

ОҢТҮСТІК-ҚАЗАҚСТАН MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ		 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казахстанская медицинская академия»
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METHODOLOGICAL RECOMMENDATIONS FOR PRACTICAL CLASSES

Discipline: ‘Physiology’

Discipline code: MF-2101-2

Speciality: 6B10101 ‘General Medicine’

Number of credits: 120 hours (4 credits)

Year – II, Term – III

Practical classes: 30 hours

Year, 2022

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Head of the department:  c.b.s., docent Zhakipbekova G.S.

Protocol of the meeting of the Department No. 10a dated '06' 05 2022

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1. Theme No. 1: Physiology of the Spinal cord, the Medulla Oblongata, and the Hindbrain.

2. Learning goals: morpho-functional features of the spinal cord, the medulla oblongata, and the hindbrain.

3. Learning objectives: to study the structural and functional arrangement of the spinal cord, the medulla oblongata, and the hindbrain according to tables and diagrams; to master the methods of conducting the clinically important spinal reflexes of a human.

4. Questions relating to the theme:

1. Structural arrangement of the spinal cord. Functions of the spinal cord.
2. Connection of the spinal cord with other parts of the central nervous system.
3. The role of the spinal cord in the regulation of motor activity.
4. The ascending and descending neural pathways of the spinal cord.
5. Reflex activity of the spinal cord
6. Methods for investigation of the spinal cord functions.
7. Features of the neural organization of the spinal cord.
8. The reflex theory and its principles.
9. Structural organization of the hindbrain. Functions of the hindbrain.
10. Connection of the hindbrain with other parts of the central nervous system.
11. Structural organization of the medulla oblongata. Functions of the medulla oblongata.
12. Connection of the medulla oblongata with other parts of the central nervous system.

5. Methods of teaching and learning – work with schemes and control questions, work in small groups.

Laboratory work No. 1.

Transection of the ventral and dorsal roots of the spinal cord

Equipment: a dissecting board, a preparation kit, cotton, ether, Ringer's solution.

The work is performed on a frog (the study object).

The content of the work. A slightly narcotized frog is laid back up on the dissection board. Dissect the skin along the middle line and shift the muscles away from both sides of the spine. Then, cut the arches of the last 4 vertebrae and remove the layers of the spinal cord. Gently dissect the dorsal roots on the one side. On the other side, cut the ventral roots after gentle shifting the dorsal ones with the glassy sticks (prepared in advance). After that, the wound is sutured and the frog is left for

3-4 hours. After an indicated period or the next day, observation is performed. Severe irritation (pinch by tweezers) of the foot of the side where the dorsal roots are retained and the ventral ones are cut causes a reflex reaction of all limbs, except the irritated one, which remains immobile (with relaxed muscles). The irritation of the other foot on the side, where the ventral roots are retained and the dorsal ones are cut, does not give any effect, but the irritation of any other part of the body causes a contraction of this limb.

Laboratory work No. 2.

Equipment: a preparation kit, a holder with a hook, hydrochloric acid solutions: 0.1%, 0.25%, 0.5%, 1%, water, 5 medical glasses, metronome, ether. Work is carried out on a frog.

The content of the work. In a frog narcotized with ether, destroy or remove the brain. Then, fix this frog by the lower jaw on a hook of a holder. Thereafter, submerge one of the legs of the frog in the acid solution of the minimal concentration. Determine the reflex time. Then wash this leg by submerging it in a glass with clean water. Thereafter, consistently submerge the leg in acid solutions of increasing concentration and determine the reflex time. Each time wash the leg from the acid by submerging in a glass of water. Intervals between irritations should be at least 2-3 minutes. The reflex time for each submerging of the foot in the acid is determined by the stopwatch or the number of metronome strokes.

Drawing the protocol. 1. Record the course of the experiment. 2. Obtained data insert in the table below.

Strength of irritation (concentration of the hydrochloric acid, %)	The reflex time, sec			Mean
	1	2	3	
0,1				
0,25				
0,5				
1,0				

3. Explain dependence of the reflex time from the strength of irritation.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. The transition from deep sleep to wakefulness can be caused by irritation of the

- A) red nucleus
- B) medulla oblongata
- C) the thalamus

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- D) reticular formation
- E) basal nuclei
- 2. The inhibition in the central nervous system was first discovered by... .
 - A) Pavlov I.P.
 - B) Anokhin P.K.
 - C) Descartes R.
 - D) Sherrington Ch.
 - E) Sechenov I.M.
- 3. The center of vomiting is located in the... .
 - A) midbrain
 - B) hypothalamus
 - C) medulla oblongata
 - D) pons
 - E) reticular formation
- 4. Conditioning inhibition is
 - A) delayed, differentiating, extinct, conditional, inhibitory
 - B) delayed, transcendental, differentiating, synaptic
 - C) transcendental, external, differentiating, presynaptic
 - D) differentiation, transcendental, extinct, external
 - E) extinct, protective, delayed, internal
- 5. The Broca Center, which provides motor programming of speech, is localized in the
 - A) third frontal cortex of the brain
 - B) anterior central gyrus of the cerebral cortex
 - C) motor nuclei of the cranial nerves
 - D) occipital region of the cerebral cortex
 - E) temporal region of the cerebral cortex
- 6. Self-regulation of body functions is based on the principle of
 - A) feedback afferentation
 - B) situational afferentation
 - C) afferent synthesis
 - D) dominant motivation
 - E) reciprocal innervation
- 7. The Wernicke's area, which provides the perception of the speech, is localized in
 - A) temporal area of the brain cortex
 - B) third frontal cortex gyrus
 - C) the front central gyrus of the brain cortex
 - D) occipital cortex
 - E) motor nuclei of cranial nerves

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8. In humans, the lumbar segments of the spinal cord innervate the

- A) pelvis, lower limbs
- B) pelvis, sole
- C) chest, pelvis
- D) ano-genital area, pelvis
- E) face, ano-genital area

9. Dorsal roots of 3-12 thoracic segments of the spinal cord provide with the

- A) sensitive fibers the skin and muscles of the trunk
- B) motor fibers the trunk muscles
- C) sensitive and motor fibers the skin and muscles of the upper limbs
- D) sensitive fibers the skin and muscles of the lower limbs
- E) motor fibers the skin and muscles of the lower limbs

10. Dorsal roots of 1 - 4 cervical spinal cord segments provide with the

- A) sensitive fibers the skin and muscles of the occiput, neck, diaphragm
- B) motor and sensitive fibers the skin and muscles of the occiput and neck
- C) motor and sensitive fibers the skin and muscles of the occiput neck, and diaphragm
- D) sensitive and motor fibers the scalp
- E) motor fibers the neck and head muscles

1. Theme No. 2: Physiology of the midbrain, the diencephalon, and the cortex of the brain.

2. Learning goals: to study the role which the CNS plays in organism activity and the morpho-functional features of the midbrain, the diencephalon, and the cortex of the brain.

3. Learning objectives: to study the structural and functional arrangement of the midbrain, the diencephalon, and the cortex of the brain according to tables and diagrams; to master the method of the encephalogram.

4. Questions relating to the theme:

1. Structural organization of the midbrain. Functions of the midbrain.
2. Connection of the midbrain with other parts of the central nervous system.
3. Structural organization of the diencephalon. Functions of the diencephalon.
4. Connection of the diencephalon with other parts of the central nervous system.
5. Structural organization of the hemisphere cortex. Functions of the cerebral cortex.
6. Connection of the brain cortex with other parts of the central nervous system.
7. The descending fibers of the cerebral cortex.
8. The ascending fibers of the cerebral cortex.
9. Functional areas of the cerebral cortex.

5. Methods of teaching and learning – work with schemes and control questions, work in small groups.

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Laboratory work No. 1.

Conditioned defensive (blinking) reflex

In humans, unlike animals, a conditioned reflex can be developed not only on specific phenomena and objects of the surrounding world (the first signal system), but also on the semantic meaning of the word, which indicates this phenomenon or stimulus (the second signal system).

Equipment: the source of the sound stimulus (you can use a cell phone buzzer, a bell, a children toy – a buzzer), a small rubber bulb with a flexible tube. The research is conducted on a human subject.

The content of the work. Offer the subject to sit on a chair. Standing on the side of him/her, direct the tube of the rubber bulb into the angle of the subject's eye. Apply a jet of air to the sclera and cornea (the rubber bulb should be squeezed slightly so that the air stream does not cause pain). Note the presence of a blinking reflex. Then apply a sound stimulus; note the presence or absence of an orienting reaction and a blinking reflex.

Having checked the effect of the sound and the air stream separately, proceed to the formation of a conditioned reflex. To do this, make close the sound source to the ear and give a sound, and then apply a jet of air until a stable conditioned reaction is formed. Combinations of irritants should be repeated 10 - 15 times with an interval of at least 5 seconds.

Suddenly, give a sound to the subject, but without irritation with air. The observed blinking indicates the formation of a conditioned reflex and the normal formation of temporary connections in the cerebral cortex. If there is no blinking (this may indicate an incorrect experiment or some inertness in the CNS activity), repeat the combination a few more times and try the isolated sound action again.

Then loudly pronounce the word “sound”. If the second signaling system operates correctly, there is blinking reflex observed.

Drawing of the protocol. 1. Describe the experiment results and make conclusion. 2. Draw the arch of the conditioned blinking reflex.

Laboratory work No. 2.

Electroencephalography

Electroencephalogram is the recording of electrical potentials of the brain.

Characteristics of the parameters of the electroencephalogram and the conditions for recording various rhythms are presented in the table below.

