

O. S. NIKITINA, M. O. WELCOME, V. A. PEREVERZEV

ANATOMY AND PHYSIOLOGY OF HUMAN

Practicum manual for specialty “Pharmacy”

In 2 parts

Part 1

Minsk BSMU 2016

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
КАФЕДРА НОРМАЛЬНОЙ ФИЗИОЛОГИИ

О. С. НИКИТИНА, М. О. ВЭЛКОМ, В. А. ПЕРЕВЕРЗЕВ

АНАТОМИЯ И ФИЗИОЛОГИЯ ЧЕЛОВЕКА ANATOMY AND PHYSIOLOGY OF HUMAN

Практикум для специальности «Фармация»

В 2-х частях

Часть 1



Минск БГМУ 2016

УДК 611+612(811.111)-054.6(076.5) (075.8)

ББК 28.706+28.707.3(81.2 Англ-923)

Н62

Рекомендовано Научно-методическим советом университета в качестве практикума 15.06.2016 г., протокол № 10

Р е ц е н з е н т ы: канд. мед. наук, доц. В. Э. Бутвиловский; д-р мед. наук, проф. А. Д. Таганович

Никитина, О. С.

Н62 Анатомия и физиология человека = Anatomy and physiology of human : практикум для специальности «Фармация» / О. С. Никитина, М. О. Вэлком, В. А. Переверзев. – Минск : БГМУ, 2016. – 132 с.

ISBN 978-985-567-572-4.

Представлены вопросы к практическим занятиям и к итоговым семинарам по всем разделам курса анатомия и физиология человека, описания лабораторных работ и протоколы их выполнения, необходимая дополнительная информация по темам занятий.

Предназначен для студентов 1-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке по программе подготовки «Фармация».

УДК 611+612(811.111)-054.6(076.5) (075.8)

ББК 28.706+28.707.3(81.2 Англ-923)

ISBN 978-985-567-572-4 (Ч. 1)

ISBN 978-985-567-573-1

© Никитина О. С., Вэлком М. О., Переверзев В. А., 2016

© УО «Белорусский государственный медицинский университет», 2016

Учебное издание

Никитина Ольга Сергеевна
Вэлком Менизебе Осайн
Переверзев Владимир Алексеевич

АНАТОМИЯ И ФИЗИОЛОГИЯ ЧЕЛОВЕКА

ANATOMY AND PHYSIOLOGY OF HUMAN

Практикум для специальности «Фармация»

На английском языке

В 2-х частях

Часть 1

Ответственный за выпуск В. А. Переверзев
Переводчики: О. С. Никитина, М. О. Вэлком
Компьютерный набор О. С. Никитиной, М. О. Вэлкома
Компьютерная верстка Н. М. Федорцовой

Подписано в печать 15.06.16. Формат 60×84/8. Бумага писчая «Снегурочка». Ризография. Гарнитура «Times».
Усл. печ. л. 15,34. Уч.-изд. л. 7,67. Тираж 29 экз. Заказ 659.

Издатель и полиграфическое исполнение: учреждение образования
«Белорусский государственный медицинский университет».
Свидетельство о государственной регистрации издателя, изготовителя,
распространителя печатных изданий № 1/187 от 18.02.2014.
Ул. Ленинградская, 6, 220006, Минск.



Переверзев Владимир Алексеевич
доктор медицинских наук, профессор
Белорусский государственный
медицинский университет
Заведующий кафедрой нормальной
физиологии



Никитина Ольга Сергеевна
старший преподаватель
Белорусский государственный
медицинский университет



Вэлком Менизебе Осайн
кандидат медицинских наук,
преподаватель 1 кафедры
физиологии человека (Madonna
University. Elele, Rivers State,
Nigeria)

SECTION I

INTRODUCTION. GENERAL PHYSIOLOGY AND BASIC HUMAN MORPHOLOGY. GENERAL PRINCIPLE OF REGULATION OF FUNCTIONS

INTRODUCTION. SUBJECT AND OBJECTIVE OF PHYSIOLOGY, ANATOMY AND HISTOLOGY

Lesson 1

Date: _____ 20____

Questions for lesson preparation: 1. Anatomy and physiology as science disciplines: definition, key concepts, the importance in the system of medical knowledge. Morphology of a complex of sciences studying the macroscopic structure (anatomy), the microscopic structure of organs and tissues (histology), the structure of cells (cytology). The value of knowledge of normal physiology with the basic of morphology for the pharmacist. 2. Stages of development of anatomy, physiology and histology (short history). The contribution of domestic scientists. History of the department of normal physiology of the BSMU. 3. The concept of anatomical, physiological and histological methods of research. Microscopic method of research. 4. Rules for working in the department of normal physiology: familiarity with the department staff, study materials, classrooms and practical books, schedule of classes and exams, working programs. 5. The research work of the department of normal physiology (main directions).	LITERATURE <i>Main</i> 1. Lecture material of the department of normal physiology. 2. <i>Physiology</i> : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
--	---

Basic terms and concepts

physiology —	regulation —
anatomy —	principle of regulation —
histology —	topography of organs —
morphology —	reserve —
function —	adrenaline —
health —	research method —
healthy lifestyle —	agonist — antagonist —
functional system — examples:	physiological system — examples:

Instruction on safety

INSTRUCTION

on safety for students and workers in the department of normal physiology

The training program at the department of normal physiology provides students to perform practical work, practical skills of working with some electrical appliances, computers, research equipment, laboratory glassware, chemical reagents and biological fluids. In addition, students can be given the right to carry out scientific work in the laboratories of the department during school hours.

General requirements

Before entering the training room students should wear their *laboratory coat*.

For general monitoring of the procedure, compliance with the rules and implementation of safety requirements when working in classrooms the duty student is assigned responsibility from among the group of students. The duty student is required to obtain a variety of materials needed to carry out practical work before class commences. At the end of the class work, the student on duty must return the collected materials and check the condition of the classroom — whether or not water and electricity are turned off.

Safety precautions when working with electrical equipment

There may be cases of electric shock and fire when working with electrical equipment and appliances.

The reason for this may be:

- defective electrical equipment (switch, sockets, etc.);
- lack of electrical grounding or earthing;
- improper use of electrical appliances; touching hands or metal objects with current carrying elements.

In case of identification of electrical defect, inform the lecturer. When working with electrical equipment and appliances, it is strictly forbidden to:

- check the voltage with fingers and touch live parts current carrying parts;
- work on ungrounded electrical equipment and devices, if it is not allowed instruction on the device;
- use faulty electrical equipment and wiring;
- leave energized electrical circuit without supervision.

Actions in case of fire outbreak

In the event of fire, you should immediately turn off the power, call for help and begin to extinguish the fire (fire extinguishers are available in rooms 104, 131, 135, 138). Before you begin to extinguish the fire, you must disconnect the power grid facilities. Then use the fire extinguisher. To extinguish, you can also use the existing fire hoses: unwind the hose, open the tap (fire tap with hoses are at the end of the corridor by the room 136 in an alcove between rooms 139 and 140, 133 and 132, as well as opposite room 104).

General rules for first aid

The first medical aid to the victims should be provided immediately and correctly. On this depends the life and the effects of trauma, burns and poisoning. You will learn about the specific rules of providing first aid in clinical departments. If electric shock caused serious injuries, burns, it is necessary to call the ambulance, with mild lesions, after provision of first aid, the victim is sent to a health facility. It should be remembered that, when assisting, a person under the influence of electric current must not be touched with bare hands. First of all, you need to turn off the installation (device), which is touched by the victim. If you are unable to turn off the entire electric system, it is necessary to separate the victim from the current carrying parts, using sticks, boards and other dry items that do not conduct electric current, or cut the wires with a dry ax handle.

In all cases, you need to call the laboratory technician on duty, which is located in room 131, or the lecturer of the department.

Instructions for formation of the protocol:

After getting acquainted with the rules and instructions on safety, sign on the protocol, as well as in the “Journal of checklists of instructing students on safety” (the journal is in the computer lab, classroom 104).

PROTOCOL

* I have read and have been instructed on the safety rules.

Date

Signature

Name of student in full

Cell theory [18]. Structure of the cell and intercellular substance (on the light microscope) [18] (fig. 1.2)

In 1838–39, botanist M. Schleiden and the zoologist Schwann T. combined their research (fig. 1.1).



Figure 1.1

Enter the main tenets of the cell theory:

Enter the name of the cell structures and extracellular matrix in fig. 1.2.

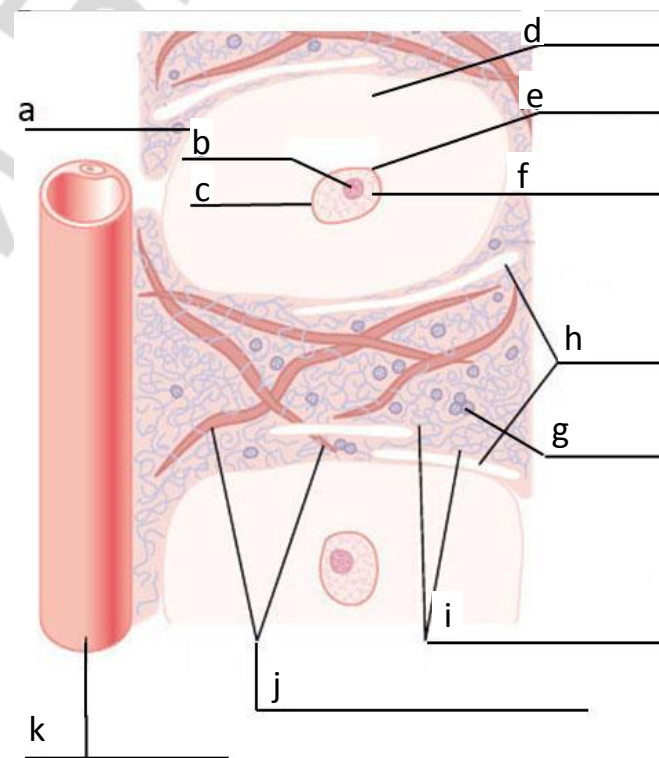


Figure 1.2

ANSWERS: a — cell membrane; b — nucleolus; c — nucleus; d — cytoplasm; e — nuclear membrane; f — nucleoplasm; g — vesicles; h — intercellular fluid; i — proteoglycan filament; j — collagen filament; k — capillary

Scheme of the structure of cell membrane of eukaryotic cell [18] (fig. 1.3, 1.4).
Control of ion channels. Functions and properties of the cell membrane (table 1.1)

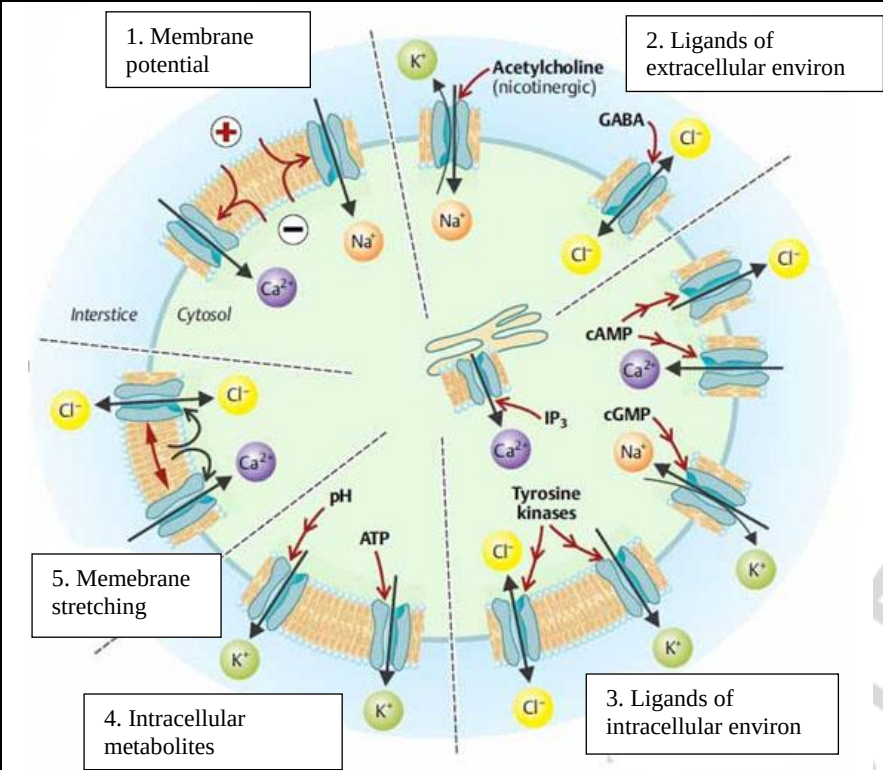


Figure 1.3. Ion channels

Enter the known ion channels and ion pumps

Study the model of structure of cell membrane.

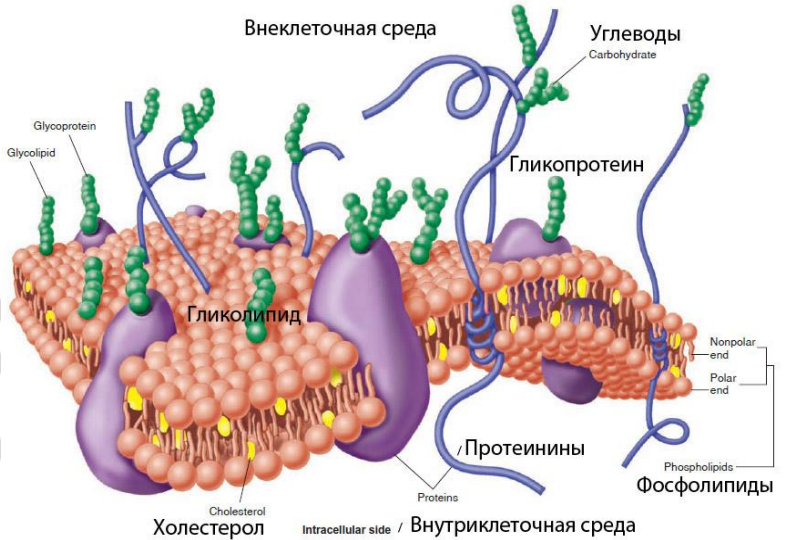


Figure 1.4

Complete the table.

Functions of cell membrane		Functions of plasma membrane proteins	
1.		1.	
2.		2.	
3.		3.	
4.		4.	

Composition of cell membrane		Properties of cell membrane	
lipids	_____ %	1.	
protein	_____ %	2.	
carbohydrates	_____ %	3.	

A) Training computer program. Student independently loads the program: opens the icon “Department of Normal Physiology” on the desktop (fig. 1.5) and familiarizes with the sections of this resource (fig. 1.6).

Figure 1.6.



Mastering of the practical book for lessons in the computer class (continuation)

B) Control computer program. Student independently loads the program “Testing” (fig. 1.7), clicks on “start testing” (fig. 1.8), selects a list of his or her group (fig. 1.9), surname (fig. 1.10) and enters the password (fig. 1.10) in the form of his or her number on the exam record booklet, selects tests for independent control (fig. 1.11), his or her faculty (fig. 1.12) and topic of the lesson, clicks on “ok” — start the test. At the end of the test (fig. 1.13) write the results on the lesson protocol.

Fig. 1.7

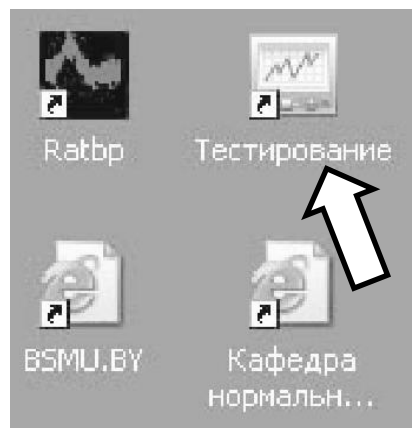


Fig. 1.8

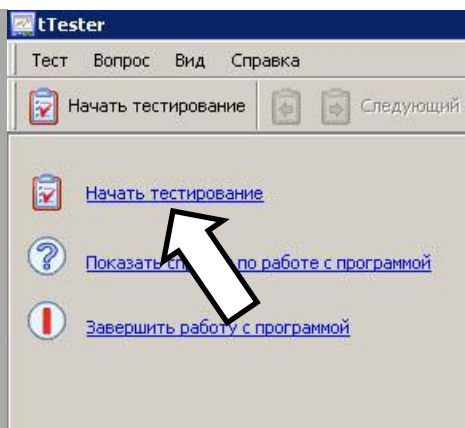


Fig. 1.9

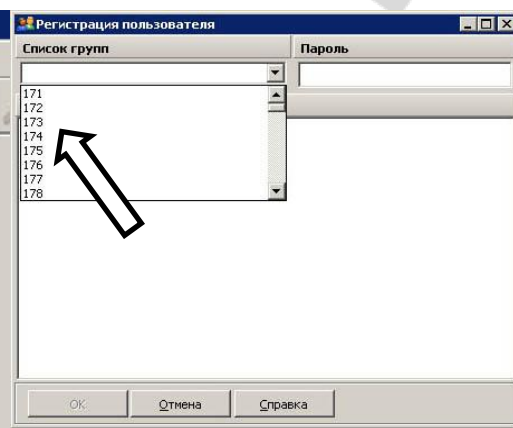


Fig. 1.10

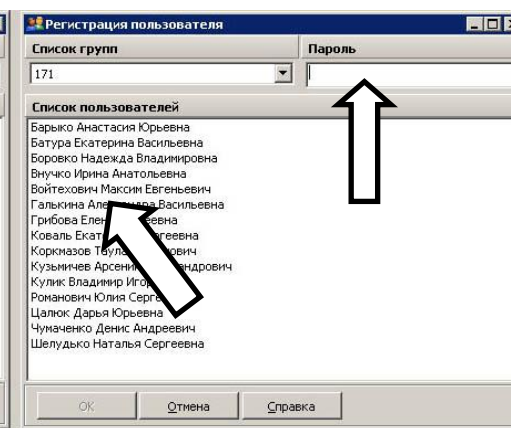


Fig. 1.11

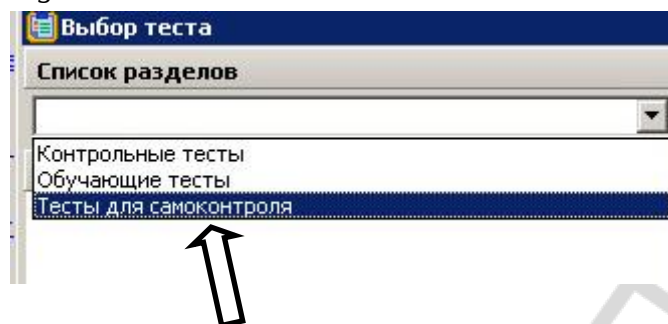


Fig. 1.12

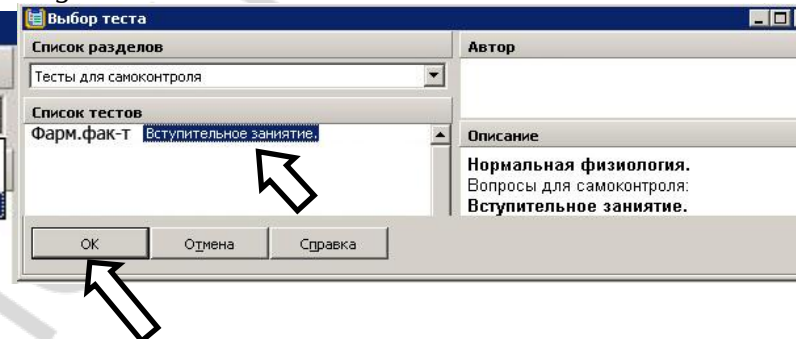
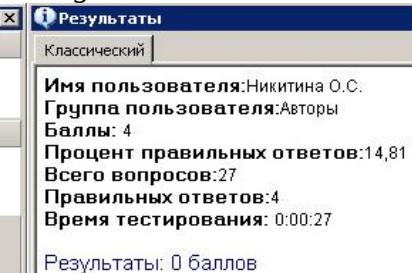


Fig. 1.13



PROTOCOL Score on test _____.

Execution of experiment on a virtual animal (rat). Studying the receptor mechanism of effect of adrenaline (Ad) on frequency of contraction of heart (HR — heart rate)

Step 1. On monitor open program

PHYSIOL 2 Fig. 1.14



Fig. 1.14

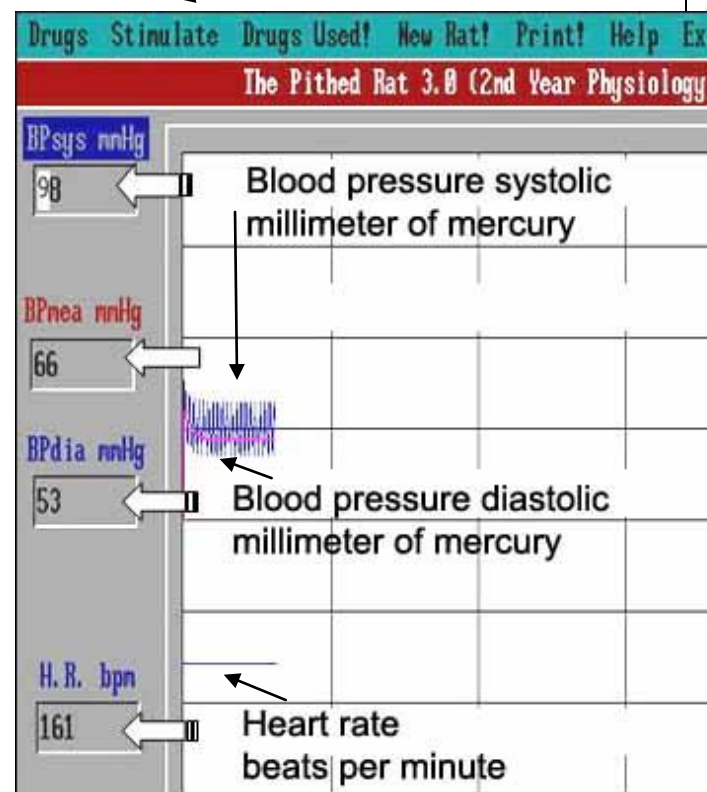
Step 2. Enter your name



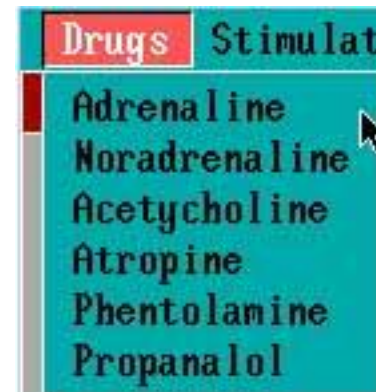
Fig. 1.15

Step 3.

