to the specific purpose of the curriculum. Assessment of the level of students' training is carried out by: interviewing students, solving and analyzing situational tasks and test tasks, interpreting the results of experimental and clinical and laboratory research, monitoring the acquisition of practical skills.

Intermediate control. Checking the possibility of students using for clinical and diagnostic analysis of theoretical knowledge and practical skills on all topics studied, as well as the results of independent work of students. Carried out in the last lesson by section by passing practical skills, solving situational problems and testing.

The final test is carried out upon completion of the study of all topics of the block at the last test lesson of the semester.

Intermediate final control (certification) and final control (exam) are allowed to students who have attended all lectures, classroom classes, performed full independent work and in the process of learning scored the number of points, not less than the minimum - 70 points in the I semester and 40 points in the II semester.

Distribution of points received by students

In the first semester, a positive assessment in each practical session can be from 2 to 6 points. A score below 2 points means "unsatisfactory", the lesson is not credited and is subject to retake in the prescribed manner. At the final test for block 1, the student can get a maximum of 80 points. The final test is considered credited if the student scored at least 50 points.

In the second semester, a positive assessment in a practical session can be from 1 to 3 points. A score below 1 means "unsatisfactory", the lesson is not credited and is subject to retake in the prescribed manner. At the final test for block 2, the student can get a maximum of 40 points. The final test is considered credited if the student scored at least 30 points.

Assessment of student performance

Type of activity (task)	Maximum number of points	Type of activity (task)	Maximum number of points
Block 1		**Block 2**	

Topic 1	5	Topic 1	3
Topic 2	5	Topic 2	3
Topic 3	5	Topic 3	3
Topic 4	5	Topic 4	3
Topic 5	5	Topic 5	3
Topic 6	5	Topic 6	3
Topic 7	5	Topic 7	3
Topic 8	5	Topic 8	3
Topic 9	5	Topic 9	3
Topic 10	5	Topic 10	3
Topic 11	5	Topic 11	3
Topic 12	5	Topic 12	3
Topic 13	5	Topic 13	3
Topic 14	5	Topic 14	3
Topic 15	5	Topic 15	3
Topic 16	5	Topic 16	3
Topic 17	5	Topic 17	3
Topic 18	5	Topic 18	3
Topic 19	6	Topic 19	3
Topic 20	6	Topic 20	3
Topic 21	6	Topic 21	2
Topic 22	6	Topic 22	2
Topic 23	6	Topic 23	2
The total number of points for current activities	**120**	Topic 25	2
Final control work for block 1	**80**	Topic 26	2
Total for block 1	**200**	Topic 27	2
		Topic 28	2
		Topic 29	2

Topic 30	2
The total number of points for current activities	**80**
Final control work for block 2	**40**
Total for block 2	**120**
Exam	**80**
Total for block 2 and exam	**200**

Criteria for assessing knowledge

Practical classes in physiology are structured and provide a comprehensive assessment in points of all types of educational activities (learning tasks), which students perform during the practical lesson:

1) at the initial stage of practical training the control of theoretical questions is carried out. His results are evaluated positively if the student gave at least 70% of the correct answer; the student does not receive points if the number of correct answers is less than 70%. In the overall assessment of current educational activities, this stage is 20%;

2) at the main stage of the practical lesson are evaluated:

2.1) performance of practical work (research), recording of the research protocol in accordance with the requirements, the ability to analyze and interpret the results of research and correctly draw sound conclusions;

2.2) solving situational problems, drawing graphs, diagrams, contours of regulation.

In the general assessment of current educational activity the student can receive the following points:

The student scores 6-5 points (3 in the second semester) if he correctly performed practical work (research), wrote down the research protocol in accordance with the requirements, was able to analyze and interpret the research results, draw sound conclusions, and correctly solved all the proposed situational tasks and other tasks.

The student scores 4-3 points (2 in the second semester) if he correctly performed practical work (research), recorded the research protocol in accordance with the requirements, was able to analyze and interpret the results of research with small errors, draw sound conclusions and solve at least half of the proposed tasks.

The student scores 2 point (1 in the second semester) if he correctly performed practical work (research), recorded the research protocol in accordance with the requirements, was able to analyze and interpret the results of the research, draw sound conclusions and did not solve any of the proposed tasks.

The student does not gain points at the main stage of educational activities, if he failed to properly perform practical work (research), record the research protocol in accordance with the requirements, analyze and interpret the results of the study, draw sound conclusions.

Criteria for evaluating the final test

Sufficient level (20 points / 10 points): The test is made outside the deadline set by the teacher. The student provided answers to 20% of the questions posed in the test.

Satisfactory level (40 points / 20 points): The test is made in the term established by the teacher. The student provided answers to 50% of the questions posed in the test.

Good level (60 points / 30 points): The test is made in the term established by the teacher. The student provides answers to 70% of the questions posed in the test.

High level (80 points / 40 points): The test is made in the term established by the teacher. The student provides answers to all questions posed in the test.

Assessment of final control (exam)

The final control (exam) is carried out upon completion of the study of the block (discipline) in the control lesson. Students who have completed all types of educational tasks provided by the curriculum, and during the study of the block scored for the current educational activity the number of points not less than the minimum are allowed to the final control (exam). The total maximum number of points for current educational activities and final control is 200 points, the minimum - 120 points. The maximum number of points that a student can score on the results of the final control (exam) - 80, the minimum number of points - 50. The student receives the following number of points: 20 points - if he gave the correct answer to at least 80% of questions, 15 points - if he gave a correct answer of at least 70%, 10 points - if he gave a correct answer of at least 60%.

7. Recommended literature

Basic

1. Moroz V.M. / Physiology: [textbook] / V.M. Moroz, O.A. Shandra. 2018. – 728 p.
2. Physiology. Edited by I.M. Karvatsky. Textbook for practical studies and individual work for English-speaking students. 2-nd Vol. – Kyiv. Phenix, 2019. V.1 – 296 p., V.2 – 296 p.
3. Guyton and Hall Textbook of medical physiology. John E. Hall, 13th ed. ElsevierInc. 2016. – 1168 p.
4. Ganong's Review of Medical Physiology 25th ed. McGraw-Hill Education. 2016. – 750 p.
5. Essentials of Medical Physiology. K Sembulingam, Prema Sembulingam, Sixth Edition. Jaypee Brothers Medical Publishers. 2012 – 1113 p.

Additional

1. Color Atlas of Physiology. 6th edition. Stefan Silbernagl, Agamemnon Despopoulos. – Thieme New York. 2009. – 455 p.
2. Medical physiology. Costanzo L. 5th Edition / Elsevier Health Sciences – 2013. – 520 p.

8. Information resources

1. http://www.physiologyinfo.org
2. http://www.medicalnewstoday.com
3. http://www.physoc.org
4. http://www.medtropolis.com
5. http://www.physiologyweb.com
6. http://www.osmosis.org