Name of the rhythm	Frequency, Hz	Amplitude, μV	Conditions of recording the rhythm
alpha-rhythm	8-13	50	In the state of mental and physical rest with closed eyes
beta-rhythm	13-30	20-25	Emotional excitation,

gamma-rhythm	> 35		mental and physical activity; under the influence of irritators
theta-rhythm	4-8	100-150	Sleeping, moderate hypoxia and narcosis; in some diseases
delta-rhythm	0.5-3.5	250-300	deep sleep, narcosis and hypoxia; damage of the brain cortex

Electroencephalography is of great diagnostic value for assessing the functional state of the central nervous system.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. The synthetic function of the brain cortex is

- A) development of a dynamic stereotype, the formation of a conditioned reflex
- B) perception of information, development of a dynamic stereotype, formation of a conditioned reflex, differentiating inhibition
- C) fading inhibition, development of a dynamic stereotype
- D) perception of information, delayed inhibition
- E) development of a dynamic stereotype, the formation of an unconditioned reflex

2. The EEG delta rhythm corresponds to the frequency and amplitude

- A) 0,5-3,5 per sec. 250-300 μV
- B) 4-8 per second. 100-150 μV
- C) 8-13 per second. 20-75 μV
- D) 15-25 per second. 10-20 μV
- E) 26-35 per second. 50-100 μV

3. Active brain functioning is accompanied by the rhythm of the EEG.

- A) beta
- B) alpha
- C) gamma
- D) theta
- E) innervation

4. The activity of the cerebral cortex obeys the laws of

- A) concentration, irradiation, mutual induction
- B) concentration, adaptation, induction
- C) irradiation, dominance, lability
- D) mutual induction, protraction, summation
- E) irradiation, reverberation, convergence

5. Alpha-rhythm on the electroencephalogram is recorded

- A) at rest

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- B) during mental work
 - C) during sleep
 - D) in an emotional state
 - E) during physical work
6. An example of negative feedback in the physiology of the central nervous system is ... inhibition.
- A) recurrent
 - B) Sechenov's
 - C) reciprocal
 - D) presynaptic
 - E) postsynaptic
7. Thin conscious movements are regulated by the
- A) motor cortex and pyramidal tract
 - B) basal nuclei and cerebellum
 - C) motor cortex and red nucleus
 - D) cerebellum and medulla oblongata
 - E) medulla oblongata and spinal cord
8. The morphofunctional unit of the cortex of the cerebral hemispheres is ...
- A) cortical column
 - B) granular cells
 - C) pyramidal cells
 - D) neuronal chain
 - E) neuroglia
9. A specially important role in the trophic influences on the body belongs to the
- A) hypothalamus and cerebral cortex
 - B) medulla oblongata and midbrain
 - C) the spinal cord and the cerebellum
 - D) cerebral cortex and spinal cord
 - E) hypothalamus and midbrain
10. The CNS has.... influences on the tissues of the body.
- A) functional, trophic, vasomotor
 - B) functional, inhibitory, subordinate
 - C) trophic, regulatory, summarizing
 - D) vasomotor, functional, humoral
 - E) nervous, humoral, trophic

1. Theme No. 3: Visual and olfactory analyzers

2. Learning goals: to study structural and functional features of the visual and olfactory analyzers.

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3. Learning objectives:

- indicate the structural elements of the analyzers according to the training tables and models;
- Identify a blind spot on the retina.

4. Questions relating to the theme:

1. Structure and function of the retina;
2. Abnormalities of the receptor system of the eye;
3. Visual adaptation;
4. The role of eye movement for vision;
5. Structure and function of the olfactory analyzer;
6. Anomalies of olfactory receptors;
7. Coding of olfactory information.

5. Methods of teaching and learning: development of clinical and physiological techniques.

Laboratory work No. 1.

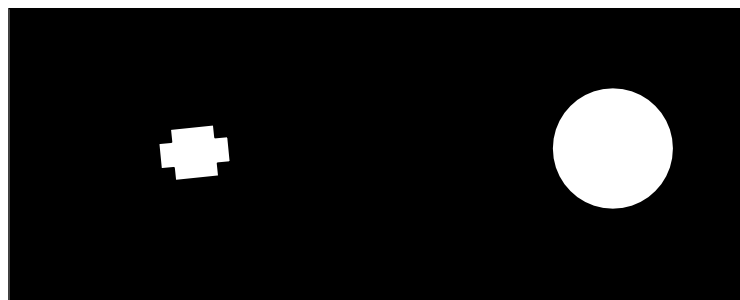
Demonstration of a blind spot on the eye retina (Mariott's Experiment)

Equipment: special black card with a picture of a white round on the right and a white cross on the left.

The content of the work. The subject of experiment is offered to close the left eye with his left hand and holding the card in his outstretched right arm; then slowly bring it closer to the open right eye. In this case, the subject should fix the view not to the left image (cross). At a distance of 20-25 cm from the eye, the right image (round) disappears. This is proof of the presence on the retina of a blind spot, i.e. a site that does not have visual receptors.

Then the experiment is repeated by the same way: the subject is asked to close his right eye and fix with his left eye the right image on the card.

The results of the work and its design. Write down the experience in the protocol and specify the distance from the eye to the card at the moment when the second image disappears.



Laboratory work No. 2

“The hole in the palm”

Equipment: a piece of paper folded into a tube.

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The content of the work. The main condition for a single vision is the position of the eye, in which the image from one object falls on identical or corresponding places of the retina. To make sure that this is the truth, fold a notebook or a piece of paper in a tube, then bring it to the right eye and apply the left palm at a distance of 20-30 cm perpendicular to the middle of the tube. During seeing objects through a tube with two eyes, the phenomenon of the "hole in the palm" arises. Alternately close the left, then the right eye – the "hole in the palm" disappears.

Design of the protocol. Describe the results of the test.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. Under the effect of an increased tone of the sympathetic nervous system, the diameter of the pupil

- A) increases
- B) decreases
- C) narrows, then widens
- D) does not change
- E) widens, then narrows

2. The main chains of the analyzer according to Pavlov I.P. ...

- A) receptive, conductive, cortical
- B) receptive, conductive, sensory
- C) bulbar, thalamic, cortical
- D) specific, nonspecific, associative
- E) receptive, thalamic, central

3. Primarily sensory receptors are

- A) olfactory, tactile, proprioceptors
- B) auditory, tactile, gustatory
- C) vestibuloceptors, proprioceptors, chemoreceptors
- D) baroreceptors, olfactory, osmoreceptors
- E) taste, auditory, vestibuloceptors

4. To study the olfactory sensitivity, the is used.

- A) olfactometry
- B) audiometry
- C) thermoesthesiometry
- D) diploscopy
- E) perimetry

5. The receptive part of any analyzer characterizes with ...

- A) specificity, high sensitivity, adaptation
- B) low sensitivity, refractoriness, functional mobility
- C) refractoriness, accommodation, specificity

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- D) lability, chronaxy, low sensitivity
E) specificity, adaptation, high threshold of excitability
6. The concept of "analyzer" includes the...
- A) specialized receptors, intermediate and central structures, and the nerve fibers connecting them
B) neurons providing reception of information from the environment
C) the structures participating in the propagating of the excitation through the structures of the central nervous system
D) receptors providing reception of information
E) subcortical formations providing information analysis
7. During observing the close objects, the lens
- A) becomes convex, the optical power increases
B) flattens, the optical power decreases
C) flattening, the optical power increases
D) becomes convex, the optical power decreases
E) does not change
8. To correct the refraction of the eye with astigmatism, the following glasses are needed
- A) cylindrical
B) biconcave
C) biconvex
D) horizontal
E) square
9. The place of the best vision is the fovea centralis of the retina, where the ... accumulates.
- A) cones
B) rods
C) rods and cones
D) ganglionic cells
E) bipolar cells
10. To study the tactile sensitivity, the is used.
- A) Weber compass
B) olfactometer
C) thermoesthesiometer
D) ophthalmoscope
E) Forster's perimeter
11. The outer layer of the retina is formed by the following cells ...
- A) pigment epithelium
B) ganglionic cells
C) bipolar cells

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- D) rods
E) cones
12. Sensitivity of photoreceptors in bright luminescence ...
A) decreases
B) does not change
C) disappears
D) increases
E) will change by phases
13. In the retina of the eye retina, there are the following pigments ...
A) iodopsin, erythrolabe, chlorolabe
B) rhodopsin, retinal, erythrolabe
C) iodopsin, rhodopsin, vitamin A
D) vitamin A, iodopsin, chlorolabe
E) vitamin A, erythrolabe, retinal
14. Sensitivity of the photoreceptors in the darkness ...
A) increases
B) does not change
C) disappears
D) decreases
E) changes by phases
15. If the fields of vision are reduced, the visual acuity ...
A) does not change
B) decreases
C) increases
D) falls sharply
E) varies by phases
16. The unequal refraction of the rays in different directions by the eye is called ...
A) astigmatism
B) refraction
C) accommodation
D) hypermetropia
E) myopia

1. Theme No. 4: Auditory, vestibular, and taste analyzers

2. Learning goals: to study structural and functional features of auditory, vestibular, taste analyzers.

3. Learning objectives:

- to indicate the structural elements of studied analyzers by the training tables and models

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- to apply research methods for hearing, vestibular, and taste analyzers.

4. Questions relating to the theme:

1. Theory of sound perception;
2. The mechanism of the sound reception;
3. Analysis of sound intensity;
4. Auditory sensitivity;
5. Analysis of the frequency of sound;
6. Methods of research of the auditory analyzer;
7. The structure and functions of the taste analyzer;
8. Structure and functions of the vestibular analyzer.

5. Methods of teaching and learning: to master clinical and physiologic methods.

Laboratory work No. 1.

Interaction of olfactory, taste, and visual analyzers.

Equipment: 2% solution of acetic acid, 10% glucose solution, pieces of sugar, potatoes, onions, apples. The study is conducted on a person.

The content of the work: The subject is offered to stick out his tongue and successively apply to it several drops of weak (2%) acetic acid solution, 10% glucose solution. Note the distinction of the tastes. (Small slices of apple, onion, raw potatoes and other food products may be applied to the tongue). Then a person is asked to close his nose and eyes. Do the same procedures and note the change or absence of taste distinction.

Drawing of the protocol:

1. Record the data in the table.

	The eyes are opened, nose is closed	The eyes are opened	The eyes are closed, nose is closed
Acetic acid 2% Sugar An apple Potatoes Bow Onion			

2. To make a conclusion about the importance of the interaction of various analyzers for a full perception of taste irritations.

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Laboratory work No. 2.

The definition of the olfactory threshold in the occurrence of taste sensations

Equipment: onion. The research is conducted on a person.

The content of the work. Firstly, the subject chews a piece of onions with closed nose (holding his nostrils with his fingers), and then after opening them compares sensations.