Injection drugs Stimulate nerve system



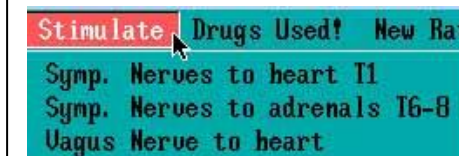
Step 4.



Step 5.



Fig. 6.



- Sympathetic nerve to heart through segment of spinal cord Thorax-1
- Sympathetic nerve to adrenals glands through segment of spinal cord Thorax 6–8
- Vagus nerve — parasympathetic nerve

Fig. 1.17



Fig. 1.18

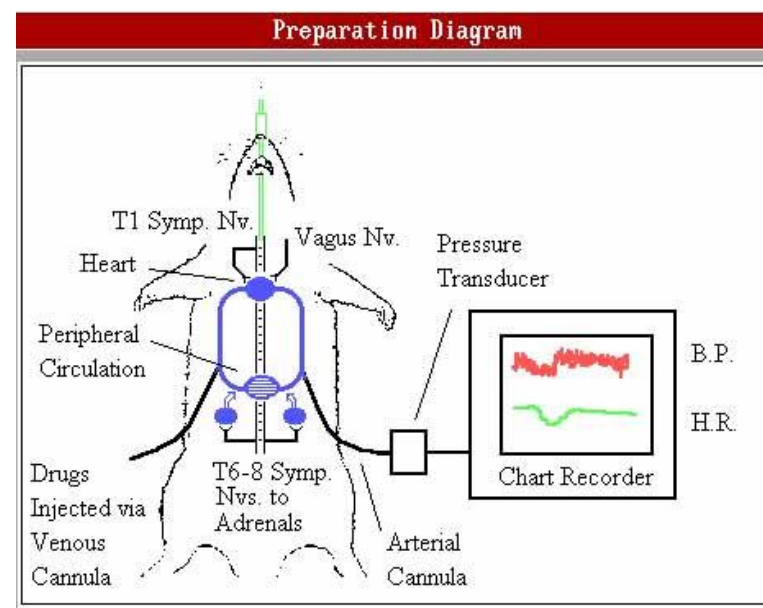


Fig. 1.19

Standard Drugs	
Adrenaline	$\alpha + \beta$ adrenoceptor agonist
Noradrenaline	$\alpha + \beta$ adrenoceptor agonist
Isoprenaline	β adrenoceptor agonist
Acetylcholine	Cholinoceptor agonist
Salbutamol	β_2 adrenoceptor agonist
Atropine	Muscarinic cholinoceptor antagonist
Phentolamine	α adrenoceptor antagonist
Propranolol	β adrenoceptor antagonist
Nifedipine	Ca channel blocker
Adenosine	Adenosine receptor agonist

PROTOCOL

Fill the table and make conclusion about the receptor mechanism of influence of adrenaline on HR, comparing its effect under the action of antagonist of β -adrenoreceptors propranolol with the initial effect.

	Experiment	Frequency of heart rate (HR)	CONCLUSION
Rat 1	Enter initial value (see step 3)	161	Remember: adrenaline increases HR via stimulation of β -adrenoreceptors, which are localized on the plasma membrane of cardiomyocytes and belongs to 7-TMS family (seven segmented transmembrane receptors). The second messenger of the action of adrenaline on the heart is cAMP (cyclic adenosine monophosphate). Explain, why after injection of antagonist (propranolol) the effect of adrenaline (agonist) does not occur or occur at low degree:
	Select DRUGS → adrenaline 5 $\mu\text{g/kg}$ → inject drug		
Rat 2	Select New Rat → Enter initial value	161	
	Select DRUGS → propranolol 100 $\mu\text{g/kg}$ → inject drug → Enter new value		
	Select DRUGS → propranolol 100 $\mu\text{g/kg}$ → inject drug → adrenaline 5 $\mu\text{g/kg}$ → inject drug → Enter new value		

**PHYSIOLOGICAL BASIS OF LIFE PROCESSES OF HUMANS.
CONCEPT OF NEURAL AND HUMORAL MECHANISM
OF REGULATION OF FUNCTIONS**

Lesson 2

Date: _____ 20____

Question for lesson preparation: 1. Leading patterns that characterize life (self-renewal, self-reproduction, self-regulation, metabolism). 2. Basic properties of a living organism (metabolism and energy, irritability, homeostasis, adaptation, reproduction, heredity and variation). 3. The concept of somatic and autonomic functions. Levels of regulation: cellular, tissue, organ, organismal. 4. Mechanisms of regulation of functions: neural (neural reflex), humoral (local humoral and endocrine regulation), myogenic. 5. The interaction of neural and humoral regulatory mechanisms, their comparative characteristics and unity. 6. Types of regulation of functions. Negative feedback. Principle of reliability. 7. System principle of regulation of functions, concept of system (I. P. Pavlov). Functional system (P. K. Anoxin), principle of self-regulation. 8. The concept of homeostasis and homeokinesis. Mechanisms of regulation of homeostasis.	LITERATURE Main 1. Lecture material of the department of normal physiology. 2. <i>Physiology</i> : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
---	---

Study computer programme “Lesson 2”

Work 2.1

(Internet Explorer → Pharmprogramme → Study programme → Lesson 2)

Work progress. Student independently loads the programme “Lesson 2” and examines the teaching material in detail.

Control computer programme “Pharm faculty Lesson 2”

Work 2.2

(Testing → Tests for self (independent) control → Pharm faculty Lesson 2)

Work progress. Student independently loads the programme “Pharm Faculty Lesson 2” and then answers questions.

PROTOCOL

1. Score on test _____. 2. Score on lesson _____.

Basic terms and concepts

metabolism —	
biosystem —	homeokinesis —
compartment —	list the mechanisms of homeostasis —
metabolism —	reflex —
energy —	mediator —
calorie — 1 calorie = _____ joule	neurohormone —
life —	hormone —
irritability —	enzyme —
homeostasis —	peptide —
adaptation —	prostaglandin —
reproduction —	examples of cyclic nucleotides —
external environment —	first messenger —
internal environment —	second messenger —
somatic functions —	target organ —
vegetative functions —	target cell —

Levels and mechanisms of regulation of functions of the organism

Enter the name of the levels of organization of an organism and the levels of regulation of its functions in fig. 2.1.

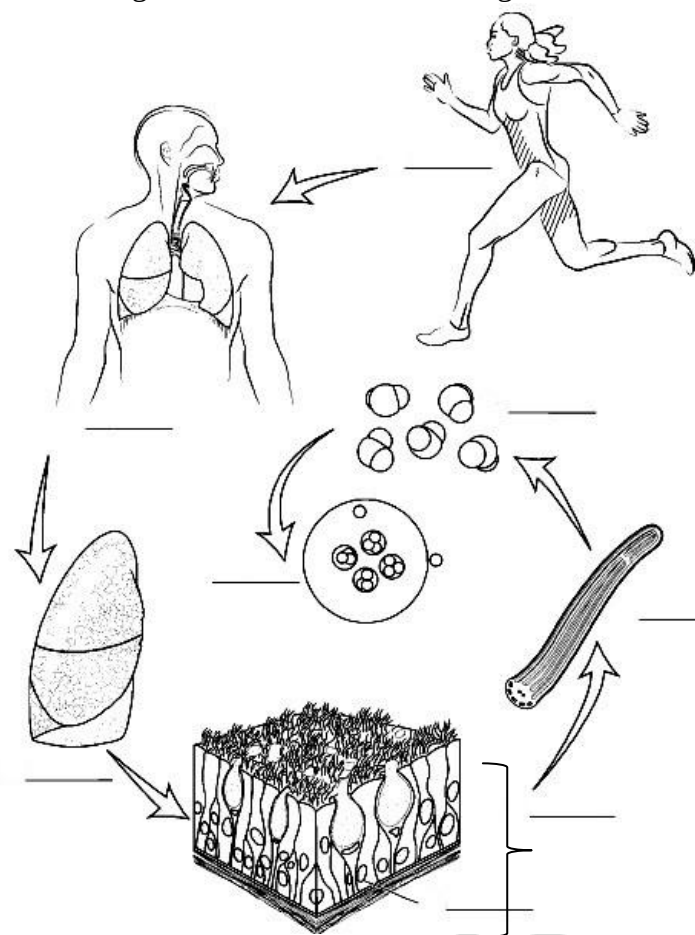


Figure 2.1. Levels of organization of organism and levels of regulation of functions [18]

Complete table 2.1.

Table 2.1

Mechanism of regulation of functions

– by metabolite – by electrolytes – by neurohormones – by tissue hormones – by hormones	– somatic reflexes – vegetative reflexes	– automaticity – contractility during tension – plasticity

ANSWERS: organismal, systemic (respiratory system), organ (lungs), cellular (epithelial cells), tissue (epithelial tissue), subcellular (mitochondria, nucleus, EPR, Golgi complex, lysosomes), molecular (ATP, enzyme, protein, H₂O), atomic (ion).
Humoral, neural, myogenic.

Mechanisms and types of regulation of functions

Correctly complete table 2.2.

Table 2.2

Comparative characteristics of neural and humoral mechanisms of regulation of functions

Parameter	Neural mechanism	Humoral mechanism
Accuracy of regulation		
Modes of communication methods		
Speed of regulation		
Duration of regulation		

Complete the scheme of regulation of functions by deviation on figure 2.2.

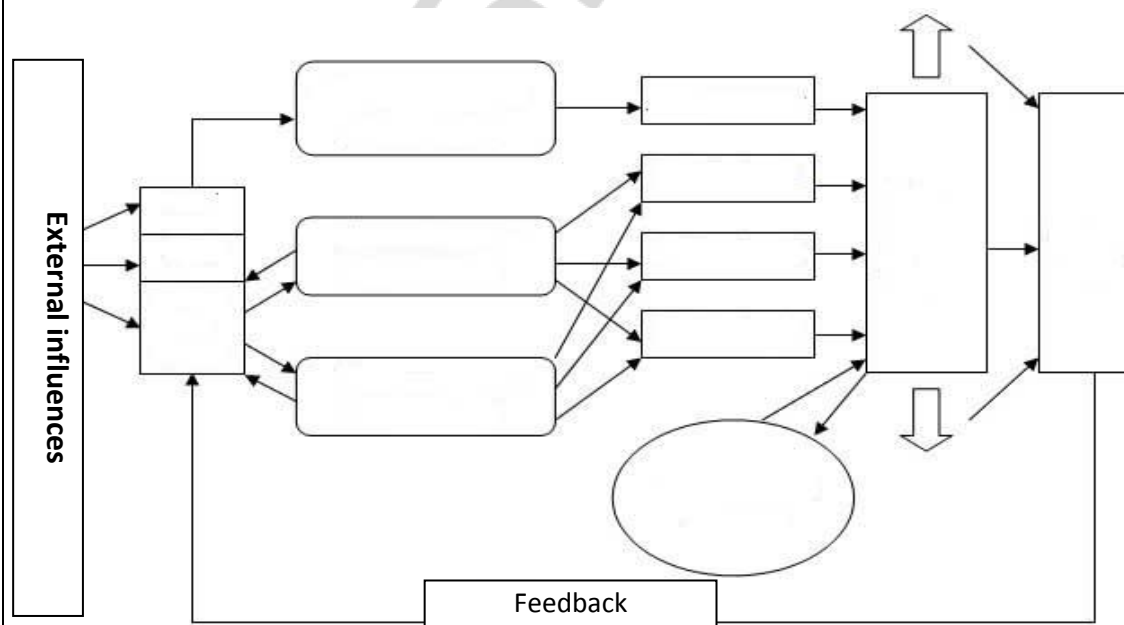


Figure 2.2. General scheme of functional system of regulation of functions "by deviation"

Functional system — is

**GENERAL CONCEPT ABOUT TISSUE. CONNECTIVE TISSUES:
TYPES, FUNCTION. HUMAN SKELETON. ROLE OF CALCIUM
AND PHOSPHATE IN BONE TISSUE AND IN THE ORGANISM**

Lesson 3

Date: _____ 20____

Questions for lesson preparation: 1. General concept about tissue. Cellular elements and non-cellular substance. Classification of tissues. 2. Connective tissues: concept, types, functions. 3. Bone tissue: cellular components and intercellular substance. 4. Role of calcium and phosphate ions in bone tissue and in the organism. Age and individual normal values of calcium, phosphate and fluorine requirements for the maintenance of healthy bone and teeth. 5. Notion about the human skeleton. Parts of skeleton. Classification of bones. 6. The concept of skeleton of the shoulder and pelvic girdle, skeleton of the upper and lower extremities. 7. Notion about the structure of the skull: bones, joints and core openings 8. The concept of types and shapes of attachments of bones. Types of joints, their structure, classification, functions.	LITERATURE <i>Main</i> 1. Lecture material of the department of normal physiology. 2. <i>Physiology</i> : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
---	---

Key terms and concepts

1. Tissue — is	9. Major mineral component of bone tissue —
2. Cell — is	10. Structural formula of hydroxyapatite —
3. Derivatives of cells: - tissue matrix — - postcellular structures — - epicellular structures —	11. Normal value of Ca^{2+} in daily diet of adult human of 25–50 years is: [_____] mg/day
	12. Optimal daily dose of consumption of fluorine by adult human is : [_____] mg/day
	13. Hormones, preventing bone resorption — are
4. Stroma of many organs is formed by —	14. Requirement of daily phosphate consumption in adult human is : [_____] mg/day
5. Varieties of adipose tissue —	15. daily intake requirement of vitamin V_3 by adult human (aged up to 50 years) is [_____] ME or [_____] mkg
6. Cells that feed bone — are	16. Osteoporosis — is
7. Cells that form bone tissue — are	
8. Cells that destroy bone tissue — are	

Study computer programme “Lesson 3”

(Internet Explorer → Pharmprogramme → Study programme → Lesson 3)

Work progress. Student independently loads the program “Lesson 3” and examines in detail the study material presented in it.

Control computer programme “Pharm faculty Lesson 3”

(Testing → Tests for independent control → Pharm faculty Lesson 3)

Work progress. The student independently loads the program “Pharm Faculty Lesson 3” and answers the questions.

PROTOCOL. 1. Score on test _____. 2. Score on lesson _____.

Classification of tissues [9]

Indicate the types of tissues.

Types of tissues

1	2	3	4

Draw scheme of types of connective tissues on figure 3.1

Features of the structure of connective tissue proper

Scheme of the microscopic structure of loose fibrous connective tissue [9] (figure 3.2).

1. Highlight with red colour, blood vessel and blood cells that have exited the bloodstream.

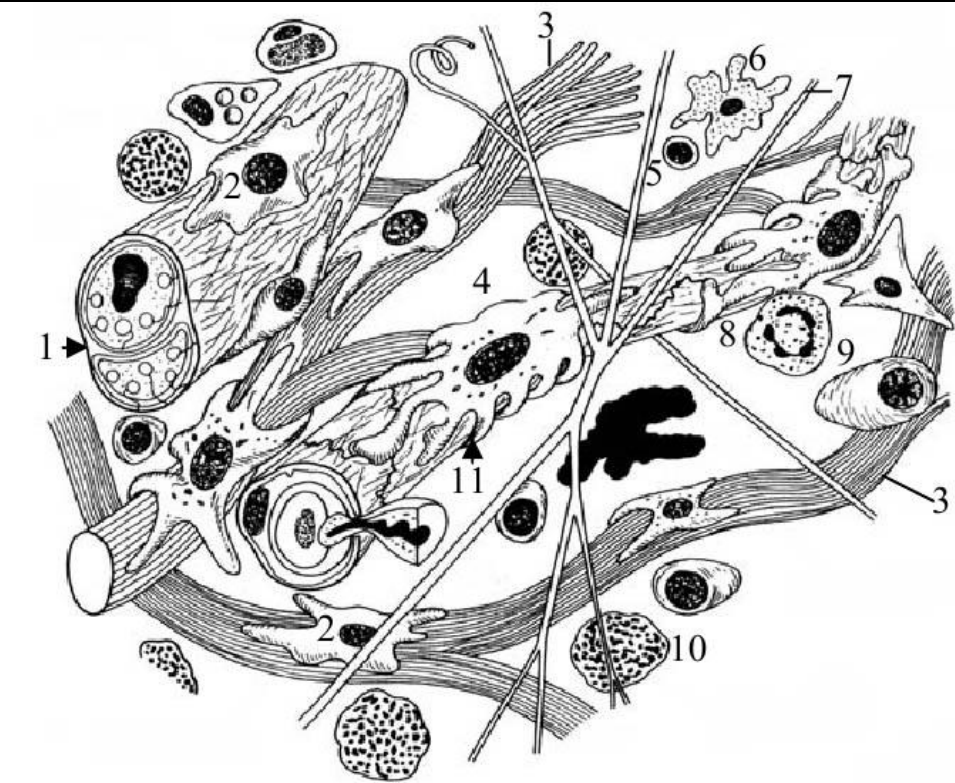


Figure 3.2

1 — nerve; 2 — fibroblast; 3 — collagen fiber; 4 — intercellular matrix; 5 — lymphocyte; 6 — macrophage; 7 — elastic fiber; 8 —neutrophil; 9 — plasma cell; 10 — mast cell; 11 — blood vessel capillary.

The main components of connective tissue actually are cells and their synthesized intercellular substance that consists of collagen, elastic and reticular fibers, as well as ground (amorphous) substance. The fibers impart strength and elasticity to the tissues. The basic substance functions as an integrative buffer medium, which serves for the passage of molecules through the connective tissue and for exchange of substances with blood. Connective tissue proper is divided into fibrous connective tissue and connective tissue with special properties.

Among the fibrous tissue, depending on the cell structure, the ratio of quantity and quality between the fibers and the ground substance, distinguish loose connective tissue and dense connective tissue. In loose connective tissue, basic substance prevails over fibers diffusely located and oriented in different directions. The dense fibrous connective tissue, on the contrary, dominates over main substance. Tissues with special properties are reticular, fatty, mucous tissue and pigment.

Cells of loose connective tissue.

2. List 10 types of cells of loose connective tissue:

1.	6.
2.	7.
3.	8.
4.	9.
5.	0.

Bone tissues: classification, structure**Classification of bone tissues:**

1	2
---	---

Types of cells of skeletal connective tissues [9]:

1)		2)		3)	
a)	b)	a)	b)	a)	b)

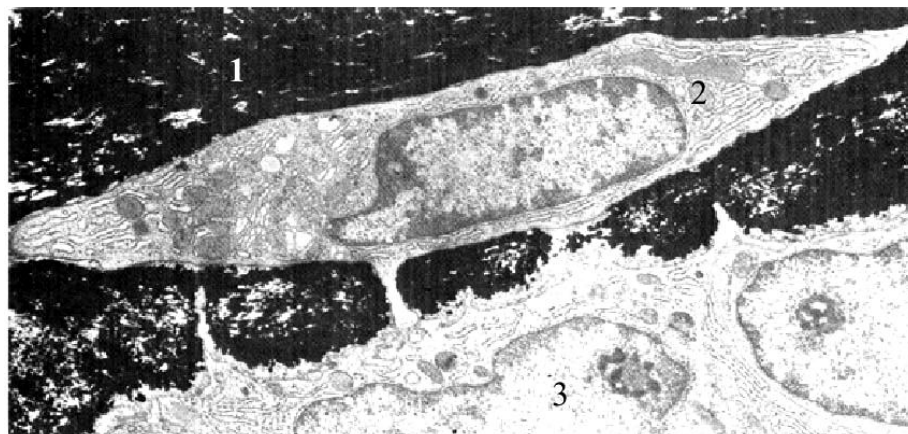


Figure 3.3. Cellular composition of bone tissue (transmission electron microscopy)

1 — mineralized matrix, 2 — osteocyte, 3 — osteoblast

Write the numbers on the scheme of figure 3.4.