Drawing of the protocol. 1. Describe the results of the study. 2. Conclude by indicating why the feeling of taste is partly lost during the runny nose.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. The lower channel of the cochlea is filled by

- A) perilymph
- B) endolymph
- C) saline solution
- D) lymph
- E) intracellular fluid

2. The receptors of the auditory analyzer are

- A) hair cells
- B) rods, cones
- C) maculae, cristae
- D) Pacinian corpuscles
- E) Ruffini corpuscle; Krause's end bulbs

3. The third part of the auditory analyzer is in the

- A) temporal cortical area
- B) parietal cortical area
- C) occipital cortex
- D) frontal cortex
- E) thalamus

4. The first neuron of the auditory analyzer is located in the

- A) spiral ganglia
- B) spinal ganglia
- C) Scarpy ganglion
- D) stellate ganglion
- E) midbrain tectum

5. The third part of the vestibular analyzer is located in the

- A) postcentral gyrus of the cortex
- B) precentral gyrus of the cortex
- C) frontal lobe of the cortex
- D) vestibular nuclei

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- E) thalamus
6. The first neuron of the vestibular analyzer is located in the
- A) vestibular ganglion
B) spinal ganglion
C) spiral ganglion
D) stellate ganglion
E) midbrain tectum
7. The receptor part of any analyzer characterizes by
- A) specificity, high sensitivity, adaptation
B) low sensitivity, refractoriness, functional mobility
C) refractoriness, accommodation, specificity
D) lability, chronaxy, low sensitivity
E) specificity, adaptation, high threshold of excitability
8. The device for determining the hearing acuity is called
- A) audiometer
B) diploscope
C) perimeter of Forster
D) Weber compass
E) olfactometer
9. The specificity of receptors is understood as the ability to respond to ... irritants.
- A) adequate threshold force
B) strong inadequate
C) weak inadequate
D) adequate subthreshold force
E) any
10. The phenomenon of "motion sickness" (seasickness) is associated with the excitation of the analyzer receptors.
- A) vestibular
B) visual
C) auditory
D) olfactory
E) locomotor
11. Corti's organ is located in the cochlea on the membrane.
- A) the basilar
B) the vestibular
C) the tectorial
D) membranous
E) drum
12. After physical work, taste sensations
- A) decrease

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B) perverted

C) increase

D) do not change

E) disappear

13. In the process of adaptation, the electrical activity of the receptor

A) decreases

B) does not change

B) increases

D) disappears

E) action potentials happen

14. Receptors, which give a sense of "sour", are located on the

A) lateral surfaces of the tongue

B) the tip of the tongue

C) the root of the tongue

D) body language

E) buccal surface of mouth

15. A person loses the ability to feel sweet, sour, salt after damage of the nerves.

A) tongue

B) vagus

C) trigeminal

D) facial

E) abducense

Theme No. 5: Physiology of the Heart. Research methods for the studying the cardiac activity.

2. Learning goals: to study physiologic characteristics and features of the cardiac muscles, phase structure of the cardiac cycle, to be familiar with the different means of the cardiac activity regulation.

3. Learning objectives: to master the research methods of cardiac activity (ECG and FCG), to record and explain the arising of the main ECG waves.

4. Questions relating to the theme:

1. Physiological properties and features of the cardiac muscle;

2. Cardiomyocytes, their structure;

3. Phase structure of the cardiac cycle;

4. Regulation of cardiac activity;

5. Nervous regulation of the cardiac activity;

6. The effects of the sympathetic nervous system on cardiac activity;

7. The effects of the parasympathetic nervous system on the cardiac activity;

8. Intracardial mechanisms of regulation;

9. Humoral regulation of the cardiac activity;

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10. Innervation of the heart.

5. Methods of teaching and learning - work with electronic tutorials, models and control schemes and with equipment.

Laboratory work No. 1.

Electrocardiography

Electrocardiography – is a method of the heart examination based on the recording and analyzing the total electrical potential that occurs during the excitation of the various parts of the heart and potentials which spread by surface of the body.

Electrocardiogram – is curve reflecting the excitation process in the heart. ECG includes waves PQRS. P wave reflects the period of atrium excitation (depolarization). Segment P-Q represent the period of time that impulse takes to pass through atrioventricular node. The complex QRS reflects the excitation in the ventricles. Q wave corresponds to depolarization in papillary muscles. R wave reflects spread of excitation in the ventricular basis. S wave corresponds to full coverage of the ventricles by excitation. T wave and segment ST reflect metabolic processes in the cardiac muscle.

According to ECG data, it is possible to evaluate the heart rhythm and diagnose cardiac disorders, to reveal various types of myocardium damage (including the conductive system), to control the action of cardiotropic drugs.

How to record ECG for standard leads

1. Set a tested person lying on his / her back in a couch.
2. Instruct the tested person to breath calmly.
3. Apply special gel on those areas of skin where electrodes are going to be fixed. In the absence of the gel, wipe these skin areas with a swab soaked by isotonic sodium chloride solution (0.9%). Gel or isotonic solution is used for increasing conductivity of the potentials between the skin and electrodes.
4. Apply four electrodes to the lower thirds of the limbs in the area of their internal surfaces (black electrode – to the right leg, red electrode – to the right arm, yellow electrode – to the left arm, green electrode – to the left leg).
Put off electrodes in opposite direction (beginning from left leg, ending by right leg).
5. ECG recording is conducted by switching on the electrodes by the following order:
I standard lead – left arm and right arm;
II standard lead – left leg and right arm;
III standard lead –left arm and left leg.
Put off electrodes in opposite direction (beginning from left leg, ending by right

leg).

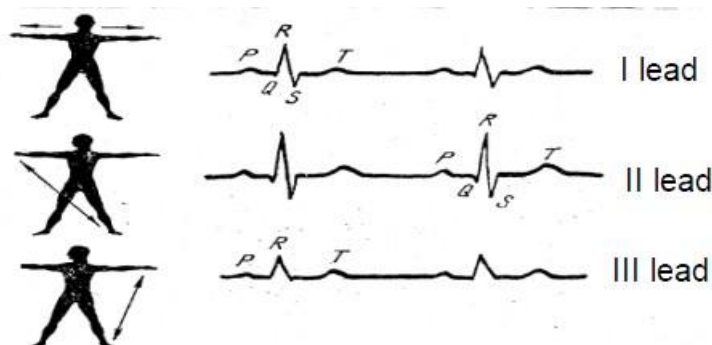
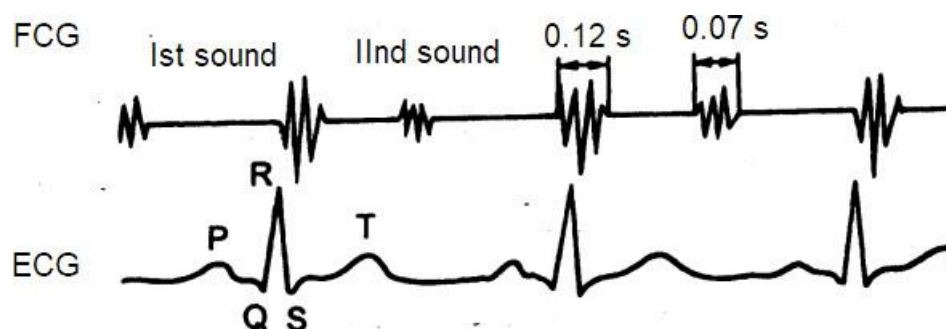


Figure. Standard ECG leads

Laboratory work No. 2

Phonocardiography

The activity of the heart is accompanied by sound phenomena, which are called the heart tones. Phonocardiography allows exploring the sounds of the heart. The interval from the beginning of the ventricular complex of the ECG to the beginning of the first sound (in the norm it is 0.06 s) is of great importance, therefore in the clinical study the phonocardiogram (FCG) is usually recorded simultaneously with the ECG.



I (systolic) sound occurs at the beginning of the systole of the ventricles and is caused by the atrioventricular valves closed;

II (diastolic) sound occurs at the beginning of the diastole of the ventricles and is caused by the semilunar valves closed;

III tone (sound of filling, protodiastolic sound) occurs at the beginning of the diastole due to vibration of the ventricular walls during the phase of their rapid filling;

IV (atrial sound) is due to contraction of the atrium myocardium during their systole.

An important diagnostic value is the study of the sound phenomena of cardiac activity for evaluation of the functional state of the cardiovascular system.

6. **Bibliography:** see appendix No. 1.

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7. Assessment procedures

Tests

1. Duration of the cardiac cycle with a heart rate of 75 per 1 min is ...

- A) 0.8 s
- B) 0.4 s
- C) 0.6 s
- D) 1.0 s
- E) 1.1 s

2. The cardiac muscle is characterized by ... contractions.

- A) singular
- B) tonic
- C) tetanic
- D) plastic
- E) phasic

3. Inotropic effects on the heart is a change of the ...

- A) strength of the cardiac contraction
- B) heart rate
- C) excitability of the heart
- D) conductivity of the heart
- E) contractility of the heart

4. An electrocardiogram characterizes the ...

- A) excitability and conductivity
- B) closing of the valves
- C) contractility and conductivity
- D) contractility and tone
- E) tone and heart beat

5. The P wave on the ECG corresponds to the...

- A) excitation of both atriums
- B) the termination of the excitation process in the ventricles
- C) the initial part of the excitation of the ventricles
- D) excitation of the left atrium
- E) transition of the excitation from the atria to the ventricles

6. Heart activity is reduced by ...

- A) K⁺ ions
- B) Ca²⁺ ions
- C) epinephrine, norepinephrine
- D) thyroxine, triiodothyronine
- E) glucocorticoids

7. Closing of the atrioventricular valves creates ...

- A) 1 sound

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- B) 2 sound
- C) 3 sound
- D) 4 sound
- E) 1 and 2 sounds
- 8. The cardiac muscle functions according to the law of ...
 - A) all or nothing
 - B) the force
 - C) isolated conducting
 - D) accommodation
 - E) convergence
- 9. A phonocardiogram characterizes the ...
 - A) sound phenomena arising during the activity of the heart
 - B) displacement of the gravity center in the chest
 - C) Electrical phenomena
 - D) mechanical phenomena
 - E) the size of the heart with the introduction of contrast medium
- 10. Diastole of the heart ventricles consists of the periods of ...
 - A) relaxation and filling
 - B) tension and eruption
 - C) tension and relaxation
 - D) filling and eruption
 - E) filling and tension

1. Theme No. 6: Basic laws of hemodynamics

2. Learning goals: to study the notions of hemodynamics, parameters of hemodynamics.

3. Learning objectives: to master the methods of carrying out the stress testing (exercise ECG testing) and testing without stress, to be able to characterize their parameters.

4. Questions relating to the theme:

- 1. The basic laws of the hemodynamics;
- 2. Blood flow in the arteries;
- 3. Blood flow in the veins;
- 4. Blood flow in the microvasculature;
- 5. Time of blood circulation;
- 6. Nervous regulation of the blood flow;
- 7. Humoral regulation of the blood flow;
- 8. The role of the arterioles in the blood flow;
- 9. Local mechanisms of the blood flow regulation;
- 10. Regulation of the blood flow volume.

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5. Methods of teaching and learning – mastering the clinic and physiologic methods.

Laboratory work No. 1.

Testing without stress (load).

The first 15 minutes person is in a horizontal position (lying on his back) with a raised head. Record the ECG at rest state and determine heart rate and blood pressure during 5-6 minutes at intervals of 1-2 minutes. Several times with the same intervals, measure blood pressure and heart rate. After this, offer the subject to quickly stand up without delay (orthostatic test); legs must be spread on the width of shoulders 10-20 minutes. Immediately after raising up, measure blood pressure and heart rate and record the ECG. Further, measure blood pressure and heart rate at 1, 2, 3, 5, 10 minutes until their parameters get initial state; record the follow-up ECG at the 10th and 15th minutes.

Stress (load) testing (exercise ECG testing)

Repeat the study from the very beginning, but immediately after standing up offer subject to do 20 sit-ups for 30 to 40 seconds. Immediately after the load, and then after 3, 6, 10, and 15 minutes register again the ECG, blood pressure and heart rate in the standing position. In the course of work, ask the subject about the presence of subjective complaints.

Assessment of testing results

The normal reaction to an orthostatic test is moderate sympathicotonic type: standing up is accompanied by a brief rise in systolic pressure by 5-10 mm Hg, although a decrease in the same limits is also possible. The diastolic pressure rises an average of 10 mm Hg, the heart rate increases by 17-20% of the initial. After returning to the horizontal position after 1-3 minutes, the hemodynamic parameters are restored.

In addition, it is possible one of four pathological types of response (Wayne AM, 1991) in the form of more pronounced changes in blood pressure and heart rate: sometimes the increase of heart rate reaches 50% of the initial. In addition, a longer period is required to restore the initial heart rate and blood pressure.

Hypersympathicotonic, or excessive vegetative supplying of the heart: an increase of the systolic and diastolic BP by more than 20 mm Hg, increasing of the heart rate is more than 30 beats per minute; the face of the subject immediately gets red color after raising up; a person feels a sensation of a rush in the head, a darkening in the eyes.

Hyperdiastolic: Diastolic BP increases by more than 5 mm Hg, but systolic BP decreases by an even larger amount. In this case, the pulse BP decreases. The heart rate rises sharply.

Hypodiastolic or asympathicotonic: Systolic and diastolic BP do not change or decrease, the heart rate remains the same or slightly increases. In the case of a sharp drop of systolic BP, fainting is possible.

Sympathoastenic immediately after standing up, normal or hypersympathicotonic reaction is observed, which at 3 - 6 minutes is replaced by a pronounced decrease of systolic BP; heart rate increases to 100%, dizziness is possible.

Drawing of the protocol. 1. The data on the functional evaluation of tolerability of the orthostatic test without stress and with the stress should be presented in the table.

Indicators of ECG, heartrate, and BP	In the lying position (background)	Immediately after the standing up without stress (load)	In the standing position after physical exercise, minutes					
			1-st	2-nd	3-rd	6-th	10-th	15-th
R – R Q – T QRS S – T P T Systolic BP Diastolic BP Pulse BP Heart rate								

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. Movement of the blood in the vascular system is provided with

A) the energy of ventricles contraction, the pressure gradient between the proximal and distal parts of the vascular system

B) the difference in blood pressure between the atria and ventricles

C) arterio-venous difference in carbon dioxide partial pressure

D) vascular resistance, energy of cardiac contraction

E) arterio-venous difference in oxygen partial pressure

2. Capillary blood flow is characterized by such indicators as blood pressure and velocity. Indicate the value of the former and the latter:

A) 20-15 mm Hg; 0.3-0.5 mm / s.

B) 130-120 mm Hg; 0.5-1 m / s.

C) 100-8 mm Hg; 0.2-0.2 m / s.

D) 80-60 mm Hg; 0.15-0.2 m / s.

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E) 40-30 mm Hg; 10-15 cm / s.

3. Narrowing of the vessels is caused by irritation of the following nerve fibers:

- A) sympathetic and adrenergic
- B) sympathetic and cholinergic
- C) parasympathetic and cholinergic
- D) parasympathetic and serotonergic
- E) somatic and cholinergic

4. The main function of capillaries in the body is ...

- A) exchange
- B) capacitive
- C) shunting
- D) conductive
- E) depositing

5. The greatest amount of blood is used with:

- A) kidney, heart, liver, brain
- B) skin, spleen, abdominal organs, skeletal muscles
- C) kidneys, skeletal muscles, brain
- D) heart, liver, abdominal organs, lungs
- E) the lungs, the brain, the skin, the smooth muscles

6. The lowest linear velocity of the blood flow is observed in

- A) capillaries
- B) venules
- C) aorta
- D) veins
- E) arteries

7. High blood pressure is present in the capillaries of

- A) the kidney
- B) the brain
- C) the lungs
- D) the liver
- E) the skin

8. Dilation of the blood vessels and the following decrease in the blood pressure occurs when

- A) the tone of the sympathetic nervous system decreases
- B) vasomotor center tone increases
- C) the tone of the sympathetic nervous system increases
- D) the tone of the respiratory center increases
- E) the tone of the somatic nervous system increases

9. The main resistance to the blood flow is created with

- A) arterioles

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B) arteries

C) veins

D) capillaries

E) venules

10. During the diastole of the heart ventricles, the blood flow through the vessels is provided by

A) elastic tension of the arteries

B) valvular heart apparatus

C) work of the heart

D) blood viscosity

E) negative pressure in the pleural cavity

11. The blood depots (organs where the blood is stored) are

A) spleen, liver, lungs, subcutaneous veins

B) liver, kidneys, muscles, capillaries

C) lungs, muscles, arterioles, sinuses

D) kidneys, veins, liver, pancreas

E) spleen, kidney, liver, hollow veins

12. Continuous blood flow throughout the vascular system is provided by... .

A) the pressure difference between the aorta and the hollow veins

B) the difference in blood pressure between arterioles and venules

C) negative pressure in the pleural cavity

D) sucking capacity of the chest

E) contraction of the skeletal muscles

13. The velocity of the pulse wave propagation depends on

A) age and elasticity of blood vessels

B) linear velocity of blood flow and the blood viscosity

C) the volumetric rate of the blood flow and blood temperature

D) vascular resistance and minute cardiac output

E) frequency of contractions and striking volume of the blood

1. Theme No. 7: Physiology of the hematopoietic organs

2. Learning goals: to study functions of the organs of hematopoiesis

3. Learning objectives: to master the basic clinical and hematological methods of investigating hematopoietic organs.

4. Questions relating to the theme:

1. The role of the red bone marrow in the process of hematopoiesis;

2. The role of the spleen in the process of hematopoiesis;

3. The role of the liver in the process of hematopoiesis;

4. The role of the lymph nodes in the process of hematopoiesis;

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5. The role of the thymus in the process of hematopoiesis;
6. Factors stimulating erythropoiesis;
7. Factors stimulating leukopoiesis;
8. Factors stimulating thrombocytopoiesis.

Laboratory work No. 1.

White blood cell count.

Leukocytes, the white blood cells, play an important role in protecting the body from microbes, viruses, from pathogenic protozoa, any foreign substances, i.e. they provide immunity. In adults, the blood contains 4,000-9,000 per one μL ($4-9 \cdot 10^9 / \text{L}$) of white blood cells.

Leukocytes are divided into 2 groups – granulocytes (grained) and agranulocytes (non-grained). The group of granulocytes includes neutrophils, eosinophils, basophils, and agranulocytes are lymphocytes and monocytes.

The percentage ratio of each leukocyte type is called the white blood cell count (leukoformula), or leukogram.

Normal white blood cell count

Basophils	Eosinophils	Neutrophils				Lymphocytes	Monocytes	Total number of leukocytes per L
		Myelocyte	metamyelocyte	Band	segmented			$4-9 \cdot 10^9$
0 – 1%	1 – 5%	0%	0-1%	1 – 5%	45 – 70%	20- 40%	2 – 10%	

In healthy people, the white blood cell count is quite constant and its changes indicate various diseases, which helps physicians to make an accurate diagnosis.

Laboratory work No. 2.

Work with schemes on hematopoiesis.

7. Assessment procedures

Tests

1. In normal state, the hematocrit is equal to ... of the blood cells.
 - A) 45%
 - B) 25%
 - C) 30%
 - D) 55%
 - E) 65%.
2. Normal value of ESR in women ... mm / hour
 - A) 2-15
 - B) 20-25
 - C) 25-30
 - D) 30-40

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- E) 60-80
3. Human blood contains hemoglobin at the level of...
- A) 125-160 g / l
 B) 50-80 g / l
 C) 85-115 g / l
 D) 170-200 g / l
 E) 220-260 g /
4. The viscosity of the blood depends on the amount in it
- A) the blood cells and proteins
 B) glucose and HB
 C) oxyhemoglobin and sodium salts
 D) leukocytes and proteins
 E) platelets and calcium salts
5. Platelets
- A) release serotonin and other substances promoting the formation of thromboplastin
 B) have group specificity, secrete antibodies, transfer O₂
 C) secrete serotonin, participate in allergic reactions, transfer water
 D) promote the formation of thromboplastin, are antagonists of mast cells
 E) secrete serotonin, heparin, prevent blood clotting
6. The blood plasma contains of proteins at the concentration of.....g / l.
- A) 65-85
 B) 5-25
 C) 25-50
 D) 150-200
 E) 250-300
7. Hemoglobin in the body
- A) participates in the transport of carbon dioxide, oxygen, maintains pH +
 B) provides oxygen transport, participates in blood clotting
 C) maintains pH, transports nitrogen, oxygen
 D) participates in clotting, immune reactions, maintains pH
 E) provides immunity, creates an oncotic pressure, transports carbohydrates
8. For erythropoiesis, it is necessary
- A) vitamin B₁₂, iron, folic acid
 B) vitamins D and B₆, acetic acid
 C) gastric intrinsic factor, vitamin E, zinc
 D) biotin, vitamin B₃, manganese
 E) retinol, fluorine, vitamin B₆
9. The normal amount of thrombocytes is ...
- A) 200-400 x 10⁹ / L

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- B) $6-8 \times 10^9 / L$
C) $150-180 \times 10^9 / L$
D) $4-4.5 \times 10^9 / L$
E) $420-480 \times 10^9 / L$
10. A patient possesses O blood group, if agglutination...
A) is absent in all sera
B) happens in sera of O, A, and B groups
C) happens in sera of Band AB groups
D) happens in sera of O and A groups
E) happens in sera of O and B groups
11. The function of leukocytes is
A) participation in the reactions of phagocytosis, immunity, and allergy
B) keeping osmotic pressure, participation in blood clotting, transport of gases
C) regulation of pH, transport, phagocytosis, immunity, allergy
D) participation in the reactions of ESR, maintenance of oncotic pressure, salt transport
E) respiratory function, keeping the viscosity, amino acid transport
12. Oncotic blood pressure is determined by
A) plasma proteins
B) proteins and salts of plasma
C) proteins and salts of blood cells
D) plasma salts
E) salts and blood cells
13. The blood contains leukocytes at the level of...
A) $4-8 \times 10^9 / L$
B) $0-1 \times 10^9 / L$
C) $1-2 \times 10^9 / L$
D) $3-5 \times 10^9 / L$
E) $9-12 \times 10^9 / L$
14. The normal value of ESR in men is equal tomm / hour.
A) 1-10
B) 30-40
C) 20-30
D) 10-20
E) 0.1-0.9
15. The last phase of blood clotting includes
A) retraction, fibrinolysis
B) thrombin formation, fibrinolysis
C) retraction, formation of vitamin B
D) fibrinolysis, the formation of prothrombin