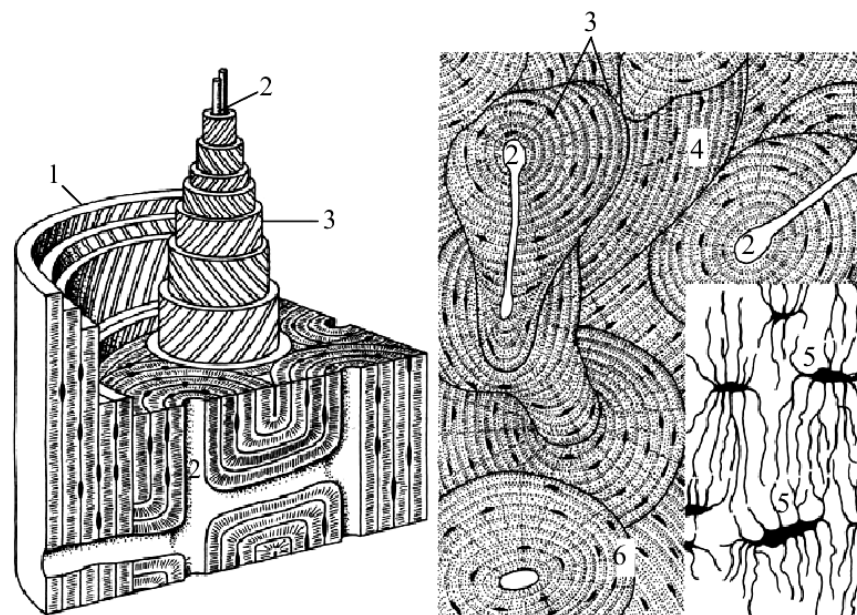


Figure 3.4. Scheme of the structure of compact bone substance

1 — outer layer of the common plate, 2 — osteon channel, 3 — concentric bony plates, 4 — intercalated bone plates, 5 — osteocyte, 6 — spine line

Variety of cartilage tissues

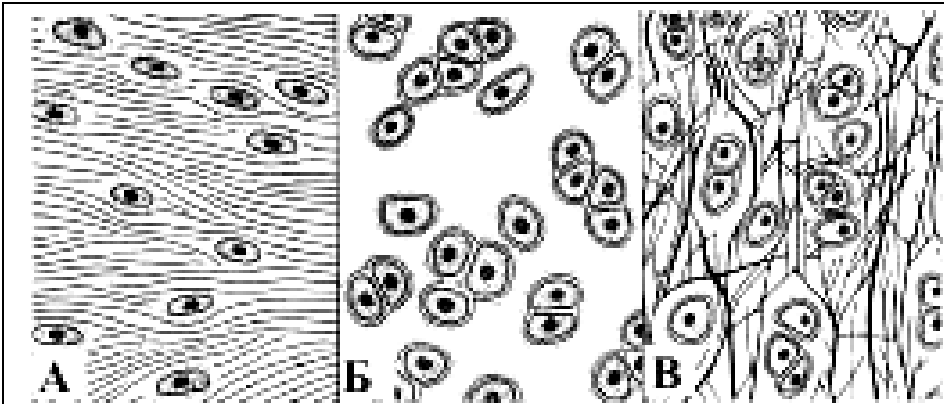


Figure 3.5. Scheme of structure of different types of cartilage tissues

Give examples of different types of cartilage localization.

A – fibrous cartilage _____

B – hyaline cartilage _____

B – elastic cartilage _____

Classification of bones with examples

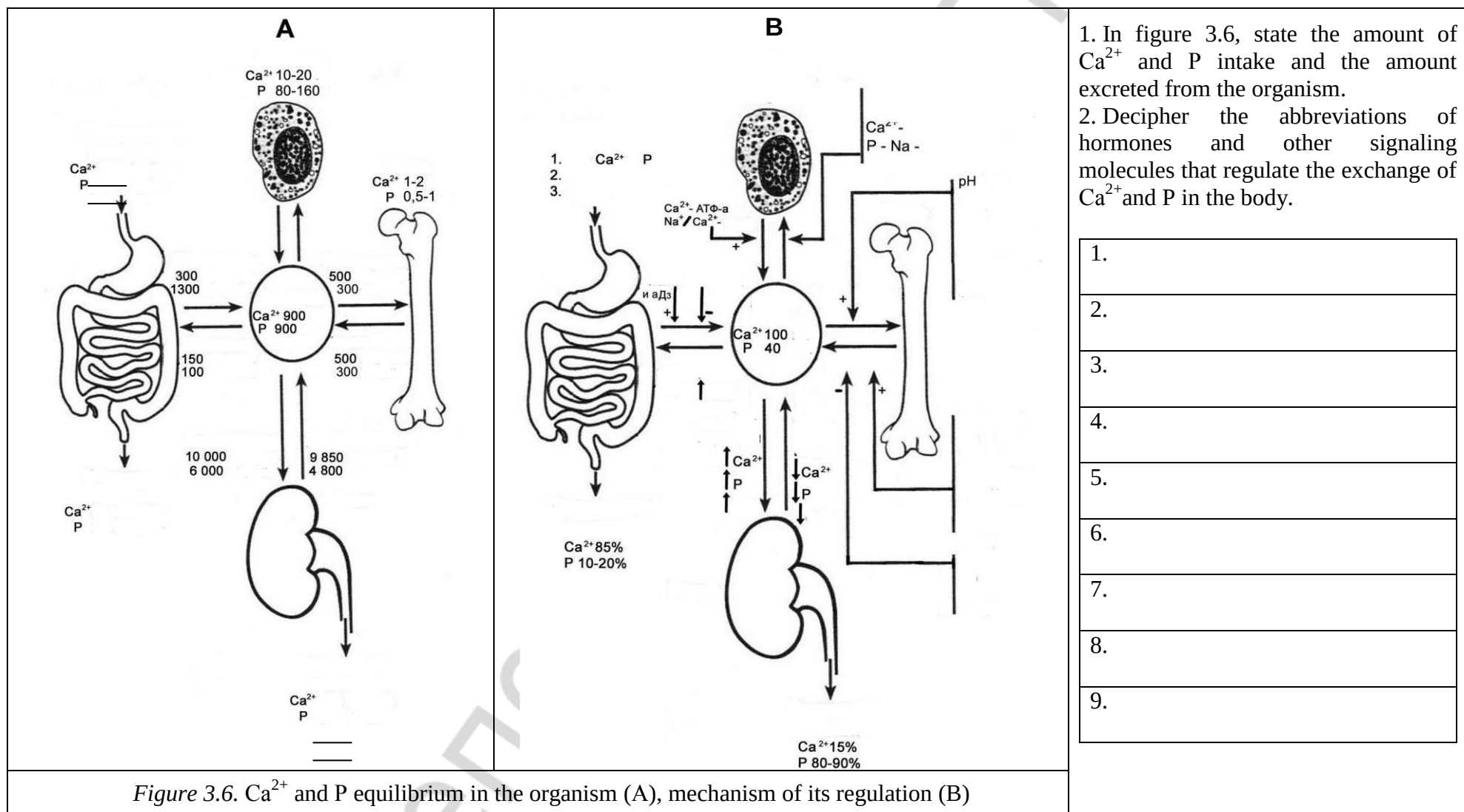
1		2	3	4

Skeleton — is

Visit to the museum of department of normal anatomy of BSMU

Familiarization with the structure of human skeleton.

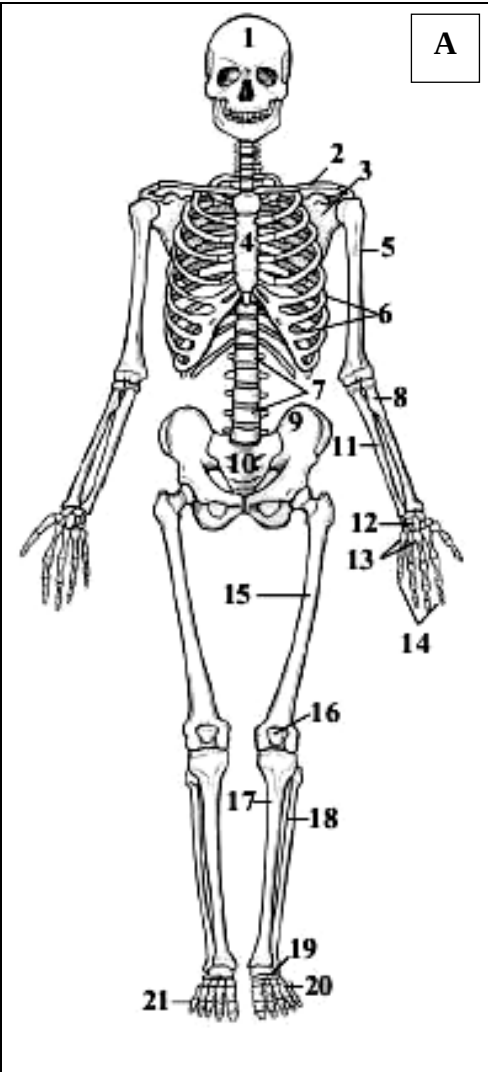
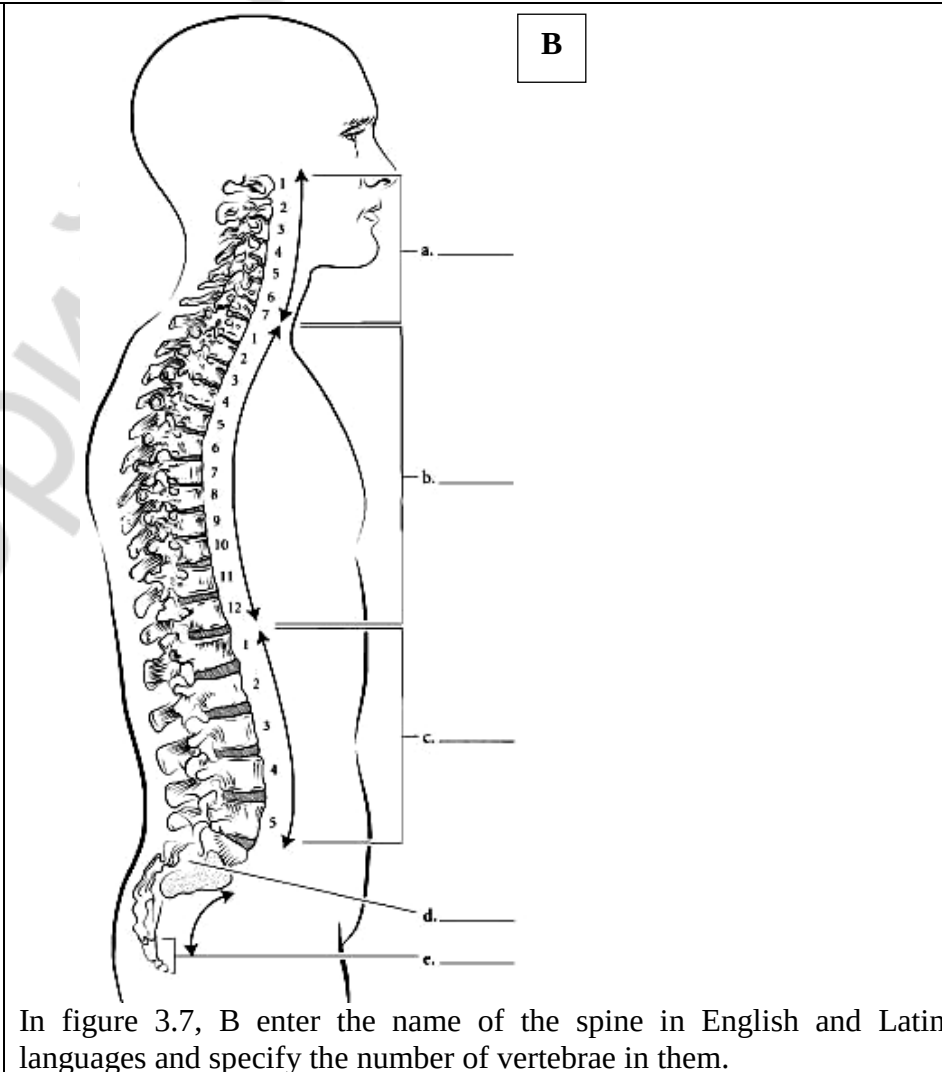
Calcium (Ca^{2+}) and phosphate (P) equilibrium in the organism and mechanism of its regulation [1]



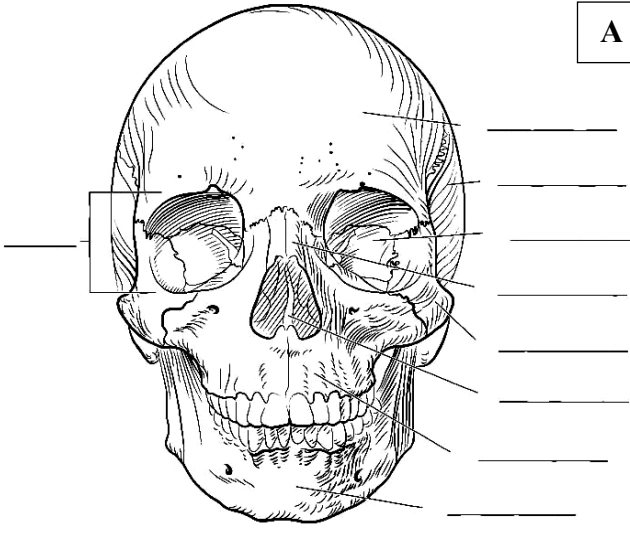
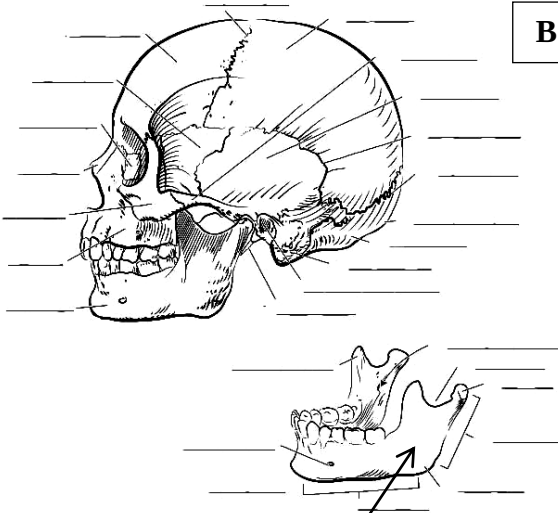
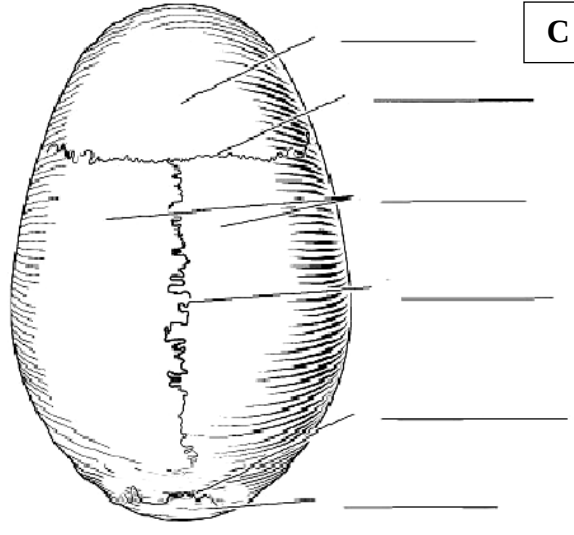
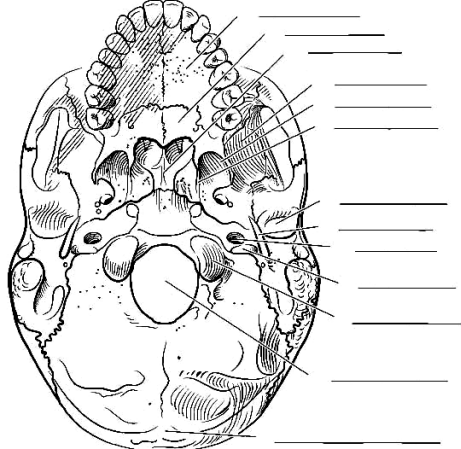
1. In figure 3.6, state the amount of Ca^{2+} and P intake and the amount excreted from the organism.
2. Decipher the abbreviations of hormones and other signaling molecules that regulate the exchange of Ca^{2+} and P in the body.

1.
2.
3.
4.
5.
6.
7.
8.
9.

Human skeleton [19]*Figure 3.7. Structure of skeleton (A) and spinal column of humans (B)*

	A Indicate which of the bones form the axial skeleton _____ _____ _____ _____ and which — are auxiliary: _____ _____ _____ _____ _____	 B a. _____ b. _____ c. _____ d. _____ e. _____ In figure 3.7, B enter the name of the spine in English and Latin languages and specify the number of vertebrae in them.
--	---	--

The human skull [19]

A 	B  The only movable bone of the skull	C 
D 	Figure 3.8. The structure of the human skull (A — anterior view, B — lateral, C — top view, D — bottom view) The human skull is divided into two parts: the cranium (neurocranium) and visceral skull (cranium viscerale). The skull serves as a receptacle of the brain and associated sense organs (sight, hearing and balance). The neurocranium include: unpaired (1 — occipital, 2 — sphenoid, 3 — frontal, 4 — ethmoid bone) and paired (6 — temporal, 7 — parietal) bone. Visceral skull surrounds the upper part of the digestive and respiratory tracts, that open to the external. The composition of the cranium viscerale includes paired bone (upper jaw, lower nasal concha, palatine, zygomatic, nasal, lacrimal bone) and unpaired bones (vomer, mandible, hyoid bone). On figure 3.8 (A, B, C, D) write the names of the bones and paint them in different colors, large opening in them, the names of intercostals joints (suture). Specify the number of teeth in an adult _____ teeth, they are: _____ incisors; _____ canines; _____ premolars; _____ molars.	

Figures 3.9, 3.10 write the names of the bones, groups of bones of the upper and lower extremities, pelvis, large pelvic orifice.

Fill in the table, using the examples of connection of bones in Figures 3.7, 3.8, 3.9, 3.10.

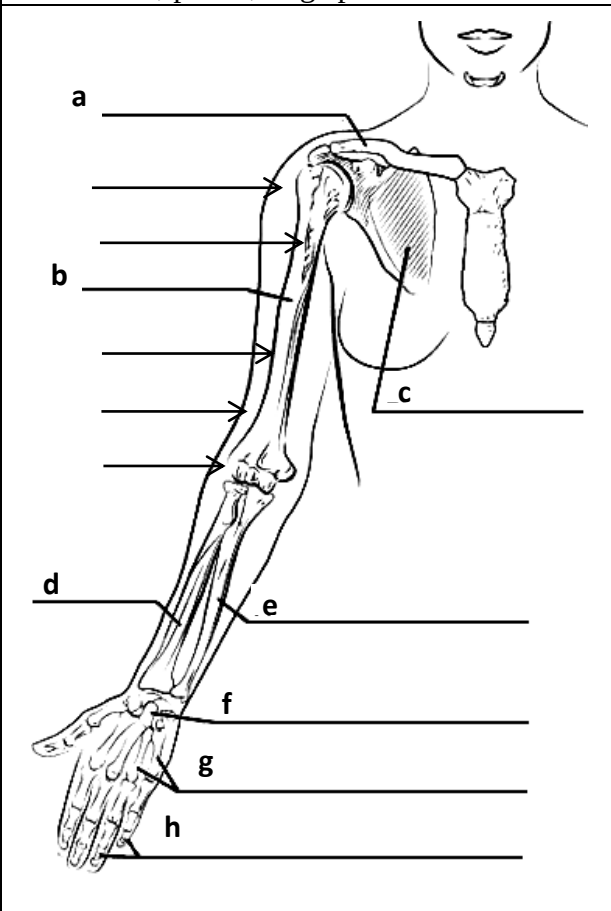


Figure 3.9. Skeleton of the upper limb:
a — collarbone, b — humerus, c — scapula, d — radius, e — ulna, f — wrist bone, g — metacarpal bone, h — phalanges

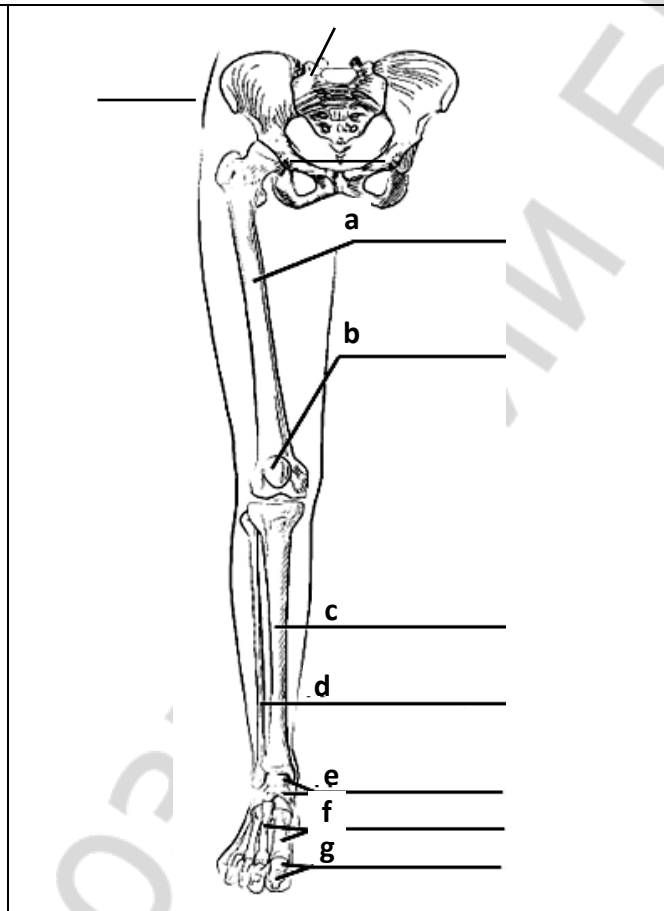


Figure 3.10. Skeleton of the lower extremity and the pelvic bones:
a — femur, b — patella, c — tibia, d — fibula, e — tarsus, f — metatarsal, g — phalanges

Connection of bones		
Fibrous (continuous, synarthrosis, non-mobile) movement between the bones is excluded	Cartilaginous (synchondroses, low mobility)	Synovial (diarthrosis, discontinuous mobile connections)

Mandibular movements in different planes. Gothic arch

Movement of the lower jaw is the result of a complex interplay of the masticatory muscles, temporomandibular joints and teeth, coordinated and controlled by the central nervous system. Movement of the mandible occurs in three planes: sagittal, frontal and horizontal and these entail in the opening (lowering of the lower jaw) and the closing (the upward movement of the lower jaw) of the mouth, forward and backward movement of lower jaw, as well as displacement of the mandible. At maximum opening movement of the mandible, lower incisors depict the part of an arc of 40 to 50 mm in length (a person can be inserted between the incisors 3 middle fingers of his hand). At the closing movement of the mandible in normal interdigitation in position of central occlusion, bite can be determined as: orthognathic (I class), prognathic (II class), prognathic (III class). The lower jaw can move in the direction (left or right) or additionally move (forward, back) from any position within the complex movements in the sagittal plane. In the view from the top on the movement of the mandible in the horizontal plane, as well as the right and left lateral movements to the limit, the trajectory of the midpoint of the lower incisors resembles the head of the arrow or arc (fig. 3.11). It is often called “Gothic arch”.