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E) thrombus formation, retraction

16. Functions of eosinophils include

- A) antiparasitic, neutralization of histamine, phagocytosis, bactericidal activity
- B) antiparasitic, bactericidal activity, exocytosis
- C) neutralization of histamine, bactericidal activity, endocytosis
- D) phagocytosis, bactericidal activity, neutralization of acetylcholine
- E) bactericidal activity, neutralization of adrenaline, antiparasitic

17. Functions of neutrophils

- A) phagocytosis, bactericidal activity, promote tissue regeneration
- B) phagocytosis, antiparasitic, promote tissue regeneration
- C) bactericidal activity, phagocytosis, antiparasitic
- D) promote tissue regeneration, antiparasitic
- E) bactericidal activity, neutralization of histamine

18. Osmotic resistance of the red blood cells is a resistance to action of ...

- A) hypotonic NaCl solution
- B) hypertonic NaCl solution
- C) isotonic NaCl solution
- D) hypotonic glucose solution
- E) isotonic solution of KCl

19. The color index of the blood characterizes

- A) degree of saturation of erythrocytes with hemoglobin
- B) degree of saturation of erythrocytes with iron
- C) hemoglobin content of blood
- D) the ratio between the number of erythrocytes and leukocytes
- E) the ratio between the plasma and the blood cells

20. In the II phase of coagulation hemostasis is formed.

- A) thrombin
- B) prothrombin
- C) tissue prothrombinase
- D) blood prothrombinase
- E) antithrombin

21. The soluble fibrinogen is converted into insoluble fibrin under the action of

- A) thrombin and XIII factor
- B) thromboplastin and V factor
- C) prothrombin and VI factor
- D) fibrinolysin and XI factor
- E) fibrinase and IX factor

22. The number of red blood cells in men is greater than that of women, since ...

- A) erythropoiesis is stimulated by male sex hormones
- B) erythropoiesis is stimulated by physical work

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- C) more muscle mass
- D) more erythropoietins are formed
- E) There is no monthly loss of red blood cells, as in women

23. The function of basophils is

- A) production of histamine and heparin
- B) maintaining a constant blood pH
- C) production of interferon, lysozyme
- D) transport of antibodies
- E) activation of the complement system

24. The gastric intrinsic factor required for absorption of the external factor (cyanocobalamin – Vit B12) is formed in ...

- A) the stomach
- B) kidney
- C) the liver
- D) the spleen
- E) the intestines

1. Theme No. 8: Special physiology of the endocrine glands.

2. Learning goals: to study the structural and functional organization of the particular glands of the endocrine system.

3. Learning objectives: to study the structural and functional organization of the hypothalamic-pituitary-adrenal system, epiphysis, thyroid, thymus, parathyroid and sexual glands by color photographs, models, and schemes.

4. Questions relating to the theme:

1. The pituitary gland. The anterior, middle, and posterior parts.
2. The epiphysis.
3. The thyroid gland.
4. The parathyroid glands.
5. The thymus.
6. The pancreas.
7. Hypothalamic-pituitary-adrenal system.
8. The testes.
9. The ovaries.

5. Methods of teaching and learning – work with color photographs, models, schemes and control questions, work in small groups

Laboratory work No. 1.

The effect of adrenaline on frog pigment cells

Adrenaline is the hormone of the adrenal medulla that causes a number of physiological reactions.

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Equipment: adrenaline solution 1: 1000, syringe with needle; work is conducted on two frogs.

The content of the work. In the experiment, two frogs are used. Inject into the lymphatic sac or subcutaneously on the dorsal surface into the area of the urostyle 0.5 ml of the adrenaline solution to one of the frogs. Both studied and intact frog to be put in a glassy bank and watch the color of the skin for 15-20 minutes. Note, after what time the skin of a frog, which has received adrenaline, will lighten up (under the influence of adrenaline, the melanophores of the skin are contracted and pull in their processes).

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. Find polypeptide hormones:

- A) glucagon
- B) insulin
- C) thyroxine
- D) parathormone

2. Find steroid hormones:

- A) estrogens
- B) progesterone
- C) hydrocortisone
- D) catecholamine

3. Tyrosine derivatives are:

- A) catecholamines
- B) thyroxine
- C) triiodothyronine
- D) insulin

4. Blood sugar level is regulated with the hormones of the

- A) pancreas
- B) adrenal gland cortex
- C) adrenal gland medulla
- D) parathyroid glands

5. The adrenal gland medulla secretes:

- A) oxytocin and vasopressin
- B) insulin and glucagon
- C) epinephrine and nor-epinephrine
- D) ACTH, TSH, GH

6. The adrenal gland cortex secretes:

- A) oxytocin and vasopressin
- B) insulin and glucagon

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C) mineralocorticoids and glucocorticoids

D) ACTH, TSH, GH

7. The anterior part of pituitary gland secretes:

A) oxytocin and vasopressin

B) insulin and glucagon

C) epinephrine and nor-epinephrine

D) ACTH, TSH, GH

8. The posterior part of the pituitary gland secretes:

A) oxytocin and vasopressin

B) insulin and glucagon

C) epinephrine and nor-epinephrine

D) ACTH, TSH, GH

9. The thyroid gland produces the following hormones:

A) releasing and inhibitory hormones

B) thyroxine, triiodothyronine and thyrocalcitonin

C) testosterone and progesterone

D) parathormone and calcitonin

10. Parathyroid glands produce the following hormones:

A) releasing and inhibitory hormones

B) thyroxine, triiodothyronine and thyrocalcitonin

C) testosterone and progesterone

D) parathormone and calcitonin

11. The thymus produces the following hormone:

A) thymosin

B) thyroxine

C) testosterone

D) parathormone

12. The epiphysis produces the following hormone:

A) thymosin

B) thyroxine

C) melatonin

D) parathormone

13. The hypothalamus produces the following hormones:

A) releasing and inhibitory hormones (libirines and statins)

B) thyroxine, triiodothyronine and thyrocalcitonin

C) testosterone and progesterone

D) parathormone and calcitonin

14. The hormone of the parathyroid glands is

A) parathyroid hormone (parathormone)

B) thyrocalcitonin

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- C) insulin
 - D) glucagon
 - E) aldosterone
15. The secretion of parathyroid hormone is caused by ... in the blood.
- A) increased level of calcium
 - B) lowered level of calcium
 - C) increased level of amino acids
 - D) lowered level of amino acids
 - E) increased level of phosphorus
16. The removal of the adrenal cortex lead to death occurs because of
- A) violations of water-salt metabolism
 - B) violations of protein metabolism
 - C) violations of fat metabolism
 - D) violations of carbohydrate metabolism
 - E) violations of vitamin metabolism
17. The growth hormone of the pituitary gland stimulates the synthesis of
- A) protein
 - B) hormones
 - C) carbohydrates
 - D) fats
 - E) vitamins
18. Secretion of the pituitary tropins are stimulated with the
- A) releasing hormones (liberins)
 - B) thyroid hormones
 - C) catecholamines
 - D) inhibitory hormones (statins)
 - E) glucocorticoids
19. Hormonal activity of the hypothalamus is regulated by
- A) feedback
 - B) direct way
 - C) humoral way
 - D) nervous way
 - E) the local link
20. Thyroid hormones are
- A) thyroxine, triiodothyronine, thyrocalcitonin
 - B) adrenaline, thyroxine, choline
 - C) secretin, cholecystrokinin, villicin
 - D) triiodothyronine, thyroxine, secretin
 - E) thyroxine, villikin, epinephrine
21. During an increase of the secretion of the antidiuretic hormone

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- A) reabsorption of water increases, urination decreases
- B) reabsorption of water decreases, urination increases
- C) reabsorption of water does not change, urination increases
- D) reabsorption of water decreases, urination does not change
- E) reabsorption of water increases, urination does not change

1. Theme No. 9: Digestion in the oral cavity and the stomach

2. Learning goals: to study the functions of the digestive system, the basic principles and mechanisms of digestion regulation, the compound and properties of saliva and gastric juice, and the role of various digestion types in hydrolysis and absorption of nutrients.

3. Learning objectives: to study the features of physical and chemical food processing of in the oral cavity and the stomach, to investigate the enzymatic properties of gastric juice, to determine the importance of reception in the oral cavity.

4. Questions relating to the theme:

1. Divisions of the digestive system;
2. Functions of the digestive tract.
3. The notion of digestion.
4. Types of digestion.
5. Classification of the salivary glands.
6. The compound and function of saliva.
7. Regulation of salivation.
8. Features of the pharynx and esophagus functioning.
9. Morphofunctional features of the pyloric and cardiac part of the stomach.
10. The glands of the stomach. Compound and properties of gastric juice.
11. Regulation of the secretion and releasing of gastric juice.
12. Regulation of absorption in the stomach.

5. Methods of teaching and learning – mastering the clinic and physiologic methods.

Laboratory work No. 1.

Research of digestive properties of gastric juice

Equipment: natural gastric juice, fibrin or frog muscle (preferably boiled), 0.5% solution of hydrochloric acid, 0.5% sodium bicarbonate solution, water bath or thermostat, alcohol lamp, holder with test tubes, tweezers, glass (стеклограф), litmus paper.

Work content: Number 4 test tubes. Fill the tubes No. 1, 2, 3 with 2 ml of gastric juice, tube No. 4 – with 2 ml of a 0.5% solution of hydrochloric acid. The content of test tube N. 2 boil on the alcohol lamp; add a solution of sodium bicarbonate to tube No. 3 until a slightly alkaline reaction (up to litmus paper gets bluish color).

Put the same amount of fibrin (0.1-0.3 g) in all test tubes and place them in a water bath or in a thermostat at temperature of 38 ° C. After 30 minutes, the tubes are extracted and determined how the contents have changed. Record the results of the experiment in the table. Fill the table below with results of the experiment.

Effect on fibrin	Time in thermostate, min	Experiment results			
		1	2	3	4
Gastric juice	30				
Boiled gastric juice	30				
Gastric juice + sodium bicarbonate	30				
0.5% solution of hydrochloric acid	30				

Laboratory work No. 2.

Compound of gastric juice (pH 0.8 – 1.5)

(by A. Ugolev)

Organic substances	Nonorganic substances
Proteases: pepsin, pepsin B, gastricsin gelatinase, rennin	Na ⁺ . K ⁺ . CA ²⁺
Lipase, mucin, gastric intrinsic factor	Cl ⁻ . HCO ₃ ⁻ . HPO ₄ ²⁻

Acidity of gastric juice and gastric content

Quality of gastric juice	Acidity, titration (Units)		
	Total HCl	Free HCl	Bound HCl
Pure gastric juice	125 – 165	110 – 136	-
Gastric content after the trial breakfast	40 – 60	20 – 40	10 – 20

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Drawing of the protocols. To draw a conclusion, in which the role of enzymes and hydrochloric acid of gastric juice in protein digestion is analyzed.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. Secretion of the salivary glands with irritation of parasympathetic nerves...

- A) increases
- B) decreases
- C) does not change
- D) changes by two phases
- E) decreases, then increases

2. causes the most prolonged secretion of gastric juice.

- A) Bread
- B) Meat
- C) Milk
- D) Oil
- E) Fruit juice

3. The.... salivary glands secrete predominantly serous secretion.

- A) parotid
- B) submandibular
- C) sublingual
- D) small internal
- E) large external

4. In humans, pure saliva can be obtained by

- A) using the Lashley-Krasnogorsky capsule
- B) by the method of electrogastrography
- C) Abel's method of vivid diffusion
- D) angiostomy by London
- E) X-ray

5. Gastric juice secretion is intensified by....

- A) enterogastrin
- B) gastrone
- C) secretin
- D) willikinin
- E) enterogastrone

6. An enzyme.... does not participate in the protein breakdown.

- A) amylase
- B) pepsin
- B) trypsin
- D) chymotrypsin

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- E) gastricsin
7. Chewing movements are recorded by the ... method.
- A) mastatiography
 - B) balloonographic
 - C) electromyography
 - D) electrogastrography
8. Salivary glands secrete the following enzymes
- A) amylase, maltase
 - B) maltase, enterokinase
 - C) amylase, lipase
 - D) maltase, lipase
 - E) trypsin, maltase
9. Correct sequence of phases of gastric secretion
- A) complex reflex, gastric, intestinal
 - B) gastric, reflex, intestinal
 - C) gastric, intestinal, reflex
 - D) intestinal, cerebral, gastric
 - E) complex reflex, intestinal, gastric
10. Secretion of the salivary glands with irritation of the glossopharyngeal nerve
- A) increases
 - B) decreases
 - C) does not change
 - D) changes in two phases
 - E) changes by phases
11. Injection into the blood of causes a decrease in the secretion of saliva.
- A) adrenaline
 - B) pilocarpine
 - C) acetylcholine
 - D) histamine
 - E) enterogastrin
12. The salivatory center is in
- A) the medulla oblongata
 - B) the middle brain
 - C) the diencephalon
 - D) spinal cord
 - E) the cerebellum
13. In gastric juice of children, there is
- A) lipase
 - B) enterokinase

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- C) amylase
- D) chymotrypsin
- E) trypsin

14. In humans, gastric juice is obtained by the method of

- A) gastric intubation
- B) intestinal intubation
- C) radiography
- D) electrogastrography
- E) Heydengine

1. Theme No. 10: Functions of the small and large intestines. The role of the liver and pancreas during digestion.

2. Learning goals: to study the makeup and properties of bile, pancreatic, intestinal juices and their role in the hydrolysis and absorption of nutrients.

3. Learning objectives: to study the features of physical and chemical processing the food in the small intestine, to investigate the enzymatic properties of pancreatic juice.

4. Questions relating to the theme:

1. Parts of the small intestine.
2. Functions of the small intestine.
3. Digestion in the small intestine.
4. Digestive function of the pancreas.
5. Makeup and properties of pancreatic juice.
6. The role of the liver in the process of digestion.
7. Bile. Makeup, properties, functions.
8. Bile secretion, its regulation.
9. Intestinal secretion.

5. Methods of teaching and learning – mastering of clinical and physiological methods.

Laboratory work No. 1.

Investigation of digestive properties of pancreatic juice

Equipment: natural pancreatic juice, fibrin or frog muscle (preferably boiled), 0.5% solution of hydrochloric acid, 0.5% sodium bicarbonate solution, water bath or thermostat, alcohol lamp, holder with tubes, forceps, litmus paper.

Work content: Numerate 4 test tubes. Pour 2 ml of gastric juice into tubes No. 1, 2, 3, add 0.5% 4-2 ml solution of hydrochloric acid in tube No. 4. Boil the content of the tubes No. 2 on a alcohol lamp, add sodium bicarbonate solution in a tube No. 3 until a slightly alkaline reaction (to bluish staining litmus paper). In each tube put the same amount of fibrin (0.1-0.3 g) and put them in a water bath or in an

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thermostat at 38 °C. After 30 minutes remove tube and determine how the contents changed. Record the results of the experiment in the table below.

Tube No.	Content of tube	Norm of fibrin	Structure of fibrin
No. 1	2 ml of pancreatic juice + fibrin		
No. 2	2 ml of boiled pancreatic juice + fibrin		
No. 3	2 ml of pancreatic juice + NaHCO ₃ + fibrin		
No. 4	2 ml of pancreatic juice + 0.5% solution of HCl + fibrin		

Laboratory work No. 2.

The role of bile in digestion (demonstration)

Equipment: glass funnels with a diameter of 1.5-2 cm, test tubes, liquid vegetable fat, paper filters, bile.

The content of the work. Wet thoroughly the filters inserted in the funnels: one with bile, another with water. Insert funnels into test tubes No. 1 and 2. Add a little oil to the funnels and observe its filtration. Pour 5 ml of bile into tube No. 3. Add liquid fat and 1 ml of water and then shake until emulsion is formed. Record the results of the experiment in the table below.

Effect on fat	Experiment results		
	1	2	3
Bile			
Water			
Bile + water			

Drawing the protocol. To draw a conclusion, in which to analyze the digestive role of bile.

Laboratory work No. 3.

Registration of the frog's large intestine contractions.

Equipment: kymograph, recording lever with a sensor, a holder, a set of dissecting instruments, solutions of adrenaline and acetylcholine (1: 1000), Ringer's solution. The object of the research is a frog.

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Work content: The frog's brain and spinal cord are destroyed; then the frog is fixed on a dissection plate. Open the body cavity and dissect the hindgut from the cloaca to the midgut. On the holder, the clamp fixes the dissection plate. At the site of the transition of the small midgut to the large hindgut, a sensor is placed and the initial contraction of the intestine is recorded (the kymograph drum should be rotated very slowly). Then 1 - 2 drops of acetylcholine solution are applied to the hindgut, which increases the contraction of the intestine. After washing the intestine from acetylcholine with Ringer's solution, adrenaline solution is applied to the intestine with following registration of the intestine contraction.

Results and their performing. Stick the registration results in the notebook.

Analyze the effect of acetylcholine and adrenaline on the contraction of the frog's hindgut and explain the effects.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. The following functions are characteristic for the small intestine

- A) secretory, motor, absorption, and excretory
- B) excretory, regulatory, motor, and endocrine
- C) absorption, secretory, depositing, and motor
- D) thermoregulatory, secretory, absorption, and motor
- E) endocrine, reservoir, motor, and regulatory

2. pH of the pancreatic juice is

- A) 7.8-8.4
- B) 1.5-2.0
- C) 3.5-4.0
- D) 4.5-6.0
- E) 6.5-7.5

3. Pure pancreatic juice can be obtained with help of

- A) applying the fistula to the pancreatic duct
- B) applying the fistula by Tiri-Vella
- C) duodenum fistula
- D) inserting the cannula into duodenum
- E) Lashley-Krasnogorsky capsule

4. The pancreatic juice contains the following enzymes... .

- A) trypsinogen, chymotrypsinogen, amylase, lipase, nuclease
- B) pepsinogen, trypsin, amylase, lipase, enterokinase
- C) imotrypsin, enterokinase, amylase, lipase
- D) trypsinogen, pepsin, enterokinase, lipase
- E) pepsinogen, gastricsin, enterokinase, amylase

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5. If there is no enzyme enterokinase in the intestinal juice, the breakdown of proteins is violated, because
 - A) enterokinase activates trypsinogen
 - B) enterokinase inhibits the release of pancreatic juice
 - C) enterokinase reduces the proteolytic properties of trypsin
 - D) enterokinase reduces the proteolytic properties of lipase
 - E) enterokinase reduces the lipolytic properties of trypsin
6. The internal causes that form the feeling of hunger are
 - A) decrease in the amount of glucose and amino acids in the blood
 - B) increase in body temperature and decrease in the amount of water in a body
 - C) weight loss and decrease in osmotic pressure of blood plasma
 - D) decrease in the amount of glucose and increase in amino acids in the blood
 - E) increase in the amount of glucose and amino acids in the blood
7. Under the influence of the parasympathetic nerves irritation, motility of the gastrointestinal tract
 - A) increases
 - B) decreases
 - C) does not change
 - D) changes by two phases
 - E) changes gradually
8. The rate of the gastric content transfer into the duodenum.....under the influence of its alkalization.
 - A) increases
 - B) decreases
 - C) does not change
 - D) changes by two phases
 - E) changes by phases
9. The motility of the intestinal villi is increased by the hormone
 - A) villikin
 - B) adrenalin
 - C) vaso-intestinal peptide
 - D) enterogastron
 - E) gastrin
10. Under the influence of the sympathetic nerves irritation, motility of the gastrointestinal tract
 - A) decreases
 - B) does not change
 - C) changes by two phases
 - D) increases
 - E) increases, then decreases

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11. Bacterial flora of the large intestine contributes to

- A) breakdown of plant fiber
- B) inhibition of the bowel motility
- C) increase in secretion of gastric juice
- D) absorption
- E) secretion of bile

12. In the digestion process secretin

- A) stimulates the secretion of pancreatic juice
- B) stimulates the secretion of gastric juice
- C) inhibits the secretion of pancreatic juice
- D) stimulates the secretion of intestinal juice
- E) increases gastric motility

13. Cells secreting bile are called

- A) hepatocytes
- B) epithelium of the gallbladder
- C) epithelium of the common bile duct
- D) endothelium of the bile capillaries
- E) villi of the intestine

14. Proteolytic enzymes (proteases) of pancreatic juice degrade

- A) proteins to peptides and amino acids
- B) carbohydrates to oligo-, di-, monosaccharides
- C) fats to glycerol and fatty acids
- D) proteins to albumins and peptones
- E) proteins to monosaccharides

15. Lipolytic enzymes (lipases) of pancreatic juice degrade

- A) fats to glycerol and fatty acids
- B) carbohydrates to monosaccharides
- C) proteins to peptides and amino acids
- D) fats to amino acids
- E) fats to monosaccharides

16. The hormoneinhibits the secretion of pancreatic juice.

- A) glucagon
- B) gastrin
- C) secretin
- D) pancreosimine
- E) nervus vagus

17. All nutrients from the native state to the final products of digestion are degraded by enzymes of the

- A) pancreatic juice
- B) saliva

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C) gastric juice

D) intestinal juice

E) bile

18. If there is no enzyme enterokinase in the intestinal juice, the breakdown of proteins is violated, because

A) enterokinase activates trypsinogen

B) enterokinase inhibits the release of pancreatic juice

C) enterokinase reduces the proteolytic properties of trypsin

D) enterokinase reduces the proteolytic properties of lipase

E) enterokinase reduces the lipolytic properties of trypsin

19. Absorption is caused by

A) capacity of villi to absorb, diffusion, osmosis, filtration

B) capacity of villi to absorb, hunger

C) diffusion, increase in blood pressure

D) osmosis, increase in blood pressure

E) filtration, decrease in blood pressure

20..... increases the motility of the digestive tract.