With regard to the teeth of the lower jaw, each of which describes an individual “gothic arch” in relation to the opposite upper tooth. In this case the teeth do not have to contact with each other. In the absence of contact between the teeth of the upper and lower jaw, movement of the later of the joints is directed by articulated surfaces of joints and proprioceptive neuromuscular mechanisms. When the lower jaw moves and the teeth are in contact, the chewing surfaces of teeth direct its movements, while the joints play a passive role.

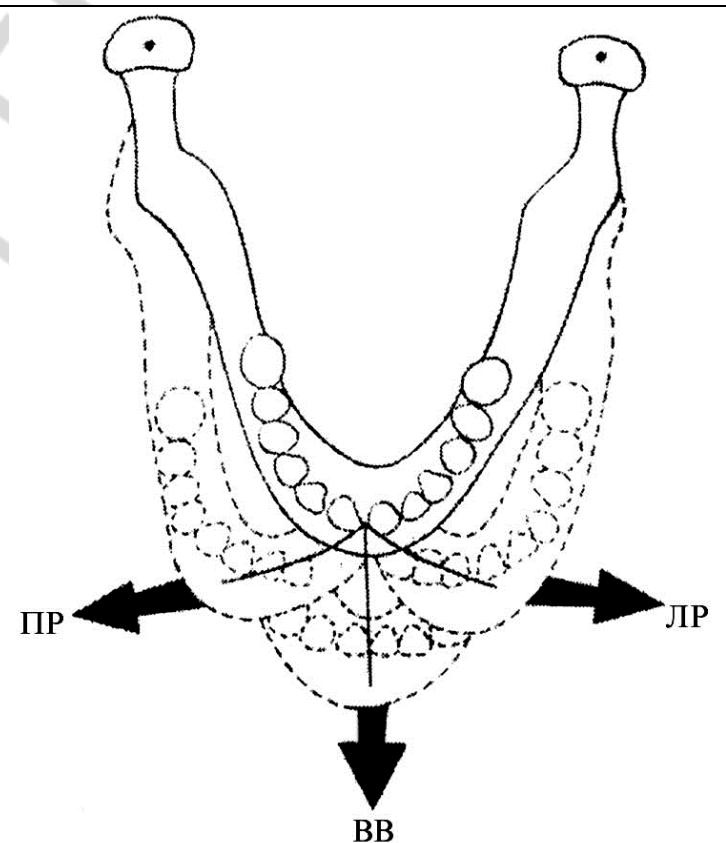


Figure 3.11. The trajectory of the midpoint of the lower incisors at the right movement (IIP), left movement (JIP) and forward movement (BB) movements of the lower jaw (gothic arch)

Mandibular movements in different planes. Gothic arch (continuation)

Under normal function of masticatory system and the optimal interaction of its components (masticatory muscles, nerves, temporomandibular joints and teeth), lower jaw performs voluntary and reflex movements (opening, closing, forward movement and the description of the “gothic arch” in contact and without contact with the teeth of the maxilla) within the limits of its movement. Disorder of the functions of any of the links in the chewing system, or the interaction between itself, manifest as restriction of the volume of movements of the mandible.

Materials and equipment: millimeter ruler.

Work progress. Ask the participant to open the mouth as widely as possible. Measure the distance between his upper and lower incisors with accuracy up to 1 mm. Normally, it is equal to 40–50 mm. Ask the participant to insert between the incisors 3 middle fingers of his or her working hand. Normally, at maximum lowering of the lower jaw, initial part of the 3 middle fingers should come between the incisors of the upper and lower jaws. Ask the participant to describe the lower jaw “gothic arch” first without contact, and then in contact with the teeth of the upper jaw. In normal functions of the chewing system, mandible uniformly (from right to left or left to right) depicts a “Gothic arch” within its range of movement either in contact or without contact with the teeth of the upper jaw.

Instructions for completion of protocol:

1. Specify the distance between the incisors of the upper and lower jaw with maximum opening of the mouth.
2. Give your assessment of the visual description of the “gothic arch” with the movement of the lower jaw of the participant.
3. Make conclusion on the volume of movement of the mandible.

PROTOCOL

1. The distance between the incisors of the upper and lower jaw with a maximum opening of the mouth was ____ mm.
2. When moving the lower jaw “gothic arch” is described by _____ (full or interrupted).
3. **Conclusion.** The volume of the lower jaw movements in the participant _____ (full or limited).

Defining the height at rest, and the height of occlusion and interocclusal space

When a person is upright and relaxed, his lower jaw is in the position of physiological rest. In this resting position, chewing muscles are in a state of minimal activity. When the lower jaw is in the position of physiological rest, the length of the face is called “the height at rest or resting height”. In the rest position, the chewing surfaces of the teeth of the upper and lower jaws are separated. The distance between the chewing surfaces in this position is called “interocclusal space” or “occlusive field”. Interocclusal space clinically defined as the difference between the resting height and occlusion height using the same arbitrary point on the face. With a harmonious (functional, physiological) occlusion, which ensures optimum interaction between the teeth and joints and presents to the adaptive capacity of the neuromuscular system, minimum requirements, needed so that between the resting height and the height of occlusion, there should be an acceptable interocclusal space, which varies on average between 2 to 4 mm. However, in different individuals, it can range from 1.5 to 7 mm. Clinical rest position changes throughout life, resulting in the removal of teeth and change of bite.

Materials and equipment: pencil (or pen), ruler, caliper

Instructions on the completion of the protocol:

1. Specify the height at rest and the height of occlusion.
2. Calculate the value of interocclusal space.
3. Make conclusion about the value of the interocclusal space.

Work progress. On the participant, mark two points on the skin: one — at the tip of the nose, the other — on the chin along the midline of the face. Ask the participant to sit up, close the lips and completely relax the muscles of the face. In complete relaxation of facial and masticatory muscles, the mandible takes a position of physiological rest. Use caliper to measure the distance between the marked points. This will be the height at rest. Then ask the participant to close the teeth in the position of central occlusion (position of maximum intertubercular clamping of teeth). Measure the distance between the same points on the skin. This will be the height of occlusion. The difference between the resting height and the height of occlusion is the interocclusal space.

PROTOCOL

1. Height at rest _____ mm; _____ mm height of occlusion.
2. Interocclusal space _____ mm
3. **Conclusion.** Value of interocclusal space _____ (normal, increased, decreased).

GENERAL PHYSIOLOGY OF EXCITABLE CELLS. BIOELECTROGENESIS. RECEPTION

Lesson 4

Date: _____ 20____

Questions for lesson preparation:

1. Excitable cells: types, properties. The concept of irritability, excitability and excitation, irritation thresholds, dependency of the response on strength and time of the stimulus, chronaxie, lability, adaptation and accommodation.
2. The laws of response of excitable cells to the action of stimuli. The concept of parabiosis (N. E. Vvedenskii).
3. Modern ideas about the nature of the excitation. Bioelectrogenesis: resting potential, local response, action potential. Membrane-ionic theory and its origin.
4. Changes in membrane excitability in the different phases of a single cycle of excitation. Refractory.
5. The concept of the principles of drug regulation of the functional state of excitable cells.
6. Reception: definition. Biological significance. Receptor: definition, structure, types. Morphological feature of cellular and sensory receptors, and their functions.
7. The concept of sensory receptors. General mechanisms of reception. Information coding in the receptors. The receptor and generator potential. Adaptation of receptors.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia: Nova Knyha, 2016. 728 p.

Study computer programme “Lesson 4”

(Internet Explorer → Pharm programme → Study programme → Lesson 4)

Work progress. Student independently loads the programme “Lesson 4” and examines the course material in detail.

Work 4.1

Control computer programme “Pharm Faculty Lesson 4”

(Testing → Tests for independent control → Pharm Faculty Lesson 4)

Work progress. Student independently loads the programme “Lesson 4” and answers the questions.

Work 4.2

PROTOCOL

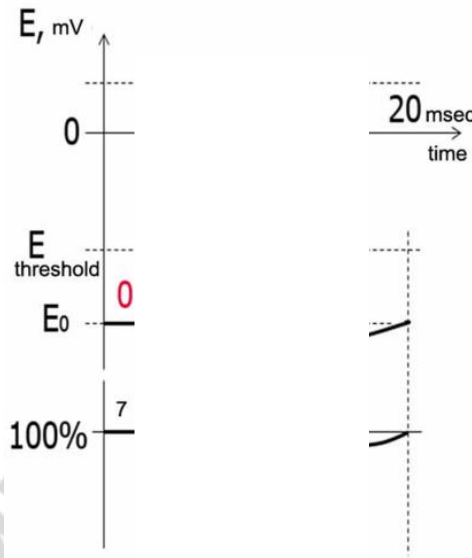
1. Score on testing _____. 2. Score on lesson _____.

Basic concepts and terms

Irritability —	Refractory —
Excitability —	Chronaxie —
Excitation —	The all or none law —
Types of stimuli (irritant) —	Force law —
Resting potential —	Parabiosis (N. E. Vvedenskii) —
Local response —	Lability —
Action potential —	Adaptation —
Polarization —	Accommodation —
Depolarization —	Receptor —
Repolarization —	Receptor potential —
Hyperpolarization —	Generator potential —
Critical level of depolarization —	
The values of the permeability of the nerve fiber membrane ($P_K^+ : P_{Na}^+ : P_{Cl}^-$) in a state of physiological rest.	The values of the permeability of the nerve fiber membrane ($P_K^+ : P_{Na}^+ : P_{Cl}^-$) when excited.

Graphs of various types of biopotentials of excitable cells

Label the axes on each figure and draw the desired diagram

The action potential		Changes excitability in the excitation process		
			0 — RP 1 — depolarization 2 — overshoot 3 — repolarization 4 — after depolarization 5 — fast repolarization 6 — hyperpolarization 7 — 100 % excitability 8 — supernormal period 9 — absolute refractory period 10 — absolute refractory period 11 — relative refractory period 12 — supernormal period 13 — subnormal period	
The laws of the response of excitable tissues to the action of irritants:				
1.		3.		
2.		4.		

Receptors: types, classification

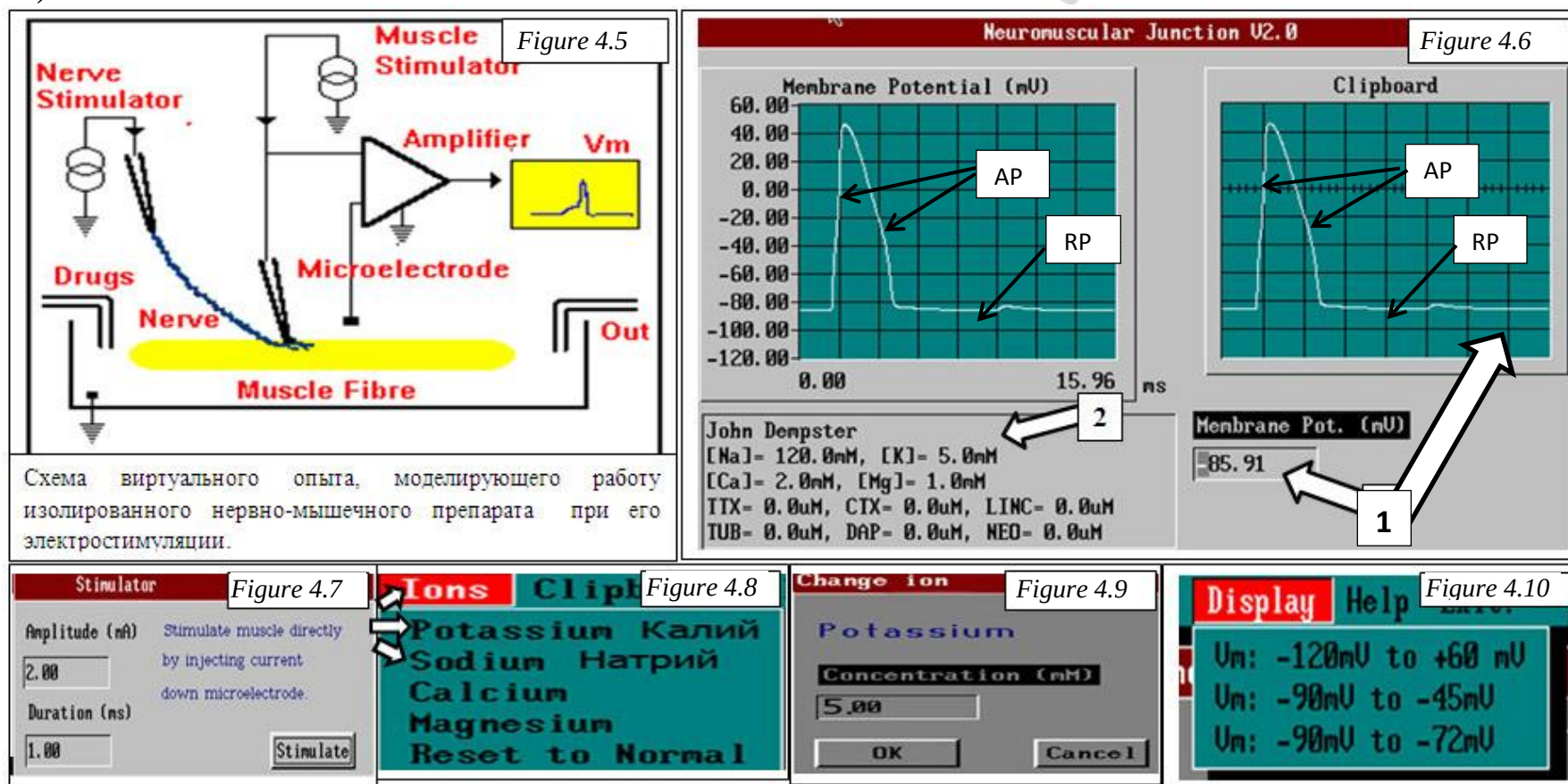
Define cell receptor and sensory receptor and outline their classification.

Draw the structure of receptors of plasma membrane of the cell.

Cellular receptor — is			Sensory receptor — is			
Classification of cellular receptors		Examples of ligands to the receptors	Classification of sensory receptors:			
Receptors of plasma membrane:						
1.						
2.						
3.						
Intracellular receptors:						
1.						
2.						
Scheme of the structure of receptors of plasma membrane of the cell.			Scheme of the structure of sensory receptors:			
1	2	3	Free nerve endings	Non-free nerve endings	Neurosensory cell	Sensory epithelial cell
			Characteristics of sensory receptors: • represent the initial part of any reflex arc; • convert the energy of stimuli of external and internal environment into bioelectric activity, transmitted by afferent nerves in the central nervous system in the form of information, encoding the properties of the stimuli; • participate in the evaluation of the parameters of useful adaptive result in functional systems of any level of organization.			

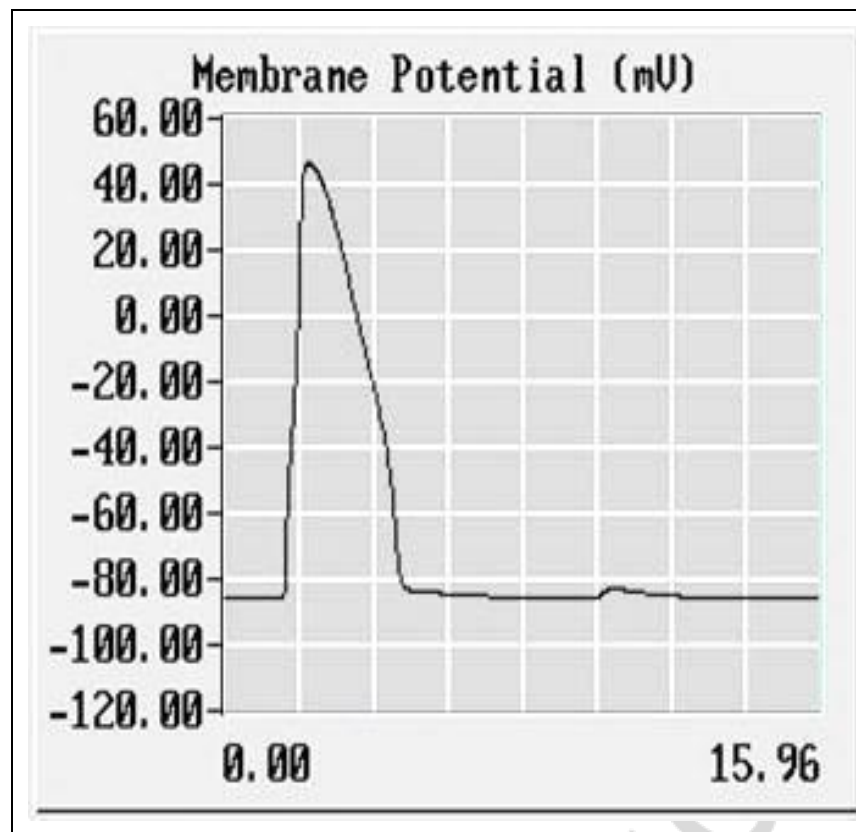
Influence of Na^+ and K^+ on the resting membrane potential and action potential

Student independently loads the programme NMJ, which virtually simulates the operation of an isolated nerve-muscle preparation, placed in a saline solution (fig. 4.5) during its electrostimulation. Figure 4.6 shows the result of the value of RP (arrow 1), in conditions of optimum ion concentration in physiological solution (saline) (arrow 2), as well as in figure 4.6 having two graphs of AP during electrical stimulation of muscle by single exposure to the electric current amplitude of 2 mA for 1 ms (fig. 4.7). The programme allows you to simulate the change in the concentration of electrolytes (potassium and sodium) in solution with the help of the command Jons (fig. 4.8) and Concentration (fig. 4.9) and record the values of RP and AP (fig. 4.10).



Influence of Na^+ and K^+ on the resting membrane potential and action potential (continuation)

Protocol. With colored pencils sketch a drawing of RP and AP in a condition of changing concentrations of potassium and sodium ions.



PROTOCOL

Example color	Concentration of ions		Values of	
	Potassium	Sodium	Resting potential	Action potential
Black	5 mmol	120 mmol	-85.9 mV	+45 mV
Green	8 mmol	120 mmol		
Yellow	2 mmol	120 mmol		
Red	5 mmol	160 mmol		
Blue	5 mmol	100 mmol		

Conclusion: The concentration of potassium ions determines to a greater extent the potential value _____, while the concentration of sodium ions to a greater extent determines the potential value _____.

**GENERAL PLAN OF THE MACRO- AND MICROSCOPIC
STRUCTURE OF THE NERVOUS TISSUE. STRUCTURE
AND FUNCTION OF PERIPHERAL NERVE, CONDUCTION
OF EXCITATION ALONG THE NERVE. SYNAPSES: STRUCTURE,
TYPES, FUNCTIONS, SYNAPTIC TRANSMISSION**

Lesson 5

Date: _____ 20____

Questions to lesson preparation: 1. General plan of structure of the nervous system: the concept of central and peripheral parts of somatic and autonomic divisions. 2. The neural theory. Neuron— structural and functional unit of the nervous tissue: types, classification, structure. The variety of neuron functions. 3. Glial cells: types, structure, functions. 4. The concept of hematoliquor and blood-brain barrier. 5. Nerve fibers: structure, types, classification, function. Axonal transport of substances. The concept of nerve regeneration. 6. The mechanism of excitation in myelinated and unmyelinated nerve fibers. The laws of conduction of excitation in nerve fibers. The idea of the principles of pharmacological regulation of excitation along a nerve (conduction block) 7. Synapse. Classification of synapses. The ultrastructure of synapses. The properties of synapses. 8. The mechanism of synaptic transmission of information in electrical synapse. 9. The mechanism of transmission of information in a chemical synapse. Mediators: mechanisms of exocytosis, action on the postsynaptic membrane, inactivation. 10. Mechanisms of EPSP and IPSP. 11. The concept of pharmacological regulation of synaptic transmission.	LITERATURE <i>Main</i> 1. Lecture material of the department of normal physiology. 2. <i>Physiology</i> : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
--	---

Work 5.1

Basic terms and concepts

Nervous tissue — is	Two major types of cell of the nervous tissue and their number 1. _____; 2. _____
BBB — is Hematoliquor barrier — is	Excitable cells of the nervous tissue — is
Two major divisions of the nervous system: on the basis of localization 1. _____; 2. _____	Main tenets of neural theory: 1) _____; 2) _____; 3) _____; 4) _____
Two major divisions of the nervous system: on the basis of function 1. _____; 2. _____	Structure-functional unit of the nervous tissue — is
Acetylcholine → N-cholinoreceptor → _____ (hyperpolarization or depolarization) → _____ (EPSP or IPSP).	GABA → GABA receptor → _____ (hyper polarization and depolarization) → _____ (EPSP or IPSP).
Myelin —	IPSP — is
Synapse —	EPSP — is

Study computer programme “Lesson 5”

Work 5.2

(Internet Explorer → Pharm programme → Study programme → Lesson 5)

Work progress. Student independently loads the programme “Lesson 5” and examines the course material in detail.

Control computer programme “Pharm Faculty Lesson 5”

Work 5.3

(Testing → Tests for independent control → Pharm Faculty Lesson 5)

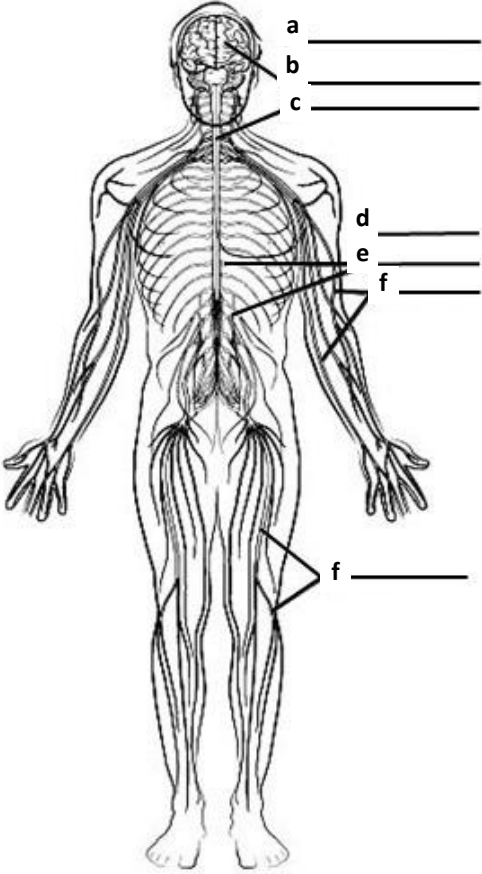
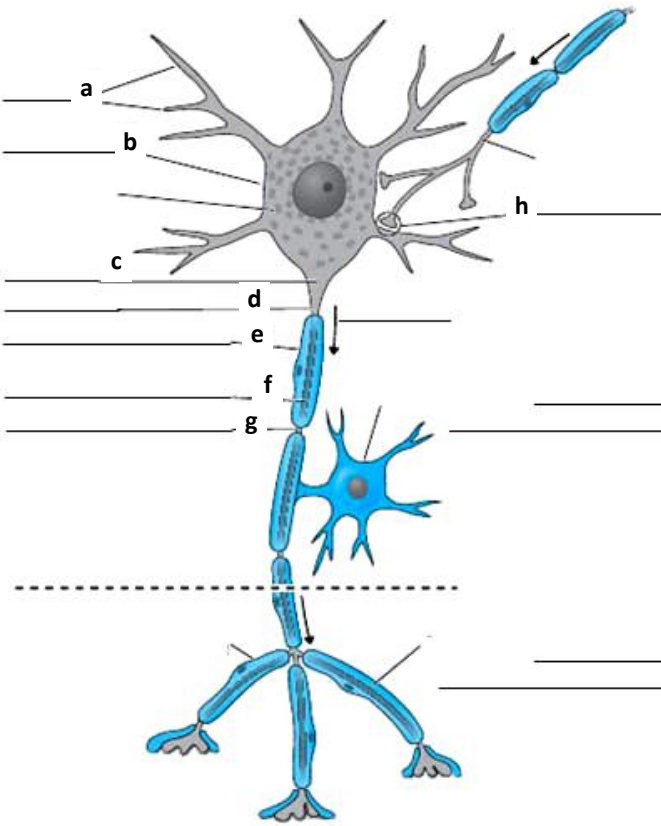
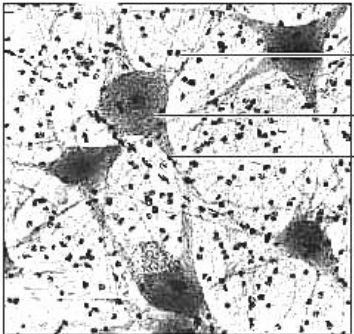
Work progress. Student independently loads the programme “Lesson 5” and answers the questions.

PROTOCOL

1. Score on testing _____. 2. Score on lesson _____.

**General plan of structure of the nervous system (fig. 5.1), the neuron (fig. 5.2).
Structure of neuron and glia under a microscope (fig. 5.3) [19]**

Write down the names of the structures of the nervous system (fig. 5.1) and neuron (fig. 5.2) and specify their functions.

 <i>Figure 5.1</i>	 <i>Figure 5.2</i>	Neuron (A) and neuroglia (B) under microscope (×400 times) [18] Neuron type (A) and glial (B) under a microscope (×400 times) [18]  A  B <i>Figure 5.3</i>
a — central nervous system, b — brain, c — spinal cord, d — peripheral nervous system, e, f — peripheral nerves and ganglia	a — dendrites, b — body of the neuron, c — axonal hillock, d — initial segment of the axon, e — myelin sheath, f — axon, g — nodes of Ranvier, h — synapse	Write down the functions of astrocyte: 1) _____; 2) _____; 3) _____; 4) _____

The structure of the nerve cell. Types of neurons

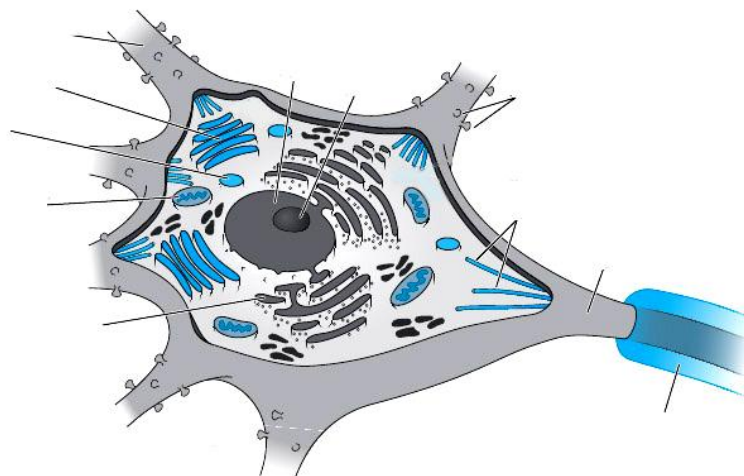


Figure 5.4. Structure of the body of neural cell

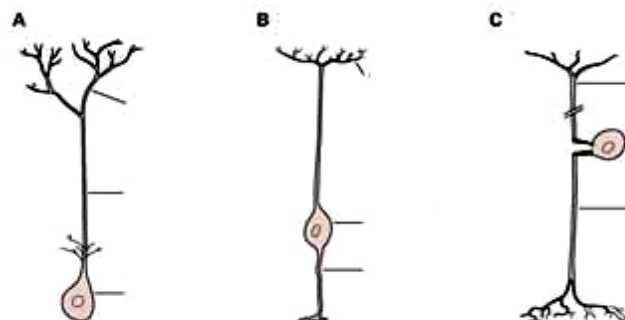
Name the three main parts of the neuron:

- a) _____; b) _____;
c) _____

What are the basic properties of neurons (based on the data presented in figure 5.4)

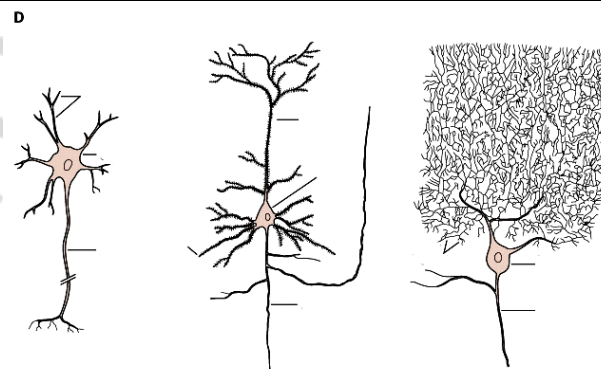
- 1)
- 2)
- 3)

Mono- and bipolar neuron



A

The main type of neurons based on the number of processes



B

In figure 5.5, B indicate excitatory and inhibitory neurons, and neurons that are located entirely in the central nervous system, neurons whose axons are involved in the formation of the peripheral nervous system.

Figure 5.5. Basic types (A) and subtypes (B) of neurons depending on their structure and the number of processes

--	--	--

Axonal transport. Glia cells

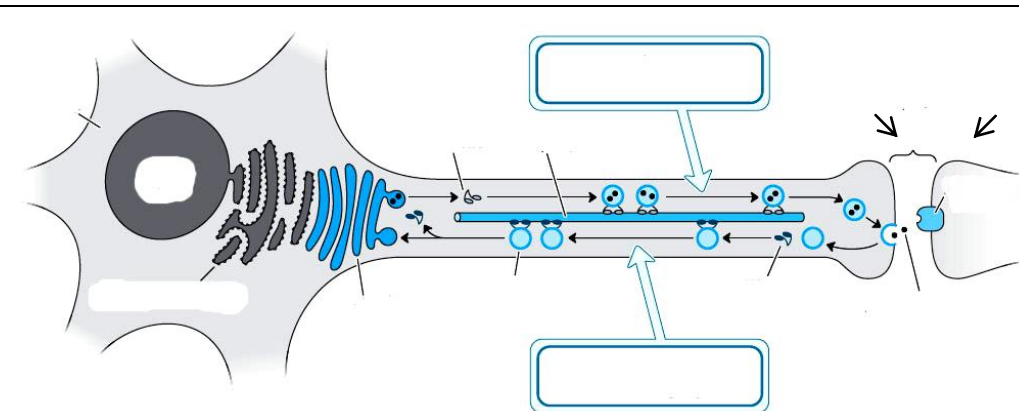


Figure 5.6. Scheme of fast axonal transport of substances

Enter the name of the two types of fast transport of substances along the axon.

Types of axonal transport of substances (based on speed)

_____ transport	_____ transport
speed _____ cm per day	speed _____ cm per day
Ensures movement:	Ensures movement:

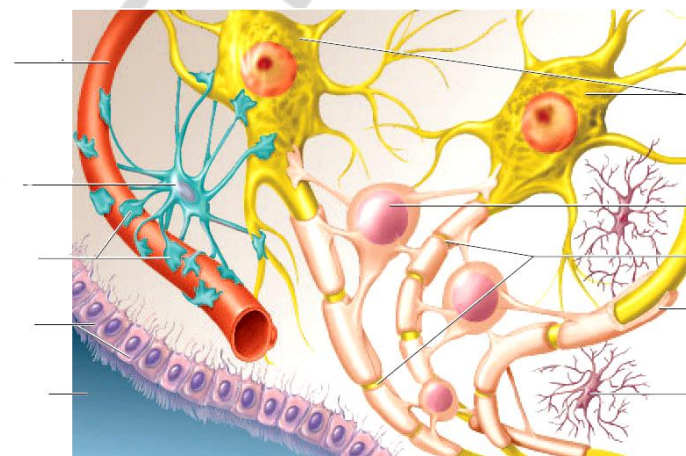


Figure 5.7. Types of gliocytes and their functions

Astrocytes provide:

- 1)
- 2)
- 3)
- 4)

Oligodendrocyte provide:

- 1)
- 2)

Microglial cells provide:

Ependymal cells are involved in the formation of CSF (Cerebrospinal fluid). The volume of CSF _____ ml, daily production _____ ml per day, the proportion by weight _____ g / l, cell count _____ cells / ml.

Synapses: classification, structure, mechanism of functioning

Scheme of classification of synapses					
Synapse					
on the basis of location					
between cells					
by the mechanism of transmission of information					
on the basis of mediator					
by action on target cells					

Figure 5.8. Structure of synapse

Sketch a diagram of the neuromuscular synapse. Specify the presynaptic membrane, postsynaptic membrane (end plate), the synaptic cleft, neuromediator, the receptor of the postsynaptic membrane, where the potential of end plate (EPSP) is formed, where the AP on the membrane of skeletal muscle is formed.

Draw a diagram of neuro-neuronal synapse. Specify the presynaptic membrane, postsynaptic membrane, synaptic cleft, neurotransmitters, receptors of the postsynaptic membrane, where the EPSP and IPSP are formed, where AP on the membrane of the neuron is formed.

**GENERAL PLAN OF THE STRUCTURE OF CNS.
THE REFLEX THEORY. NERVE CENTERS: THEIR PROPERTIES,
PRINCIPLES OF FUNCTIONING. EXCITATION AND INHIBITION
IN THE CENTRAL NERVOUS SYSTEM, THEIR MEDIATOR
MECHANISMS**

Lesson 6

Date: _____ 20____

Questions for lesson preparation: 1. General plan of structure of the central nervous system: topography, main parts, gray and white matter. 2. Meninges and their functions. 3. The brain ventricles, and their relationship with each other and with the cavity of the spinal canal. 4. Liquor (cerebrospinal fluid, CSF): formation, circulation, outflow, volume, composition, functions. The concept of lumbar puncture and its importance for diagnostics. 5. Reflex. Types of reflexes. Analysis of the reflex arc: the sensor (receptor), afferent, central, efferent part, target organs. The idea of the efferent part of autonomic and somatic reflexes. The concept of reverse afferentation and its importance. 6. The nerve centers. The physiological properties of the nerve centers: fast fatigue, unilateral conduction of excitation, summation of excitation, low lability, transformation of rhythm of excitation, high sensitivity to lack of oxygen and chemicals (strychnine, amphetamine, caffeine, alcohol). 7. The basic principles of coordination of the nerve centers: the principle of reciprocity, convergence, common final path, feedback, dominant, switching and induction. 8. Central inhibition: types, mechanisms, importance. 9. The concept of the neurotransmitter systems of the brain.	LITERATURE <i>Main</i> 1. Lecture material of the department of normal physiology. 2. <i>Physiology</i> : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
--	--

Basic concepts and terms

Central nervous system consists of two main structures: 1) _____, 2) _____	Reverse afferentation (feedback) is
Reflex — is	The principle of “common terminal path” is
All structures of CNS are _____ organs.	Central inhibition is
CNS structures have a good mechanical protection and located in 1) _____ 2) _____	Primary inhibition is
There are five parts or elements in the structure of reflex: 1 — 4 — 2 — 5 — 3 —	Secondary inhibition is
Nerve center— is	Main inhibitory mediators (full names) —
Unilateral spread of excitation in the central nervous system entails	Efferent neurons of somatic reflexes are: 1) 2)
Properties of nerve centers:	

Study computer programme “Lesson 6”

Work 6.2

(Internet Explorer → Pharm programme → Study programme → Lesson 6)

Work progress. Student independently loads the programme “Lesson 6” and examines the course material in detail.

Control computer programme “Pharm Faculty Lesson 6”

Work 6.3

(Testing → Tests for independent control → Pharm Faculty Lesson 6)

Work progress. Student independently loads the programme “Lesson 6” and answers the questions.

PROTOCOL

1. Score on testing _____. 2. Score on lesson _____.

Visit to the museum of the Department of Normal Anatomy of BSMU.

Work 6.4

Scheme of two-neuronal (monosynaptic) reflex arc and three-neuronal (polysynaptic) reflex arc

Work progress. The work is carried out by students on their own in preparation for the lesson and verified during the lesson.

Instruction on the completion of protocol:

Enter the names of the parts of the reflex arc next to the numbers in Figure 6.1

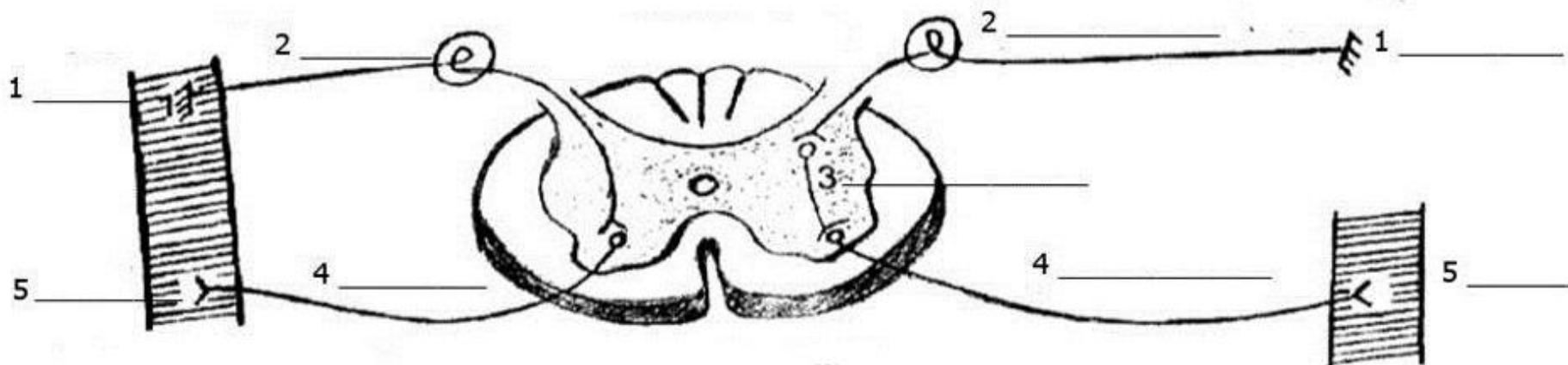
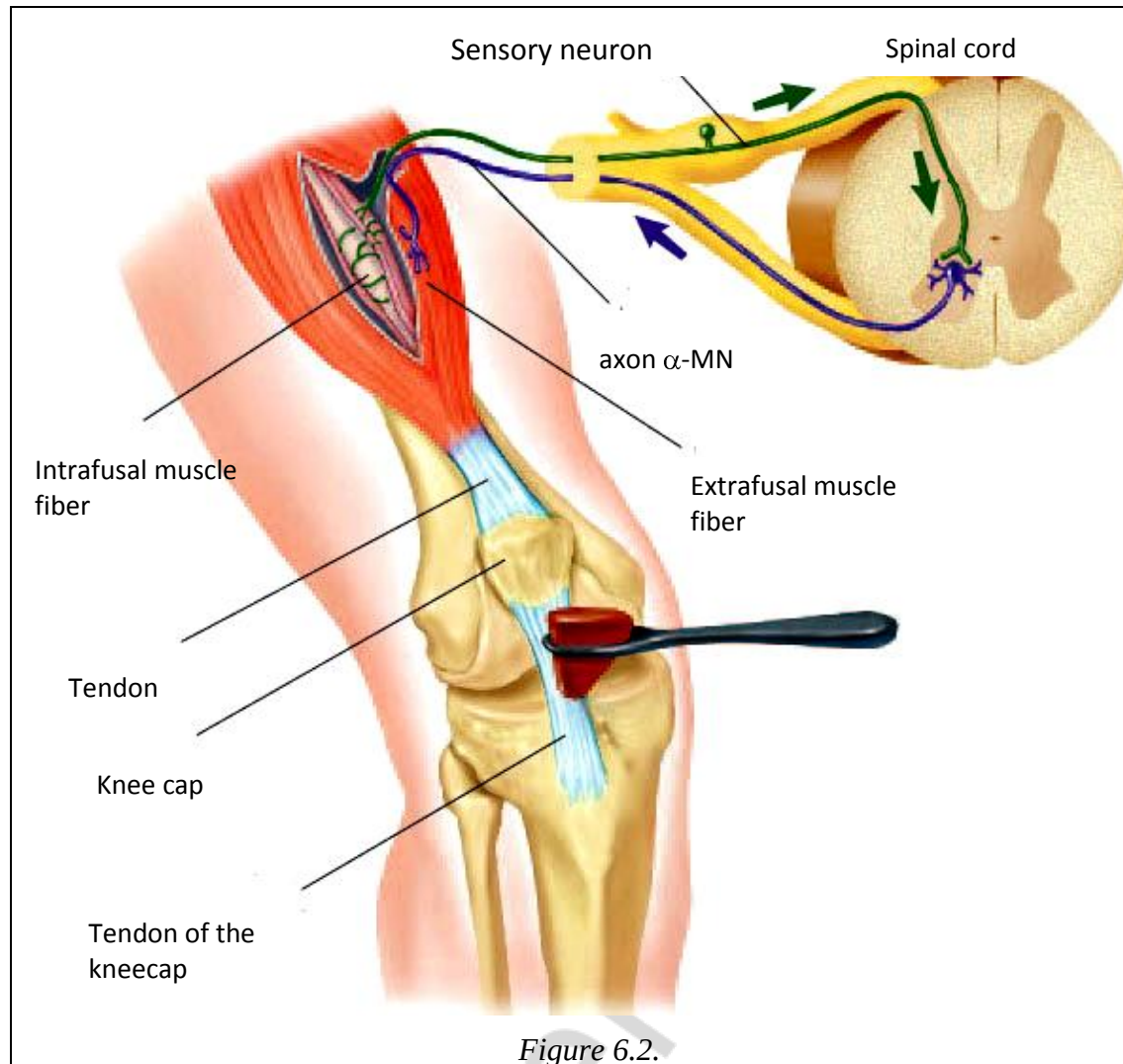


Figure 6.1. Scheme of reflex arc of somatic spinal reflexes

Investigation of the knee (tendon) reflex in humans [18]



Tendon reflexes are basic unconditioned reflexes carried out by severely deterministic programme, and have a clearly defined structural framework, confined to the level of individual segments of the spinal cord (e. g., lumbar L2–L4 for a knee-jerk) or nuclei of certain cranial nerves. They are of local importance, caused by local irritation of receptors of the body segment and manifested in the form of local segmental contraction of striated muscle. The study of tendon reflexes are widely used in clinical practice (especially in neurology) to assess the functional status of various parts of the reflex arc and topical diagnosis of lesions of the nervous system in a number of diseases and / or injuries.

Materials and equipment: neurological hammer.

α MN — alpha motoneuron

Work progress. The participant been examined is asked to sit on a chair, put the foot on his knee of the other leg bent at the knee, and relax the muscles of the legs. Then apply a neurological hammer on 1–2 cm below the patella of the dangling legs, i. e. on the tendon of the quadriceps femoris. Watch the nature of reflex reaction (extension) in the leg joint. Compare reflex reaction on both legs. In a healthy person in normal, reflex reaction of the same (symmetric) are expressed on both extremities.

Instructions to the completion of the protocol:

1. Specify the presence or absence of knee-jerk reaction in the subject and their symmetricity on both feet.
2. Draw a diagram of the reflex arc of knee-jerk and specify the level of completion of the reflex arc in the spinal cord, as well as a place of localization of receptors (the receptor level), which triggers a reflex.

PROTOCOL

1. In the participant, patellar reflex in _____ (expressed or absent) on _____ (one or both) knee-jerk test.
2. Scheme of the reflex arc of knee-jerk in humans.
3. Spinal cord (segments _____)

<i>Figure 6.3. Scheme of somatic monosynaptic patellar reflex</i> posterior horns anterior horn	The links of the reflex arc: 1) _____; Specify the localization and name of the receptors 2) _____; List the names and type of neuron 3) absent 4) _____; List the name and level of the spinal cord segments 5) _____; Specify the type of muscle tissue.
--	--

The study of reciprocal inhibition of motor responses by electromyography

Electromyography (EMG) — is a method of skeletal muscle function study that records their electrical activity. Considering that the muscle functioning depends on its muscle innervation and its functional unit is a neuromotor, the EMG is used not only to study the status of skeletal muscles, but also for the study of peripheral nerves and the central nervous system, including for analyzing relationships of motor centers of antagonist muscles. These relationships of antagonistic muscles may be minimal (at rest), antagonistic (in flexion and extension of arms) or synergistic exertion.