A) Acetylcholine

B) Gastrogastone

C) Transection of the vagus nerve

D) Irritation of the celiac nerve

E) Somatostatin

21. Types of motor activity of the large intestine are

A) pendulum, peristaltic, antiperistaltic, tonic

B) change in tone, segmentation, peristalsis, motion of villi

C) hungry, rhythmic segmentation, tonic, antiperistaltic

D) propulsive contractions, peristaltic, tetanic, pendulum.

E) tonic, automatic, segmentation

22. The motility of an isolated intestine segment is ... by adrenaline, is ... by acetylcholine.

A) inhibited; increased

B) increased; inhibited

C) not changed; increased

D) inhibited; not changed

E) increased; increased

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

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1. Theme No. 11, 12: Physiology of the respiratory system

2. Learning goals: to study the functional system, which ensures the constancy of the gas compound of the blood; to master the methods of studying the breathing.

4. Questions relating to the theme:

1. The notion of a respiratory system. Its importance for the body. Stages of the breathing (ventilation) process.
2. The notion of external respiration.
3. The importance of the respiratory muscles in the process of ventilation.
4. The mechanism of inspiration and expiration. The role of the respiratory muscles with calm and forced breathing.
5. Pleura, pleural cavity. Pressure in the pleural cavity. Its meaning in the process of breathing. The notion of pneumothorax.
6. Lung volumes and lung capacities, methods for their determination.
7. Pulmonary and alveolar ventilation. Methods for determining the minute volume of respiration (MVR).
8. Residual volume, its meaning.
9. Expiratory and inspiratory reserve volumes. Their calculation.
10. The concept of the structural and functional unit of the lungs.
11. Composition of atmospheric, exhaled, and alveolar air. Determining and comparison.
12. Patterns that ensure the diffusion of gases from one environment to another.
13. Gas exchange in the lungs. The partial pressure of gases in the alveolar air and the pressure of gases in the blood.
14. Transport of oxygen by blood. Oxygen capacity of blood.
15. Transport of carbon dioxide by blood. The value of carbonic anhydrase.
16. Functional system that ensures constant level of gases in the blood.
17. Structure of the respiratory center.

5. Methods of teaching and learning – work with the equipment and discussion the results of the study.

Laboratory work No. 1.

Measurement of a human vital capacity using a spirometer

Equipment: spirometer, nose clip, cotton wool, alcohol for disinfection of the mouthpiece. The research is conducted on a human.

The content of the work. Move the spirometer arrow to the zero position. Wipe the mouthpiece with alcohol. After the maximal inhalation, a tested person must clamp the nostrils and make the maximal exhalation through the mouthpiece into the spirometer. In this case, a person must contract all respiratory muscles including the abdominall muscles. This process must be repeated 3 times. Using the spirometer scale, determine the mean value. Record the result.

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Drawing the protocol. 1. Record the measurement results in the table, calculate the average. 2. Evaluate the results obtained, taking into account the individual characteristics of a studied person.

Laboratory work No. 2.

Influence of physical exercise on human respiration

Equipment: gas meter, breathing valve with mouthpiece, nose clip, three-way valve, connecting tubes, stopwatch, alcohol.

The content of the work. Determine the minute volume of respiration (MVR) in a tested person at rest. A mouthpiece must be wiped with alcohol; tested person must take it in mouth, then put the nose clip on the nose, and breathe through the gas meter for 5 minutes. During the experiment, make protocol which reflects gas meter indicators by the minutes. Record the gas meter indicators at the end of every minute. Then, sum up all the values made by the gas meter and divide the resulting amount by the time (5 minutes) during which the experiment is conducted.

Determine the MVR for the tested person during physical exercises. Without separating the breathing valve from the gas meter, note the gas meter value. Calculate the MVR value at the physical exercise. After squats, the person is asked to sit and continue to breathe through the gas meter until reaching the level of lung ventilation at the rest.

Drawing the protocol. 1. To draw a research protocol. 2. Note the change in the value of the MVR during physical exercise and during the recovery period. 3. Explain the cause of changes in pulmonary ventilation during physical exercises.

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. Pneumography is the method of registration the... .

- A) respiratory movements of the chest
- B) movements of the lungs
- C) respiratory volumes
- D) movements of the diaphragm
- E) contractions of intercostal muscles

2. Eupnea is the breath

- A) at rest
- B) with high rate
- C) with low rate
- D) at physical work
- E) with pauses

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3. The specific factor that triggers the respiratory center is
 - A) carbon dioxide
 - B) oxygen
 - C) adrenaline
 - D) acetylcholine
 - E) nitrogen
4. Peak flow meter is used to determine the
 - A) strength of the respiratory musculature
 - B) respiratory volumes
 - C) amount of gases in the blood
 - D) respiratory movements
 - E) pressure in the pleural cavity
5. The number of respiratory movements at restper a minute.
 - A) 16-20
 - B) 5-10
 - C) 20-25
 - D) 27-35
 - E) 40-50
6. The inspiratory capacity includes
 - A) inspiratory reserve volume and tidal volume
 - B) tidal volume and expiratory reserve volume
 - C) expiratory reserve volume and residual volume
 - D) functional residual capacity and tidal volume
 - E) residual volume and vital capacity of the lungs
7. Passive participation of the lungs in breathing is studied on the model of
 - A) Donders
 - B) Douglas
 - C) Holden
 - D) Barcroft
 - E) Sechenov
8. The breath stops if an intersection is made
 - A) under the medulla oblongata
 - B) along the anterior edge of the pons
 - C) along the lower edge of the pons
 - D) at the level of the lumbar part of the spinal cord
 - E) at the level of the diencephalon
9. The functional unit of the lungs is the
 - A) acinus
 - B) lobe
 - C) alveolus

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- D) segment
E) zone

1. Theme No. 13: Excretory and non-excretory functions of the skin

2. Learning goals: to study excretory and non-excretory functions of the skin.

3. Learning objectives: to study features of the digestive functions of the large intestine.

4. Questions relating to the theme:

1. The excretory function of the skin.
2. Sweat glands and their composition.
3. Sebaceous glands and their role in protecting the skin.
4. The skin's role in the process of thermoregulation.
5. Receptor and protective functions of the skin.
6. Barrier function of the skin.

5. Methods of teaching and learning – work with color photographs, models, schemes, and control questions, work in small groups

Laboratory work No. 1.

Influence of physical and chemical factors on the permeability of the frog skin barrier.

Equipment: 2 holders, 4 glass tubes, ligatures, 4 glasses, saline solution (0.9% NaCl), water, 1% methylene blue solution, 1% histamine solution, water thermometer, glass. The work is carried out on two frogs.

The content of the work. In two frogs, cut the spinal cord and the brain. Remove the skin from the hind legs. Prepare from the skin 4 "sacs". For one of them, leave the skin turned out; in three remaining ones, create a normal position. For all the "sacs", tie glass tubes and fix them in the holder. Fill all tubes with the same amount of 1% methylene blue solution. Mark its level. In two glasses, pour 50 ml of saline; in the third one pour water heated to 50° C; the fourth glass fill with 1% solution of histamine: number the glasses.

"Sac" of the turned out skin and one "sac" with a normal position of the skin is immersed in glasses with a saline solution (0.9% NaCl) of normal temperature. The third "sac" is put in a glass of hot water (50° C), the fourth – in a 1% solution of histamine. Observe for 30-40 minutes. Estimation of permeability is made by rate and intensity of coloring the skin and by coloring the liquid in the glasses. Note the time from the moment of immersing each of the "sacs" into the glass till the start, and then till the most intensive staining of the skin or solution.

Protocol drawing.

1. Note:

- * Which sac did pass the colorant the first?

* Which sac did not pass paint at all?

* Where the skin was painted faster – in a solution of histamine or in saline solution (0.9% NaCl)?

If everything was done correctly you will see:

- * Absence of staining for the sac of turned out skin;
- * Quick and intensive staining of the skin in a glass with hot water;
- * Faster skin staining in the solution of histamine than in saline solution (0.9% NaCl).

2. Note the moment of immersing the "sac", from which the countdown begins, and the time of the beginning of the staining. Obtained results are performed in the form of a table.

Skin "sac"	Skin position	Solution	Time of submersing	Onset of the staining	The most intensive staining
The first	Turned out				
The second	Normal				
The third	Normal				
The fourth	Normal				

2. Draw conclusions from the experience. Note the role of histamine

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. Heat production is increased by the hormone

- A) thyroxine
- B) insulin
- C) glucagon
- D) mineralocorticoid
- E) parathyroid hormone

2. With 1 g of water being evaporated from the skin surface, a body loses of heat.

- A) 0.56 kcal
- B) 56 kcal
- C) 5.6 kcal
- D) 0.056 kcal
- E) 0.68 kcal

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3. With an increase in the temperature of the environment, in homoiothermal animals, the heat production ..., the heat transfer

- A) decreases; increases
- B) increases; decreases
- C) decreases; decreases
- D) increases; increases
- E) increases at a constant level

4. The main centers of thermoregulation are located in the

- A) hypothalamus
- B) thalamus
- C) cerebellum
- D) subcortical ganglia
- E) spinal cord

5. Chemical thermoregulation includes the following processes

- A) changes in the intensity of metabolism
- B) thermal conductivity
- C) heat radiation
- D) convection
- E) evaporation

1. Theme No. 14: Excretory functions of the kidneys. Processes of urine formation.

2. Learning goals: to study the basic processes of urination, the composition of the final urine.

3. Learning objectives: to study the processes of filtration, reabsorption, and secretion by schemes and models

4. Questions relating to the theme:

1. The structural and functional unit of the kidney.
2. The process of glomerular ultrafiltration.
3. Process of tubular reabsorption.
4. Process tubular secretion.
5. The composition of the final urine.
6. Non-excretory functions of the kidneys.

5. Methods of teaching and learning – work with electronic tutorials, models and control schemes.

Laboratory work No. 1.

Analysis of urinalysis

The content of the work. 1. Give a conclusion on each of the urograms: indicate the most obvious differences compared to the norm.

2. Specify which stages of urination are disordered and how exactly.

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3. Try to use "Additional data" to assess the possible causes of urination disorders.

Urinalysis No. 1

Diuresis	800 ml
Density	1,023
Color	Pale yellow
Transparency	Opaque
pH	Slightly alkaline
Protein	1g/L
Glucose	No
Ketone bodies	No
Sediment microscopy: erythrocytes are 40-50 in the field of vision, single hyaline and erythrocyte casts. Additional data: BP – 165/105 mmHg, residual blood nitrogen 50 mg% (32.4 μ mol / L).	