Materials and equipment: surface silver electrodes (6 pcs.), electrically conductive paste, 70 % ethanol, cotton-gauze pads, rubber clamps (2 pcs.), a set of loads from 0.5 to 3 kg, bioamplifier (UBP4-03), recorder (N388), oscillographic indicator (MI-789) and the myographic analyzer (AMG-01)

Instructions on completion of the protocol:

1. Draw the EMG recorded under the above conditions.
2. On the basis of clinical (visual) EMG analysis, draw conclusions about the state of activity (minimum, maximum, antagonistic, synergistically-active) of the motor centers, innervating the biceps and triceps muscles, and their relationships in a variety of conditions.

Procedure of work. The subject on standing position, fix the bipolar electrodes on the skin of the biceps and triceps muscles of the right hand shoulder. The common electrode is applied to the skin of the shoulder not far from the point of registration of EMG. Initially the point of placement of electrode on the skin is degreased with alcohol, the electrodes are smeared with paste, and then EMG is recorded and analyzed in different functional states: rest; flexion of arm at the elbow; extension of arms; synergistic exertion of the shoulder muscles (arm extended parallel to the ground, fingers clenched into a fist).

PROTOCOL

1. Registration of EMG in different conditions:

Registration of EMG from the	at rest	flexure of hand	extension of the hand	synergistic exertion
Biceps				
Triceps				

2. Conclusion. The activity of motor centers, innervating the biceps and triceps in a condition of rest _____; in flexion and extension of the arm at the elbow _____; synergistic exertion _____ shoulder muscles.

Comparison of excitatory and inhibitory synapses (table 6.1)

Choose from the proposed factors of the first column, matching the location, neurotransmitters, receptors and mechanism

Table 6.1

	Excitatory synapses	Inhibitory synapses
1. Localization of synapses: neuromuscular neuro-glandular neuro-neural		
2. Neurotransmitters and their receptors: Ach Nch receptor (acetylcholine and nicotine sensitive receptor) Ach Mchr (acetylcholine and muscarine sensitive receptor) NA α - and β -AR (norepinephrine and alpha- or beta-adrenoceptor) GABA — GABA receptor		
3. The following occurs at the postsynaptic membrane: IPSP EPSP depolarization hyperpolarization		
4. The mechanism of postsynaptic potential $\uparrow$ Na $\uparrow$ K $\uparrow$ Cl		

The idea of efferent part of somatic and autonomic reflexes

Figure 6.4. Efferent part of somatic and autonomic reflexes

- Enter the name of reflexes (under the numbers 1, 2, 3), to which the efferent portion shown in the figure. 6.5 belong.
- Specify the location of neuron A, B, C and neuron D, E.

Table 6.2
Сравнение эфферентных частей соматического и вегетативного рефлексов и их органов-мишеней Compare efferent parts of the somatic and autonomic reflexes and their target organs Compare efferent parts of the somatic and autonomic reflexes and their target organs

Index	Somatic reflex	Autonomic reflex
Efferent neuron is located		
Target organ (muscle)		
The number of neurons in afferent pathways		
Neurotransmitter in neuroeffector synapse (connection)		
Neurotransmitter receptors present in the target cell		
The response of a target cell (potential of end plate, excitation, IPSP, EPSP, inhibition)		

MUSCLE TISSUE: TYPES, MACRO- AND MICROSCOPIC STRUCTURE. STRIATED MUSCLE TISSUE: MORPHOLOGICAL AND FUNCTIONAL CHARACTERISTICS, MECHANISMS OF REGULATION. SKELETAL MUSCLE: TYPES, FUNCTIONS. THE MECHANISM OF CONTRACTION AND RELAXATION OF SINGLE MUSCLE FIBERS AND MUSCLE. SMOOTH MUSCLE: LOCALIZATION, STRUCTURE, REGULATION MECHANISMS

Lesson 7

Date: _____ 20____

Questions for lesson preparation:

1. Muscle tissue: types, structure, comparative characteristics.
2. Skeletal muscle. Classification of muscles. Muscle as an organ. Auxiliary apparatus of muscle.
3. The main functional groups of muscles of the human body: muscles of the head, neck, back, chest, abdomen (diaphragm), muscles of the shoulder girdle and upper limb, muscles of the pelvic girdle and lower limb.
4. The mechanism of contraction and relaxation of single muscle fibers and muscle.
5. Types and modes of skeletal muscle contraction. Work and fatigue of muscle.
6. Smooth muscle tissue. Features of the structure and functions.
7. The concept of myoepithelial cells.
8. Features of control of the work of skeletal and smooth muscle, myoepithelial cells
9. The value of physical activity for health.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Study computer programme “Lesson 7”

Work 7.1

(Internet Explorer → Pharm programme → Study programme → Lesson 7)

Work progress. Student independently loads the programme “Lesson 7” and examines the course material in detail.

Control computer programme “Pharm Faculty Lesson 7”

Work 7.2

(Testing → Tests for independent control → Pharm Faculty Lesson 7)

Work progress. Student independently loads the programme “Lesson 7” and answers the questions.

PROTOCOL

1. Score on testing _____.
2. Score on lesson _____.

Basic concepts and terms

Muscle tissue — is	Respiratory function of skeletal muscle is provided by the following muscles: 1) 2)
Examples of skeletal muscle functions: 1) 3) 2) 4)	Types of movement provided by the contraction of skeletal muscle: 1) 3) 2) 4)
The main function of the heart muscle —	The main factor that provides interfacing electrical (chemical) and mechanical processes in muscle tissue —
Examples of smooth muscle functions:	Smooth muscle — is
Examples of myoepithelial cell functions:	Three energy source for muscle work: 1) 2) 3)
What are the general properties of muscle tissue: 1) 2) 3)	Control of the work of skeletal muscle carried out
Skeletal muscle — is	Control of the work of smooth muscles and myoepithelial cells carried out by _____ nervous system, as well as _____ system and their ability to _____

Muscle tissue: types, structure, comparative characteristics

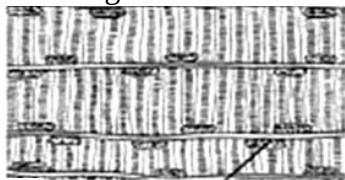
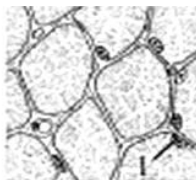
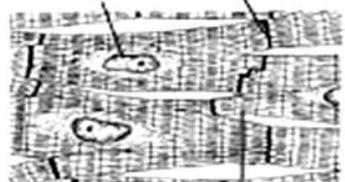
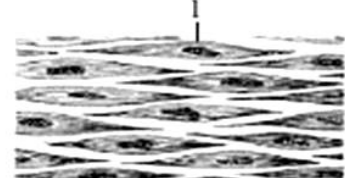
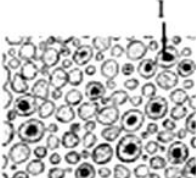
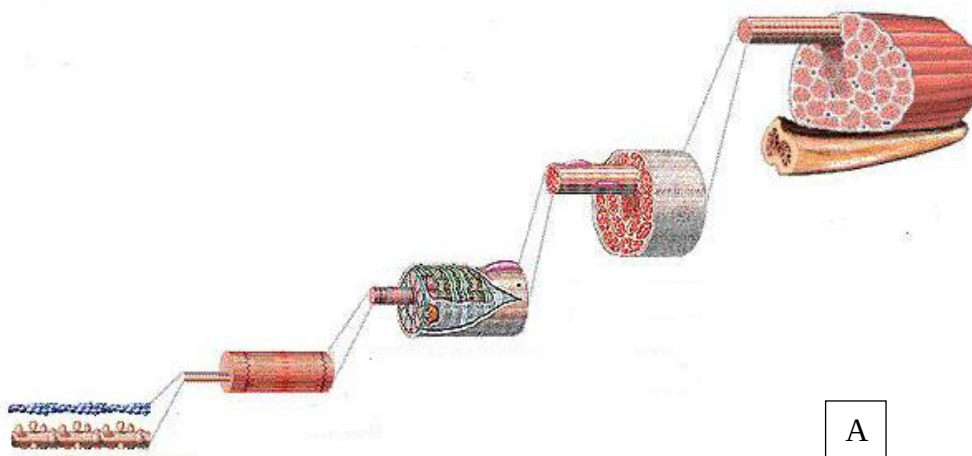
Enter the name of each type of muscle tissue.		
Longitudinal sections	Transverse sections	
		
A		
		
B		
		
C		
Figure 7.1. Longitudinal and transverse cross sections of different types of muscle tissue: 1 — nucleus; 2 — intercalated disk; 3 — anastomosis		
Morphofunctional clarification of muscle tissue <pre>graph TD A[Morphofunctional clarification of muscle tissue] --> B[Striated] A --> C[Smooth muscle] B --> D[Skeletal] B --> E[Cardiac] C --> F[Multiunit] C --> G[Unitary]</pre>		

Table 7.1		
Parameter for comparison	Skeletal muscle	Smooth muscle
Number of nuclei in the cell		
Striations		
Location of nuclei in the cell		
Size of neuclus		
Functional syncytia		
Plasticity		
Changes in cell activity after denervation		
Excitability		
Conductivity		
Contractility		
Phenomenon of automaticity		
Subordination of consciousness		
Contractile function is controlled		
Change of activity of cells after binding of the ligand (neurotransmitter and/or hormone) to the receptor		
Neurotransmitters at synapses and their receptor types on the muscle cell sarcolemma		
Initial readiness of myosin to interact with actin		
Initial readiness of actin to interact with myosin heads		
ATPase activity of myosin		
Contraction		
Sources and pathways of calcium entrance into the sarcoplasm		
Mechanism of action of Ca ²⁺		
Pathways of removal of Ca ²⁺ from the sarcoplasm		

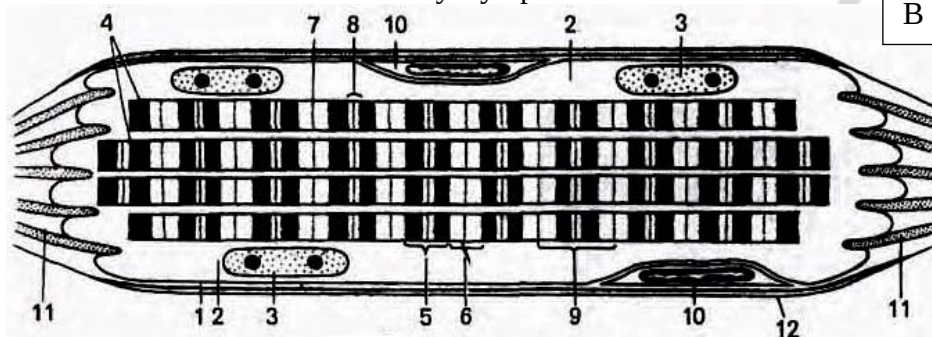
Striated (skeletal) muscle tissue

Figure 7.2. Levels of organization of skeletal muscle (A), structure of striated muscular fibers (myosymplast) (B)



A

Enter the name of structures of myosymplast.



B

1 — plasmalemma; 2 — sarcoplasm; 3 — nucleus of myosymplast; 4 — myofibrils; 5 — anisotropic disc (band A); 6 — isotropic disc (band I); 7 — telofragme (band H), in the middle of which passes mesophragme (line M); 9 — sarcomere; 10 — myosatellitocyte; 11 — tendon fibers; 12 — basement membrane.

Enter the name of the muscle in figure 7.3.



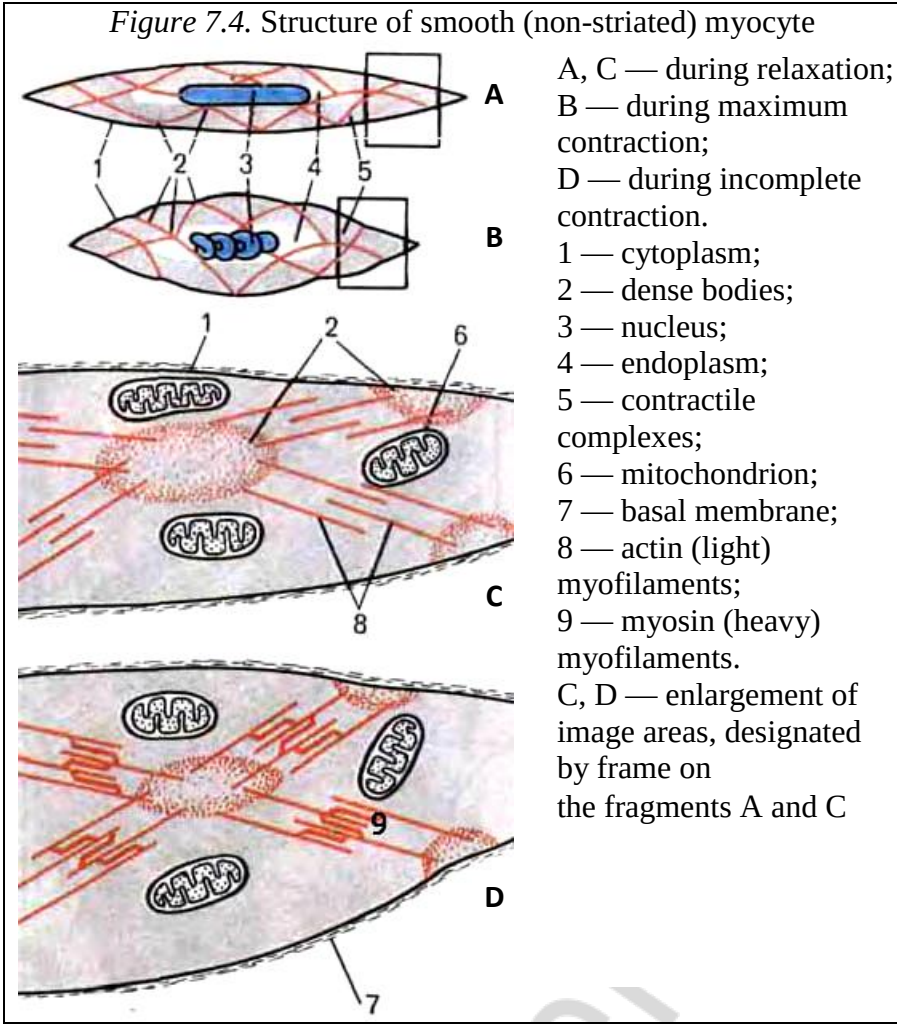
A



B

Figure 7.3. Muscles of body

Smooth (non-striated) muscle tissue



Write down the name of each type of smooth muscle (A, B).

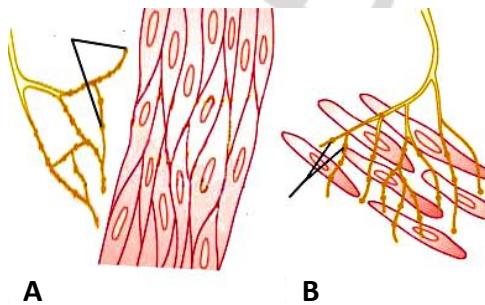


Figure 7.5. Two type of smooth muscle and feature of their innervation

Located in internal organs, blood vessels, possess automaticity, form functional syncytia.

Located in the iris of the eye, duct, hair follicles, well innervated, does not possess automaticity.

Mechanism of contraction of smooth muscle cell, their regulating factors

Factors that cause contraction of smooth muscle cell:

- 1.
- 2.
- 3.
- 4.
- 5.

Mechanism of contraction of smooth muscle cell:

Mechanism of relaxation of smooth muscle cell:

Electromyography

Electromyography (EMG) — method of study of the functions of skeletal muscle that record the electrical activity (biocurrents).

Lead of muscle biopotentials is carried out by using surface (skin, overhead) or needle (injected) electrodes. The advantage of the total EMG — non-invasive research and, as a rule, the absence of electrical stimulation of muscles and nerves. This method allows us to investigate the nature of biocurrents of muscle at rest and during voluntary contraction, which ensured its widespread use in physiological and clinical practice. Electromyogramme is a result of interference of multiple of action potentials occurring asynchronously in different motor units. At present, a quantitative analysis of the EMG is performed using special instruments that allow to measure the oscillation frequency, spectral analysis and conduct an assessment of the total and the average impulse amplitude. One common way to analyze muscle biocurrents is their integration, i.e. the sum of all amplitudes per unit time. When dividing the total amplitude by the number of impulses, their average amplitude is calculated. This parameter is proportional to the force developed by the muscle. At rest, low-amplitude EMG (5–10 mcV) is recorded, which is associated with the redistribution of muscle tone while maintaining posture. For weak contraction and tension of muscle, there is observed increase in electrical activity, which reaches a maximum at an arbitrary force (amplitude of biocurrents may increase up to 3000 mV at a frequency up to 100 Hz).

Materials and equipment: surface silver electrodes (6 pcs.), electrically conductive paste, 70 % ethanol, cotton-gauze pads, rubber clamps (2 pcs.), a set of loads from 0.5 to 3 kg, amplifier of biopotential (UBP4-03), writer (N388), oscillographic indicator (MI-789) and the myographic analyzer (AMG-01).

Work procedure. The subject on standing, fix the bipolar electrodes on the skin of the biceps muscle of his right hand. The common electrode is applied to the skin of the shoulder not far from the point of registration of EMG. Initially, the point of placement of electrodes on the skin is degreased with alcohol and lubricated with paste, and then recorded and analyzed using EMG in different functional states:

- a) rest: arms hanging freely down, the muscles are relaxed;
- b) flexion of arm at the elbow from the position “a”;
- c) extension of the hand from position “b”;
- d) fixation of the elbow: the hand is extended parallel to the ground, fingers clenched into a fist, and;
- e) fixation of the forearm in the horizontal position, arm bent at the elbow;
- f) increasing physical activity in the palm with 0.5 and 3 kg at the position “d”.

Electromyography (continued)**Instructions on the completion of the protocol:**

1. Draw EMG in different conditions (fig. 7.6).

2. Perform a clinical (visual) and statistical (quantitative) analysis of biocurrents of the biceps: average total density of biocurrents of the muscles (ΣA), average amplitude (A) of EMG oscillations:

$$\Sigma^A = (N - D) \cdot K, \text{ mV/s,}$$

where N — number of impulses of the integrator in the analysis of the EMG for 1 s in the set time;

D — number of impulses during closure of the amplifier at a specific time of 1 s _____;

K — calibration signal value equal to 500 mcV / s per impulse (0.5 V = 1000 impulses)

3. Evaluate the change of frequency and amplitude of EMG waves in the different experimental conditions. Make conclusion about the change of the electrical activity of the biceps under the experimental conditions.

PROTOCOL

Figure 7.6

1. EEG recording in a variety of conditions of the status of shoulder muscles:

EEG recording of the biceps	rest	flexion	extension	fixation

2. Conclusion: The electrical activity of the biceps muscle in experimental conditions (when arm is flexed at the elbow and, especially, with the additional muscle tension to hold the load) relative state of rest significantly _____ (increases or decreases), evidenced by _____ (increase or decrease) in the amplitude and EMG frequency waves.

Hand and Standing Dynamometry

Dynamometry — method of measuring the force of muscle contraction. Muscle strength — an important indicator of contractile capacity, as well as the physical development of the human body. It estimates the weight of loads, which the muscle is able to hold at the maximum excitation, without changing its length. Muscle strength depends on its physiological cross-section, original length, speed of contraction and other factors. The strength of muscle contraction is measured with dynamometers and is expressed in absolute terms (kilograms or N, and in kg/cm^2 of muscle cross-section (constituting from 2 to 10 kg/cm^2)) or in relative terms (relative to body weight, expressed in %). Dynamometry (especially hand-held) is widely used in medicine and physiology of labor and sports activities.

Materials and equipment: Hand dynamometer, standing dynamometer, lever weighing scale.

Work progress. Force of hands is determined by hand-held dynamometer (ANC-120 or other). Dynamometer is held in the hand, stretched parallel to the floor. A maximum compression dynamometer is produced by the hand. The measurement is carried out three times with each hand. Of the three measurements (for each hand) the highest is selected. Measure the mass of the participant (without shoes) on the weighing scale and subtract from it 1 kg (conditionally taken as the weight of clothes) to obtain body mass. Then calculated the relative strength (RS) of muscles of the right and the left hand using the formula: $\text{RS} = \frac{\text{arm strength (kg)}}{\text{body weight (kg)}} \times 100 (\%)$. Evaluation of the relative strength of muscles of hands is shown in table 4.1.

The force of the extensor muscles of the back are measured with standing dynamometer three times and choose the highest value of the index. Parameter of relative (standing) force of the extensors of the back is calculated by dividing the maximum value of the indicator of standing force postural force (in kg) by body weight of the participant (kg). Satisfactory indicator of relative postural strength is considered to be 2 for men and 1.5 for women.

Table 7.3

Parameters of relative force of hand in males and female

Sex	Level of the relative strength of muscles of hands (%)				
	low	below average	average	above average	high
males	less than 61	61–65	66–70	71–80	more than 80
females	less than 41	41–50	51–55	55–60	more than 60

Instructions on the completion of the protocol:

1. Specify the gender, body weight, and highest indicators of arm strength and extensor muscles of the back.
2. Calculate the parameters of relative muscle strength.
3. Make conclusion, assess the relative strength of the muscles of the participant
4. In the case of low and below average parameters of the relative strength of hands and / or poor parameter with respect to the tripod strength, explore methods of muscle strength in the book “Physical Culture” for students of higher educational institutions of the Republic of Belarus, edited by E. S. Grigorovich and V. A. Pereverzev (Minsk Executive wk, 2011).