Urinalysis No. 2

Diuresis	2800 ml
Density	1,009
Color	Pale yellow
Transparency	Perfect
pH	Slight acidic
Protein	2 g/L
Glucose	No
Ketone bodies	No
Sediment microscopy: single erythrocytes are in the field of view, hyaline cylindrical renal casts. Additional data: BP – 185/100 mmHg, residual blood nitrogen 80 mg% (47.0 μ mol / L).	

Urinalysis No. 3

Diuresis	420 ml
Density	1,011
Color	Bright yellow
Transparency	Opaque
pH	Acidic
Protein	2 g/L
Glucose	No
Ketone bodies	No
Sediment microscopy: terythrocytes and hyaline casts are sparse in the field of	

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view.

Additional data: BP is 175/100 mmHg, residual blood nitrogen is 190 mg% (130 μmol / L).

Urinalysis No. 4

Diuresis	1000мл
Density	1,037
Color	Bright yellow
Transparency	Not enough
pH	Alkaline
Protein	33 g/L
Glucose	No
Ketone bodies	No
Sediment microscopy: granular and waxy casts in large quantities.	
Additional data: blood pressure – 120/65 mmHg, residual blood nitrogen 35 mg%	

Urinalysis No. 5

Diuresis	1900 ml
Density	1,025
Color	Pale yellow
Transparency	Perfect
pH	Alkaline
Protein	No
Glucose	2.5%
Ketone bodies	No
Additional data: blood glucose is 3.8 mmol / L	

Urinalysis No. 6

Diuresis	5500 ml
Density	1,040
Color	Pale yellow
Transparency	Perfect
pH	neutral
Protein	No
Glucose	4%
Ketone bodies	Positive reaction
Additional data: blood glucose 18 mmol / L. The total body weight is above the norm by 50%	

Laboratory work No. 2.

Study of urination in vivisection experiment

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Equipment: a stimulant, irritating electrodes for the sciatic nerve, a set of surgical instruments, cannulas for the ureters and the femoral vein, syringes for 1, 10, and 20 ml, elastic tubes, silk, cotton wool, napkin, Nembutal, saline solution (0.9% NaCl), 10% NaCl solution, 40% urea solution, 1% methylene blue solution. The object of the study is a dog, a cat or a rabbit.

Course of the work. The dog is injected a solution of Nembutal (50 mg / kg, intraperitoneally); then fix it on the operating table. On the midline of the abdomen, below the navel, the abdominal cavity is opened. Push the bowel away and find the ureter. Two ligatures are placed under the ureter. With the first ligature the ureter is tied and below the binding the ureter cut. Then, an incision is made on the ureter, through which the cannula is inserted and fixed with the second ligature. By the same way another cannula is inserted into the second ureter. On the free ends of the cannulae, rubber or other elastic tubes filled with saline solution (0.9% NaCl) are put on. The ends of the tubes are withdrawn through the incision of the abdominal wall and submerged into a glass. In the femoral vein, a cannula is inserted and irritating electrodes are applied to the sciatic nerve. After this, experiments begin.

As a test animal for the study of urination in a vivsection experiment, a cat or a rabbit can also be used. When using a rabbit, the cannula is inserted not into the ureter, but into the bladder, on which two ligatures are placed closer to the urethra and a cut is made between them.

Task 1. Evaluation of the initial level of diuresis

Half an hour after the end of the preparing for operation, animals are evaluated for the amount of urine released per 3 – 5 minutes. This evaluation is made by counting the drops flowing from the ureters through the cannula and tube. Drops are calculated visually or by means of special automatic counters.

Task 2. Hypertonic NaCl solution influence on a diuresis

10-15 ml of 10% NaCl solution is injected into the femoral vein (via the cannula) and after some time the amount of urine released is determined.

Task 3. Urea influence on diuresis

When diuresis after the experiment (task 2) get the baseline level, 5 ml of a 40% urea solution is injected into the femoral vein. In this case, diuresis is increased again.

Task 4. Isolation of methylene blue by the kidneys

3 ml of 1% methylene blue solution is injected into the femoral vein and after some time (2 – 3 min), excretion of colored urine is observed.

Task 5. Effect of the sciatic nerve irritation on diuresis

Having the change in diuresis under the influence of urea determined, irritate the sciatic nerve. Under the influence of pain stimulation diuresis sharply decreases (reflex oliguria) or stops (reflex anuria).

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6. Bibliography: see appendix

7. Assessment procedures

Questions

1. Which excretory organs do you know?
2. What is the structural and functional unit of the kidneys?
3. How does urination occur? What processes urination consists of?
4. What is primary urine? How many is it formed per day? What is the composition of the primary urine?
5. What is the final urine? How many is it formed per day? What is the composition of the final urine?

Test

1. The value of glomerular filtration is normal in women:
 - A) 135 ml / min
 - B) 80 ml / min
 - C) 50 ml / min
 - D) 110 ml / min
 - E) 150 ml / min
2. Primary urine is formed at ... per day.
 - A) 170-180 L
 - B) 50-60 L
 - C) 70-80 L
 - D) 90-110 L
 - E) 130-160 L
3. Per day the amount of excreted urine is:
 - A) 1000-1500 ml
 - B) 500-750 ml
 - C) 2500-3000 ml
 - D) 4000-5000 ml
 - E) 5500-6000 ml
4. In the loop of Henle, ... are reabsorbed:
 - A) water and sodium
 - B) glucose and sodium
 - C) urea and water
 - D) potassium and sodium
 - E) sodium and vitamins
5. Reabsorption of water is provided by the following hormone:
 - A) antidiuretic hormone

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- B) glucagon
 - C) somatotropin
 - D) parathyroid hormone
 - E) insulin
6. Quantitative methods for the studying kidney function are
- A) determining renal blood flow, secretion, filtration, and reabsorption
 - B) Zimnitsky test, determining filtration, Folgard, electrophysiological method
 - C) determining the filtration, reabsorption, secretion, electrophysiological method
 - D) radioisotope method, Zimnitsky test, electrophysiological method, Folgard
 - E) Folgard, determining the coefficient of purification, secretion, renal plasma flow
7. More acid urine is formed after:
- A) considerable physical activity, meat consumption
 - B) intake of milk and vegetable food, water intake
 - C) intake of vegetarian food, physical activity
 - D) reception of salty foods, fruit juices
 - E) physical load, eating fruit
8. Secondary urine differs from primary one by the fact that:
- A) there is no glucose, urea, and high concentration of sulfates
 - B) there is no glucose, proteins, and high concentration of sulfates
 - C) there is no glucose, creatinine, and low concentration of sulfates
 - D) there is high concentration of salts, low concentration of glucose and sulfates
 - E) there is globulin, penicillin, low concentration of phosphates
9. The non-threshold substances are
- A) creatinine, inulin, sulfates
 - B) creatinine, glucose, inulin
 - C) creatinine, glucose, sulfates
 - D) creatinine, inulin, phosphates
 - E) amino acids, inulin, water
10. ... stimulate the formation of ADH:
- A) Decrease in the blood volume and an increase in its osmotic pressure, increased air temperature
 - B) Increased blood pressure, air temperature and decreased osmotic pressure of the blood
 - C) Increase in volume and osmotic pressure of blood, high environment temperature
 - D) Decrease in blood pressure, air temperature and decrease in osmotic of the blood
 - E) Decrease in the blood temperature and an increase in the blood osmotic pressure
11. On the basis of urine formation, there are three processes

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- A) glomerular filtration, tubular reabsorption and secretion
- B) glomerular reabsorption, tubular filtration and secretion
- C) glomerular secretion, tubular reabsorption and filtration
- D) glomerular secretion and filtration, tubular reabsorption
- E) glomerular reabsorption and secretion, tubular filtration

1. Theme No. 15: Human reproductive functions.

2. Learning goals: to study phases of the menstrual cycle and sexual functions regulation.

3. Learning objectives: to study phases of the menstrual cycle and sexual functions regulation by tutorials, schemes, and models (dummies).

4. Questions relating to the theme:

1. Physiology of the sexual development;
2. Functions of the male genitalia;
3. Functions of the female genitalia;
4. Phases of the menstrual cycle (hypothalamic, hypophyseal, ovarian, and uterus);
5. Pregnancy and mother-fetus relationships;
6. Lactation;
7. Regulation of the sexual functions.

5. Methods of teaching and learning – work with atlases, electronic tutorials, models (dummies), and control schemes.

Laboratory work No. 1.

Phases of female menstrual cycle (hypothalamic, hypophyseal, ovarian, and uterus)

Laboratory work No. 2.

Stages of the sexual development (males and females)

6. Bibliography: see appendix No. 1.

7. Assessment procedures

Tests

1. The testis secretes hormone... .

- A) testosterone
- B) estrogen
- C) progesterone
- D) adrenaline
- E) thyroxin

2. Hormones controlling the menstrual cycle

- A) FSH, estrogens, LH, progesterone
- B) melanotropin, androgens, LH, progesterone

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- C) GH, FSH, progesterone, estrogens
- D) FSH, glucagon, STH, parathyroid hormone
- E) FSH, insulin, progesterone
- 3. Female sex hormones are... .
- A) estrone, estriol, estradiol
- B) parathyroid hormone, serotonin, calcitonin
- C) serotonin, estriol, bradykinin
- D) thyroxine, estrone, testosterone
- E) testosterone, thyroxine, serotonin
- 4. Steroid hormones are:
- A) estrogen
- B) progesterone
- C) hydrocortisone
- D) catecholamine
- E) serotonin
- 5. Female sexual glands secrete hormones:
- A) estrogens and progesterone
- B) thyroxin, triiodothyronine, thyrocalcitonin
- C) liberins and statins
- D) androsterone and testosterone
- E) serotonin and bradykinin
- 6. Male sexual glands secrete hormones:
- A) androsterone and testosterone
- B) thyroxin, triiodothyronine, thyrocalcitonin
- C) estrogens and progesterone
- D) liberins and statins
- E) parathormone and calcitonin
- 7. Hypothalamus secrete the following releasing-factors:
- A) liberins and statins
- B) thyroxin, triiodothyronine, thyrocalcitonin
- C) testosterone and progesterone
- D) parathormone and calcitonin
- E) estrogens and progesterone

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3	Republican interuniversity electronic library	http://rmebrk.kz/

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4	'Student Advisor' Electronic Library of Medical University	http://www.studmedlib.ru
5	'Paragraph' information system 'Medicine' section	https://online.zakon.kz/Medicine
6	'Legal' electronic source of legal information	https://zan.kz
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8	'BooksMed' Electronic Library	http://www.booksmed.com
9	'Web of science' (Thomson Reuters)	http://apps.webofknowledge.com
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