PROTOCOL

1. The mass of the participant _____ (kg), sex ____ (m or f), strength of right hand _____ (kg), strength of the left hand _____ (kg), tripod strength _____ (kg).
2. The relative strength of the right hand _____ (%), left hand _____ (%), extensors of the back _____.
3. **Conclusion.** Level indicators of the relative strength of the right hand _____, _____ left hand (low, below average, average, above average, high). The indicator of the relative postural strength _____ (satisfactory, unsatisfactory).

**EPITHELIAL TISSUE: TYPES, STRUCTURAL FEATURES
AND FUNCTIONS. THE GLANDULAR EPITHELIUM, SECRETION.
GLANDS: TYPES, STRUCTURE, FUNCTION. SKIN: STRUCTURE,
FUNCTION**

Lesson 8

Date: _____ 20____

Questions for lesson preparation.

1. Epithelial tissue: types, structural features and functions. Basal and apical membranes of epithelial cells and their functions.
2. Surface epithelium: types, structure, functions.
3. Glandular epithelium. Glands of external and internal secretion.
4. The concept of secretion, its products: secreta, excreta, increta. Types of secrets: proteinous, mucous, mixed, sebaceous.
5. Cellular mechanisms of secretion: secretory cycle phase secretion, types of secretion (apo-, mero-, holocrine)
6. Skin: structure and function.
7. Derivatives of the skin, their functions.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Basic concepts and terms

Epithelial tissues — these are tissues, characterized	Glandular epithelium — this glandulocyte, whose main function is
	Types of secretions: a) _____; b) _____; c) _____; d) _____
The main types of epithelial tissues: 1) 2) 3)	There are two groups of glands: 1) _____; 2) _____
	Secretory cycle includes four phases: 1) _____ 2) _____ 3) _____ 4) _____
List morphofunctional properties of epithelia: a) _____ d) _____ b) _____ e) _____ c) _____ f) _____	Skin — is _____ organ, with a mass _____ % of body mass, comprising of three layers: a) _____; b) _____; c) _____
	Functions of skin: a) _____; b) _____; _____; c) _____; d) _____; e) _____; f) _____
List the derivatives of the skin: a) _____; b) _____; c) _____; d) _____; e) _____	

Study computer programme “Lesson 8”

(Internet Explorer → Pharm programme → Study programme → Lesson 8)

Work progress. Student independently loads the programme “Lesson 8” and examines the course material in detail.**Control computer programme “Pharm Faculty Lesson 8”**

(Testing → Tests for independent control → Pharm Faculty Lesson 8)

Work progress. Student independently loads the programme “Lesson 8” and answers the questions.**PROTOCOL**

1. Score on testing _____. 2. Score on lesson _____.

Localization of the different types of surface epithelia and their functions

Morphological classification of surface epithelium: examples of localization and function. Draw scheme.

	Localization	Functions

Figure 8.1

Types of epithelial tissues

Write down the names of epithelia in fig. 8.2, and give examples of their localization:

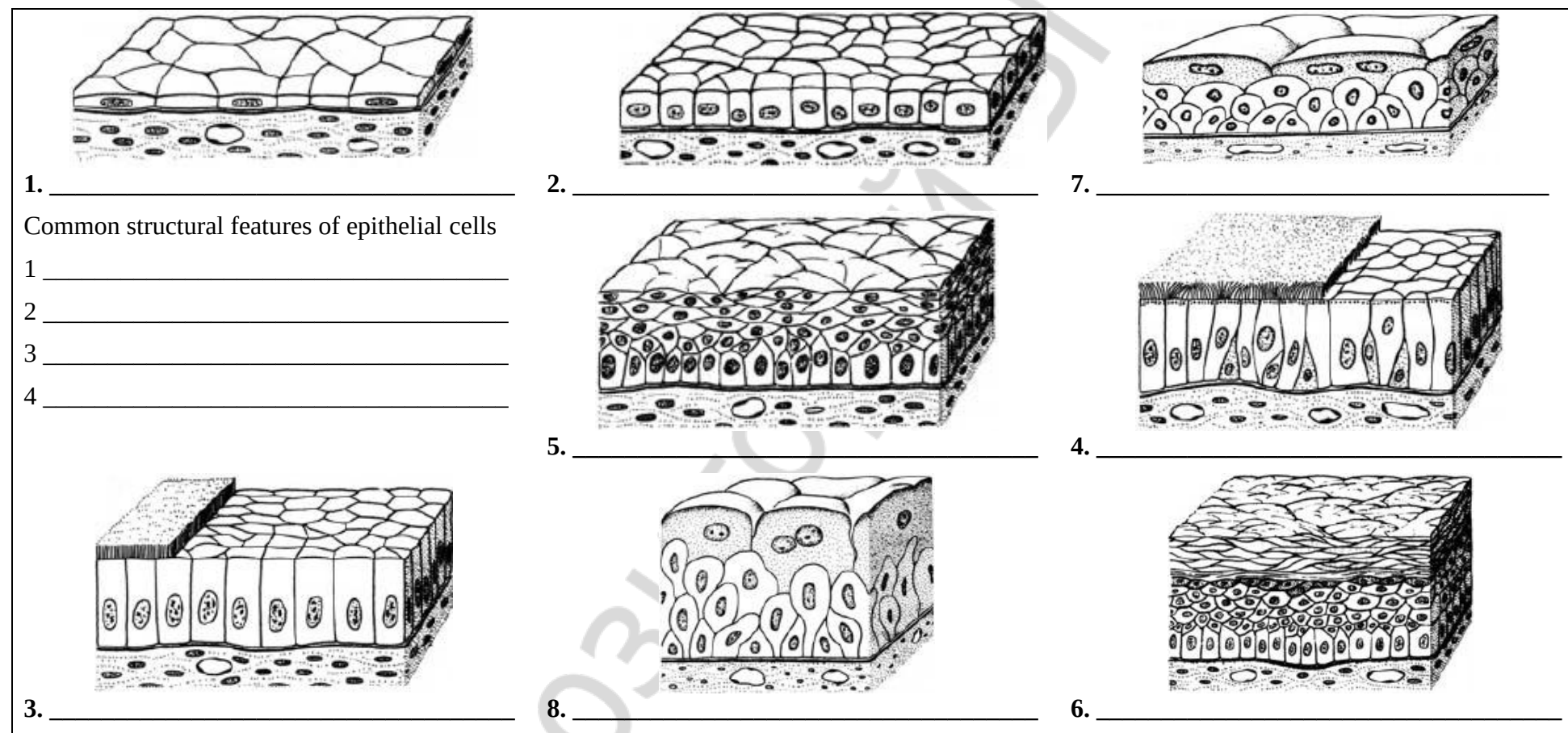


Figure 8.2. The structure of different types of covering epithelial tissue

Answers: 1 — stratified squamous, 2 — single-layered cubic, 3 — single-layer prismatic, 4 — simple pseudostratified prismatic, 5 — stratified squamous nonkeratinized, 6 — stratified squamous keratinized, 7, 8 — transition.

The structure of epithelial cells

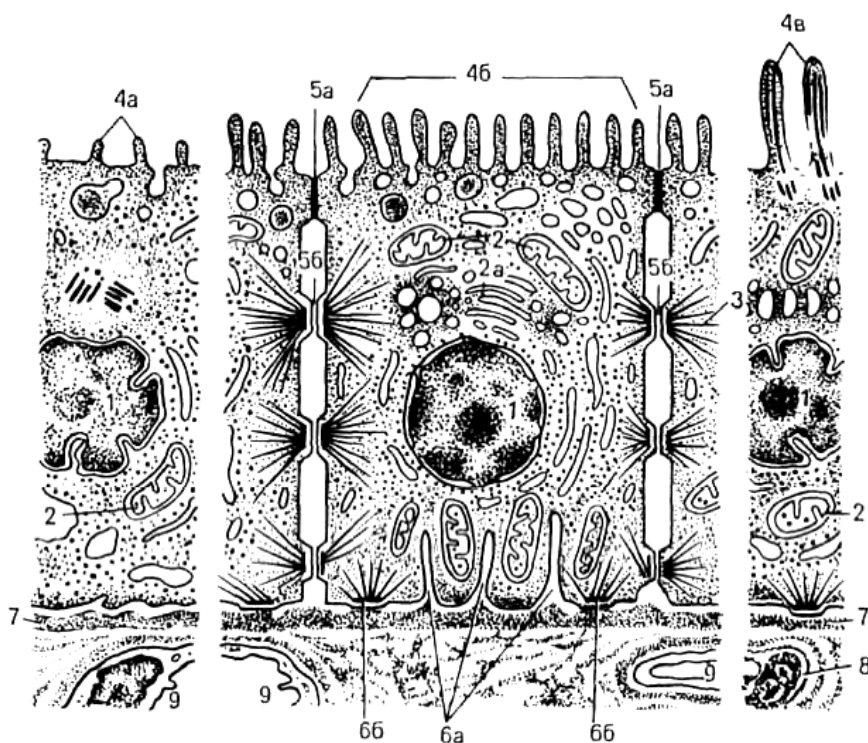


Figure 8.3. Structure of single layer epithelium (scheme according to E. F. Kotovsky)

In figure 8.3, specify the location of the basal and apical membranes and list their functions:

1. Function of the basal membrane:

2. Function of the apical membrane:

Give examples of the localization and function of single layer epithelial:

a) with microvilli _____

b) with brush border _____

B) with cilia _____

Features of the structure and function of the exocrine and endocrine glands

Gland _____

A B

- Specify the name of the glands in figure 8.4. and the features that allow you to make the right conclusion.
1. _____
2. _____
- The vessels are marked in red, gland — yellow. Iron is
- Classification of glands by composition of secretion.

Figure 8.4. Glands

Correctly complete table 8.1.

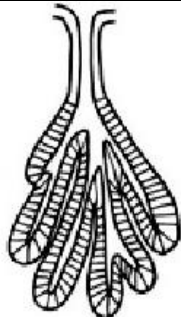
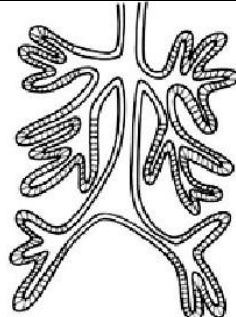
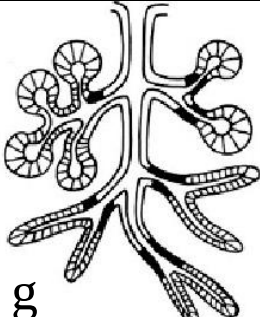
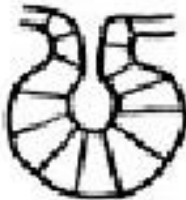
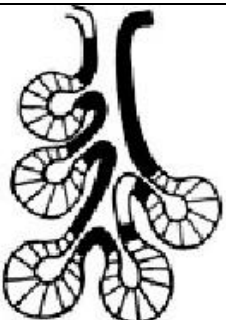
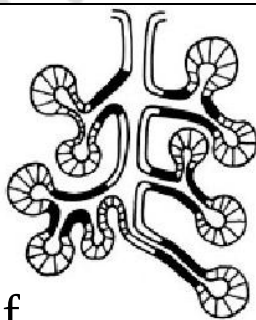
Comparative characteristics of exocrine and endocrine glands		
Parameter	exocrine glands	endocrine glands
Ducts (absent or present)		
Exit of secretion		
Example of secretions		
Functions		

Table 8.1

Classification of exocrine glands

Write down the full names of exocrine glands and give examples of their localization in the body, indicating the function of these glands.

Figure 8.5. The structure of different types of exocrine glands

 a	 b	 e	 g																											
 c	 d	 f	Principles of classification: <table><tr><td colspan="3">A) shape of the secretory region</td></tr><tr><td>1)</td><td>2)</td><td>3)</td></tr><tr><td></td><td></td><td></td></tr><tr><td colspan="3">B) branching secretory region</td></tr><tr><td>1)</td><td colspan="2">2)</td></tr><tr><td></td><td colspan="2" rowspan="2"></td></tr><tr><td colspan="3">C) branching of duct</td></tr><tr><td>1)</td><td colspan="2">2)</td></tr><tr><td></td><td colspan="2"></td></tr></table>	A) shape of the secretory region			1)	2)	3)				B) branching secretory region			1)	2)					C) branching of duct			1)	2)				
A) shape of the secretory region																														
1)	2)	3)																												
B) branching secretory region																														
1)	2)																													
C) branching of duct																														
1)	2)																													

Types of secretions

The glandular epithelium is specialized in secretory function. Substances synthesized by the secretory cells, enter the bloodstream (endocrine) or on the epithelial surface (exocrine), while the process of secretion itself is carried out cyclically (secretory conveyor). This cycle is divided into four phases:

- 1) absorption of the starting components from the blood;
- 2) synthesis of secretions from these components;
- 3) exit of secretion outside the cell;
- 4) restoration of its structure.

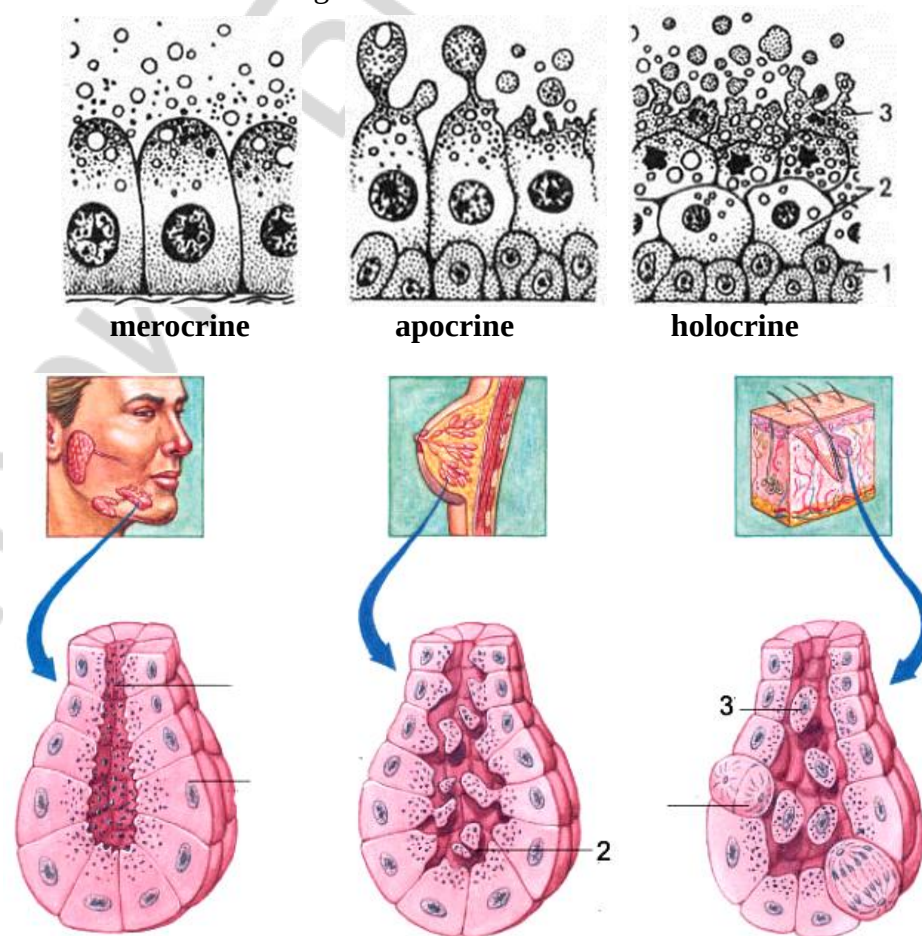
In the absorption phase, transport flows are activated, routed through the basal membrane from hemocapillary of the cell. In the synthesis phase, there is increased functional activity of the endoplasmic reticulum and the Golgi apparatus. Changes occurring in the cells in the exit phase depend on the secretion mechanism.

In merocrine type, secretory granules by acto-myosin complex moves to the cell membrane and are excreted outside the cell without destroying the cytolemma. This type of secretion is characterized for digestive glands, including part of the salivary glands.

In apocrine secretions (e. g., mammary and some sweat glands), apical part of the cell is destroyed in exit phase.

Holocrine type of secretion leads to the complete destruction of the glandular cells. The skin sebaceous glands function in a similar way. The remaining glands in the basal layer cambial elements ensure the restoration of destroyed population of glandulocytes.

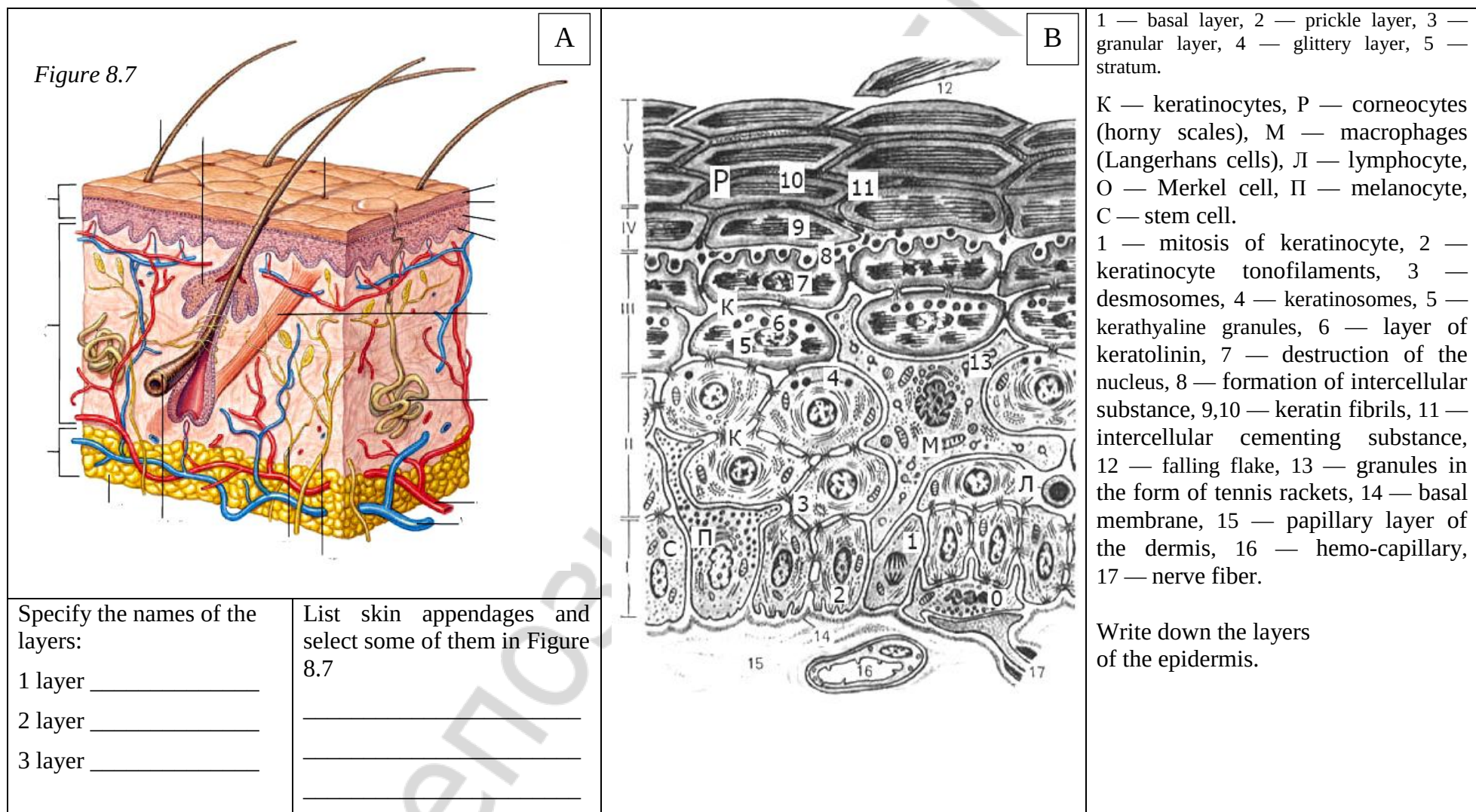
Figure 8.6. Scheme of types of secretion of glands with examples of exocrine glands and their functions



1 — low differentiated cell, 2 — evolving, 3 — cells being destroyed

Structure of the skin

Figure 8.7. Scheme of the structure of the skin as an organ (A) and its epidermal part (B)



Calculation of the area of skin by Turovsky and the body surface by nomogramme

The skin consists of three layers: the epidermis, dermis and subcutaneous tissue (hypodermis). Hair, nails, sebaceous and sweat glands are skin appendages. Knowing the body weight, breast volume and height of the individual, the area of his skin can be determined. Sometimes medication dose calculation is conducted on unit per body area (e. g., in oncohematology).

Formula for the calculation of area of skin:

1. Formula of Turovsky: 1 kg of adult weight accounts for 221 cm² of skin surface, whereas in adolescents — by 378 cm².
2. The nomogramme for the determination of the body surface area.

Instructions on the completion of the protocol.

Calculate the surface area of your body from the formulas and the nomogram.

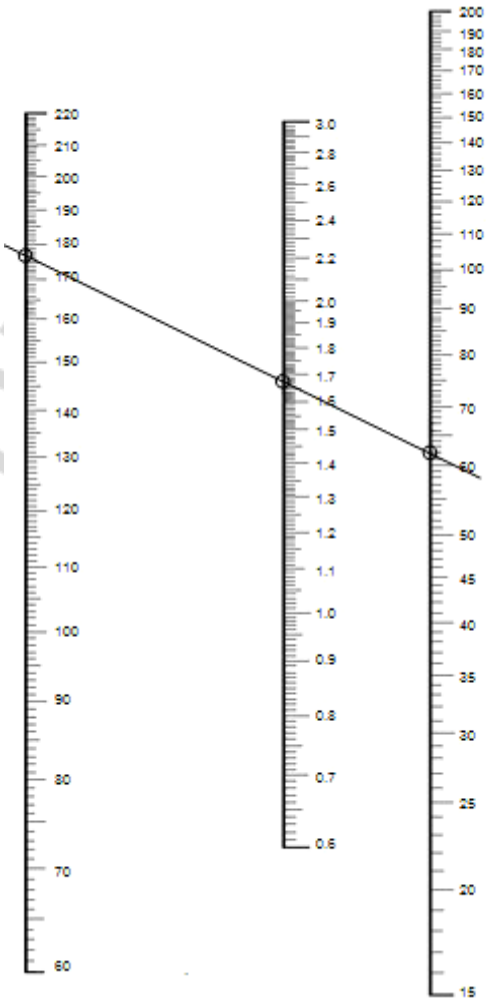
PROTOCOL

1. Calculation of skin surface area by Turovsky:

S of body in cm = body mass in kg × 221 cm² = _____ cm²

2. Calculate the body surface of the skin by normogramme:

S of body in cm² = _____ m²



Nomogramme — a graphical representation of the function of several variables (in this case, growth and body mass of the subject), which allows using simple geometrical operations (e. g., applying a ruler) to explore functional dependence without calculations.

**THE FINAL LESSON ON THE SECTION “GENERAL PHYSIOLOGY
WITH THE BASICS OF HUMAN MORPHOLOGY. GENERAL
PRINCIPLES OF REGULATION OF FUNCTIONS”**

Lesson 9

Date: _____ 20____

Questions for preparation to the final lesson:

1. Physiology and morphology as science: definition, basic concepts, the importance in the system of medical knowledge. The importance of knowledge in Physiology with the basics of morphology for doctor-pharmacist.
2. Stages of development of anatomy, physiology and histology (short history). The contribution of domestic scientists.
3. The concept of anatomical, physiological and histological methods of research. Safety precautions when working at the Department of Normal Physiology.
4. Leading patterns that characterize life (self-renewal, self-reproduction, self-regulation, metabolism)
5. The concept of somatic and autonomic functions. Levels of regulation: cellular, tissue, organ, organismal.
6. Mechanisms of regulation of functions: neural, humoral, myogenic. The interaction of neural and humoral mechanisms of regulation, their comparative characteristics and unity. Types of regulation functions.
7. The system principle of regulation of functions, concept of system (I. P. Pavlov). Functional system (P. K. Anokhin), principle of self-regulation
8. The concept of homeostasis and homeokinesis.
9. The general concept of tissues. The cellular elements and non-cellular substance. Classification of tissues.
10. Connective tissues: concept, types, functions.
11. Bone tissue: cellular composition and extracellular matrix, role of calcium and phosphate ions. Classification of bones.
12. Regulation of calcium and phosphorous homeostasis in the body. Age and individual requirements of calcium, phosphate and fluorine.
13. The concept of the human skeleton. Parts of the skeleton. The concept of the skeleton of the shoulder and pelvic girdle, the skeleton of the upper and lower extremities. Representation of the structure of the skull: bones, joints and basic openings.
14. The concept of the types and forms of bone. Types of joints, their structure, classification, functions.
15. Excitable cells: their types, properties. The concept of irritability, excitability and excitation, irritation thresholds, dependency of the response time on the strength and the stimulus, chronaxie, lability, adaptation and accommodation.
16. The laws of response of excitable cells to the action of stimuli. The concept of parabiosis (N. E. Vvedenskii).

17. Modern ideas about the nature of excitation. Bioelectrogenesis: resting potential, local response, action potential. Membrane-ionic theory of their occurrences.
18. Changes in membrane excitability in different phases of a single cycle of excitation. Refractory.
19. Reception: definition. Biological significance. Receptor: definition, structure, types. Morphological feature of cellular and sensory receptors, and their functions.
20. The concept of sensory receptors. General mechanisms of reception. Information coding in the receptors. The receptor and generator potential. Adaptation of receptors.
21. General plan of structure of the nervous system: concept of central and peripheral parts of the somatic and autonomic divisions.
22. The neural theory. Neuron – structural and functional unit of the nervous tissue: types, classification, structure. The variety of neuron functions.
23. Glial cells: types, structure, functions. The concept of hemoliquor and the blood-brain barriers.
24. Liquor (cerebrospinal fluid, CSF): formation, circulation, outflow, volume, composition, functions. The concept of lumbar puncture and its importance for diagnostics.
25. Nerve fibers: structure, types, classification, functions. Axonal transport of substances. The concept of nerve regeneration.
26. The mechanism of excitation in myelinated and unmyelinated nerve fibers. The laws of conduction of excitation in the nerve fibers. The idea of the principles of pharmacological regulation of excitation along the nerve (conduction block).
27. Synapse. Classification of synapses. The ultrastructure of synapses. Properties synapses.
28. The mechanism of synaptic transmission in the electric synapse.
29. Mechanism of transmission of information in a chemical synapse. Mediators: types; mechanisms of exocytosis, action on the postsynaptic membrane, inactivation. Mechanisms of EPSP and IPSP.
30. The concept of pharmacological regulation of synaptic transmission.
31. General plan of the structure of CNS: topography, main regions, gray and white matter.
32. Meninges and functions.
33. The ventricles of the brain, their relationship with each other and with the cavity of the spinocerebral canal.
34. Reflex. Types of reflexes. Analysis of the reflex arc: the sensor (receptor), afferent, central, efferent part of the target organs. The idea of the efferent part of autonomic and somatic reflexes. The concept of reverse afferentation its value.

35. Nerve centers. Physiological properties of the nerve centers: fatigue, unilateral conduction of excitation, summation of excitation, low lability, transformation of rhythm of excitation, high sensitivity to lack of oxygen and chemical substances.
36. The basic principles of coordination of nerve centers: principle of reciprocity, convergence, common final path, feedback, dominancy, switching and induction.
37. Central inhibition: types, mechanisms, importance.
38. The concept of neurotransmitter systems of the brain.
39. Muscle tissue: types, structure, comparative characteristics.
40. Skeletal muscle. Classification of muscles. Muscle as an organ. Auxiliary unit of muscles.
41. The main functional groups of muscles of the human body: muscles of the head, neck, back, chest, abdomen (diaphragm), muscles of the shoulder girdle and upper limb, muscles of the pelvic girdle and lower limb.
42. The mechanism of contraction and relaxation of single muscle fibers and muscle.
43. Types and modes of skeletal muscle contraction. Work and fatigue of muscle.
44. Smooth muscle tissue. Features of structure and function. The concept of myoepithelial cells.
45. Features of control of the functions of skeletal and smooth muscle, myoepithelial cells.
46. Epithelial tissue: types, structural features, functions. The basal and apical membrane of epithelial cells, their functions.
47. Surface epithelia: types, structure, functions.
48. The glandular epithelium. Glands of external and internal secretions.
49. The concept of secretion, its products: secreta, excreta, increta. Types of secretions: proteinous, mucous, mixed, sebaceous.
50. Cellular mechanisms of secretion: secretory cycle, phase of secretion, types of secretions (apo-, mero-, holocrine).
51. Skin: structure and functions.
52. Derivatives of skin, their function.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Instructions on the completion of the protocol:

Students sit for the final classes in the final form of a computer or written test (if required in combination with an oral examination) with the mandatory rating score.

Computer testing is the first step, which involves for the completion of control work in the computer class on the programme “Testing – Control testing – final pharm. faculty General Physiology with the basics of human morphology”. Lesson 9. Knowledge assessment involves grading from 1 to 10 points on the following scale:

99–100 % — 8 points

91–98 % — 7 points

81–90 % — 6 points

76–80 % — 5 points

71–75 % — 4 points

61–70 % — 3 points

51–60 % — 2 points

41–50 % — 1 points

21–40 % — 0 points

0–20 % — 0 point

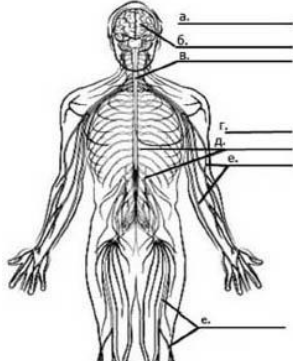
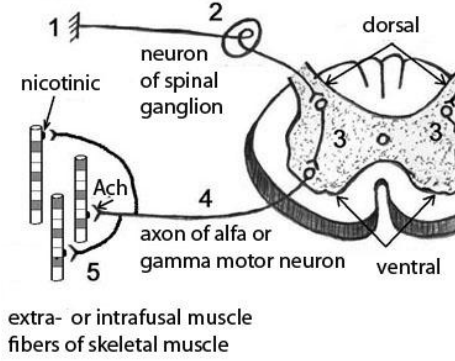
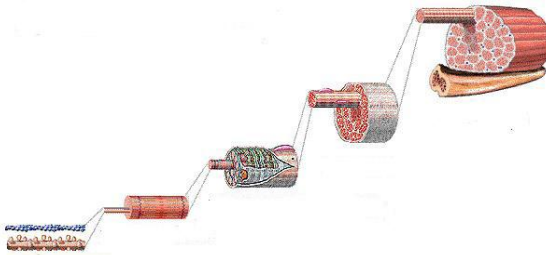
Each student is required to calculate the rating of their academic performance, which is taken into account when placing the final score. Rating is determined by the summation of all scores obtained in each lesson and dividing this sum by the number of score.

PROTOCOL

Total number of questions _____. Number of correct answers _____. Score on testing _____. Rating _____.

Final grade for the colloquium _____ points _____;

taking into account the rating, is calculated as follows: (score on rating + score on testing) _____ + / 2 = _____ points.

The exam for the discipline “Anatomy and physiology” for students of the Faculty of Pharmacy specialty: 1-79 01 08		Approved by Head of Department, Doctor of Med. Sci, professor _____ V. A. Pereverzev Protocol № 10 on 16 April 2015.	
TICKET 01			
1. Specify the names 		5. State the incorrect name of the scheme:  extra- or intrafusal muscle fibers of skeletal muscle	
2. Name the type of digestion carried out by enzymes that are part of the food substance:		7. State the level of organization of skeletal muscle: 	
3. State the main structural components of histohematological barriers: ☐ endothelium of capillaries ☐ basement membrane with pericytes ☐ adventitial cells of organs and tissues ☐ keratinocytes of epidermis		6. The convergence of several excitatory influences on the same neuron is called: ☐ irradiation ☐ convergence ☐ induction ☐ reverberation	
4. The enzyme, which plays a major role in the mechanisms of maintaining the pH of the kidneys: ☐ Urokinase ☐ Carbonic anhydrase ☐ Cyclooxygenase ☐ Phosphodiesterase		8. Specify with matching arrows in which spinal cord segments are situated the following centers: - diaphragm C ₂ -C ₅ - sympathetic (preganglionic neurons) C ₈ -L ₂ - parasympathetic (preganglionic neurons) S ₂ -S ₄	
9. Specify the vessel that have the greatest resistance to blood flow, maintaining blood pressure; regulate the volume flow rate, maintaining the distribution of blood flow in different vascular areas: ☐ cushioning ☐ exchange ☐ shunt		☐ resistance ☐ capacitance ☐ transmission	
10. Calculate the body mass index (BMI) of a 24 year old male with a height of 1.8 m and 79 kg body weight and evaluate the received result: Underline the correct answer: the lack, or an excess of the norm		11. General principles of the structure of sensory systems, their classification.	
		12. Methods of assessing the state of the functions of the endocrine system in humans.	

INTRODUCTION

Dear students!

Textbook “Anatomy and physiology. Practical” for the laboratory classes at the Department of Normal Physiology, Belarusian State Medical University will help you to master this important discipline for pharmacist.

Each lesson in the practical consists of three parts: the first part includes a list of issues under study, the second — provides additional theoretical information and tasks for independent work in preparation for the lesson, and the third — is designed to perform laboratory work in the classroom and signed by the lecturer. Each lesson provides links to sources of basic and additional literature for independent training (see literature).

LIST OF ABBREVIATIONS

BP	arterial blood pressure	IP3	inositol-3i-phosphate	SC	the spinal cord
ADH	antidiuretic hormone	IGF	Insulin-Like Growth Factor	SD	standard deviation
Cl⁻	chlorine	CT	calcitonin	STH, GH	somatotropin, GH
F⁻	fluoride	LH	luteinizing hormone	T3,T4	triiodothyronine, thyroxine
NaCl	sodium chloride	LGchannel	Ligand gated channels	TMS	transmembrane segment
a/D3	active form of vitamin D3 (Calcitriol)	LTH (PRL)	luteotrophic hormone (prolactin)	IPSP	inhibitory postsynaptic potential
BPd	blood pressure, diastolic	MSH	melanocyte stimulating hormone	TSH	thyroid-stimulating hormone
BPs	blood pressure, systolic	BM	body weight	PLC	Phospholipase C
Bpm	blood pressure, middle hemodynamic	mChR	Muskarinic cholinoreceptor	tnf	tumor necrosis factor
ADTH	adrenocorticotrophic hormone	nChR	Nicotinic cholinoreceptor	cAMP	cyclic adenosine-monophosphate
ANS	autonomic nervous system	OPG	Osteoprotegerin, osteoclastogenesis inhibitory factor (OCIF)	cGMP	cyclic guanozin-monophosphate
Ach	acetylcholine	AP	action potential	CNS, NS	the central nervous system, nervous system
AIDS	acquired immune deficiency syndrome	PKA и PKC	protein kinase a and protein kinase C	CSF	cerebrospinal fluid
EPSP	excitatory postsynaptic potential	EPP	endplate potential	CN	cranial nerves
GABA	gamma-aminobutyric acid	RP	rest potential	PR	pulse rate
SMC	smooth muscle cell	PH	parathyroid hormone	HR	heart rate
DAG	diacylglycerol	P	phosphorous (phosphate)	E₂	estradiol
VC	vital capacity of lungs	RAAS	Renin-angiotensin-aldosterone system	EMG	elektromio (-gram or-graphy)
IL	Interleukin	Ca²⁺	calcium		
BMI	body mass index				

STRUCTURE OF THE BOOK

The topic of lesson and date of conducting it are stated in the publication. Next, the main questions for the class, on which the students study at home, in the library, in the computer laboratory are presented. References are located in the right corner. Part of the practical work is performed independently by the student. Part of the work is done in class. When you are carrying out the work, pay attention to: 1) title; 2) aim of the work; 3) progress of the work; 4) results; 5) conclusions.

Aim of work — is the main objective of experience, for which a clear conclusion must be formulated at the end of the work.

Work progress — a brief but clear description of the main activities in carrying out the work to the extent necessary for an understanding of the results.

Results are written in detail with text, digital data, graphs are provided including charts, pictures.

Conclusion — specially accountable section of the Protocol. It should assess the results obtained using the theoretical material of textbooks and lectures.

! It is important to trace the connection between the aim of the study and results. If in the course of experiment, unusual phenomena occur, they are objectively reflected in the report. The protocol is verified and signed by the teacher, and only after that, the lesson is considered done.

In each lesson, the student surely receives one score on the test, using the computer program.

When entering the score on the final class, the student's rating is put into consideration during the practical sessions (average score on practical exercises plus score on the final lesson) / 2.

Navigation: our website — bsmu.by → student

№	Date	Topic of lecture: 1 semesters (20 hours – 10 lecturer)	Lesson is credited, Signature of lecturer
1.	01.09.2016	Introduction. Basic concepts of Anatomy and Physiology. Subject and objectives of Physiology, Anatomy and Histology. The concept of the mechanisms of regulation of functions.	
2.	15.09.2016	Physiology of excitable tissues. Physiology of the nervous tissue. Physiology of synapses. Structure and functions of the central nervous system. Nerve centers. Reflex theory.	
3.	29.09.2016	Physiology of muscle tissue. Skeletal muscles. Smooth muscles.	
4.	13.10.2016	Glandular epithelium. Myoepitheliocytes. Skin: structure and function.	
5.	27.10.2016	Autonomic nervous system: structure, function. Autonomic reflexes.	
6.	10.11.2016	Endocrine system: structure, functions. Reproductive system. The concept of stress.	
7.	24.11.2016	Sensory system. Nociceptive and antinociceptive systems: structure, function, mechanisms of regulation.	
8.	08.12.2016	Integrative function of brain.	
9.	19.12.2016	Body fluids (blood, lymph, liquor, saliva, etc.). Physiology of blood.	
10.	22.12.2016	Blood cells. Hemopoiesis. Blood groups.	

Navigation: our website — bsmu.by → student

№ of week	- Academic lessons from 01.09.2015 to 13.01.2016. - Academic practical, first week (period of carrying out the practical for each group is approved by the Rector). - Examination session from 14.01.2016 to 22.01.2016. - Holiday from 23.01.2016 to 05.02.2016. Topic of lesson: (57 hours — 19 lessons)	Lesson is credited, Signature of lecturer
1.	Introduction. Subject and objective of physiology, anatomy and histology	
2.	Physiological basis of human life. The concept of neural and humoral mechanisms of regulation of functions	
3.	The general concept of tissues. Connective tissue: types, functions. Human skeleton. The role of calcium and phosphate in bone and body	
4.	General physiology of excitable cells. Bioelectrogenesis. Reception	
5.	General plan of the macro- and microscopic structure of the nervous tissue. Structure and functions of peripheral nerves, conduction of excitation on them. Synapses: structure, types, functions, synaptic transmission	
6.	General structure of CNS. Reflex theory. Nerve centers: their properties, principles of functioning. Excitation and inhibition in the CNS, and their mediator mechanisms	
7.	Muscle tissue: types, macro- and microscopic structure. Striated muscle tissue: morphological and functional features, mechanisms of regulation. Skeletal muscle: types, functions. The mechanism of contraction and relaxation of single muscle fiber and muscle. Smooth muscle: localization, structure, mechanisms of regulation	
8.	Epithelial tissue: types, structural features and functions. Glandular epithelium, secretion. Glands: types, structure, functions. Skin: structure, functions	
9.	Colloquium “General physiology with basics of human morphology. General principles of regulation of functions”	
10.	Physiology and morphology of CNS, its role in motor control. Somatic reflexes	
11.	The autonomic nervous system: structure, functions, mechanisms of functioning and control of activity of internal organs. Autonomic reflexes	
12.	General characteristics of the structure and functions of the endocrine system. Structure and functions of the central organs of the endocrine system: the hypothalamus, the pituitary gland. Pineal gland: structure, topography, functions	
13.	Structure, topography and endocrine functions of the thyroid, parathyroid, adrenal glands and pancreatic incretory cells. The concept of diffuse endocrine system	
14.	The reproductive system of male and female. The endocrine functions of gonads	
15.	Colloquium “Physiology and morphology of the nervous and endocrine systems. Reproductive system”	
16.	The general principles of the structure of sensory systems. Structure and functions of the visual, auditory and vestibular sensory systems	
17.	The structure and functions of the olfactory, gustatory, cutaneous and visceral sensory systems. Nociception. Nociceptive and antinociceptive system: structure, functions, mechanisms of functioning	
18.	Integrative functions of the brain. Congenital and acquired forms of behavior. Higher mental functions of the brain	
19.	Indicators of physiological functions. Credit lesson	
ATTENTION: 1 st semester – lectures – 20 h (10 lecture), practical class – 57 h (19 lessons), colloquium – 2 (9 and 15), credit including present all lecture and practical class, completed practical manual, text of lecture, positive marks of colloquium. If you have penalty, go to deans office, take penalty paper, then prepare lesson or lecture, fill up the practical manual, lecture and then go to yours lecturer and answers orally (practical class) or writing (lecture).		

SECTION II

MORPHOLOGY AND PHYSIOLOGY OF THE NERVOUS AND ENDOCRINE SYSTEMS. REPRODUCTIVE SYSTEM

Lesson 10

PHYSIOLOGY AND MORPHOLOGY OF THE CENTRAL NERVOUS SYSTEM, ITS ROLE IN THE MANAGEMENT OF THE MOVEMENTS. SOMATIC REFLEXES

Date: _____ 20____

Questions for lesson preparation:

1. Spinal cord: localization, structure, shell (оболочки), functions. Microstructure of a segment of the spinal cord, gray and white matter. The nerve cells of the dorsal, ventral and lateral horns, their functions. The composition and functions of the anterior and posterior roots. The concept of spinal cord pathways.
2. Spinal reflexes, their types and value. The concept of motor units. The structure of the “arc” somatic reflex. The role of the spinal cord in the regulation somatic functions.
3. The brain, the main structure. The brain: morphofunctional organization, vital centers, function. The concept of the cranial nerves: number, localization of nuclei, functions. The role of brain stem in maintaining body position, regulation and redistribution of muscle tone.
4. Reticular formation: morphofunctional organization. Characteristics of ascending and descending influences the reticular formation. The concept of stem nerve centers as points of the application action of medicinal substances.
5. The cerebellum: morphofunctional organization. The role of the cerebellum in motor functions.
6. Diencephalon. Thalamus: morphofunctional organization (specific and nonspecific nuclei, their function).
7. Hypothalamus: morphofunctional organization; the main centers; connection with other divisions of the brain.
8. Cerebrum. Cortex of cerebrum: basic gyrus and sulcus. Afferent, efferent, and associative field and their relationships.
9. Localization of function in cortex. The right and left hemisphere. The concept of cerebral asymmetry and dominance of the hemispheres. Corpus Callosum: topography and functions. Code: topography and functions.
10. Limbic system: morphofunctional organization. The role of the limbic system in the formation of emotions, motivation, memory.
11. Basal nuclei and their functions.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Basic terms and concepts

The spinal cord is	Extrapyramidal tract is
The brain is	Three centers of the brainstem: 1) _____; 2) _____; 3) _____
Grey matter of spinal and brain is	Three basic division of cerebellum: 1) _____; 2) _____; 3) _____
White matter brain and spinal cord is	The structure of the medulla oblongata, the pons and the midbrain can unite under a common name
“Motor homunculus” is	The thalamus and the hypothalamus are integral parts _____ of brain.
«Sensitive homunculus» is	Cortex of cerebrum and basal ganglia are components _____ of brain.
The motor unit is	The limbic system is
Three shells of spinal cord and brain: 1) _____; 2) _____; 3) _____	Basal ganglia is
Afferent neural pathways is	The cerebellum is
Efferent nerve path is	Nerve nucleus is
Pyramidal tract is	Module (cerebral cortex) is

Understanding the Stretch Reflex (or Myotatic Reflex) of spinal cord

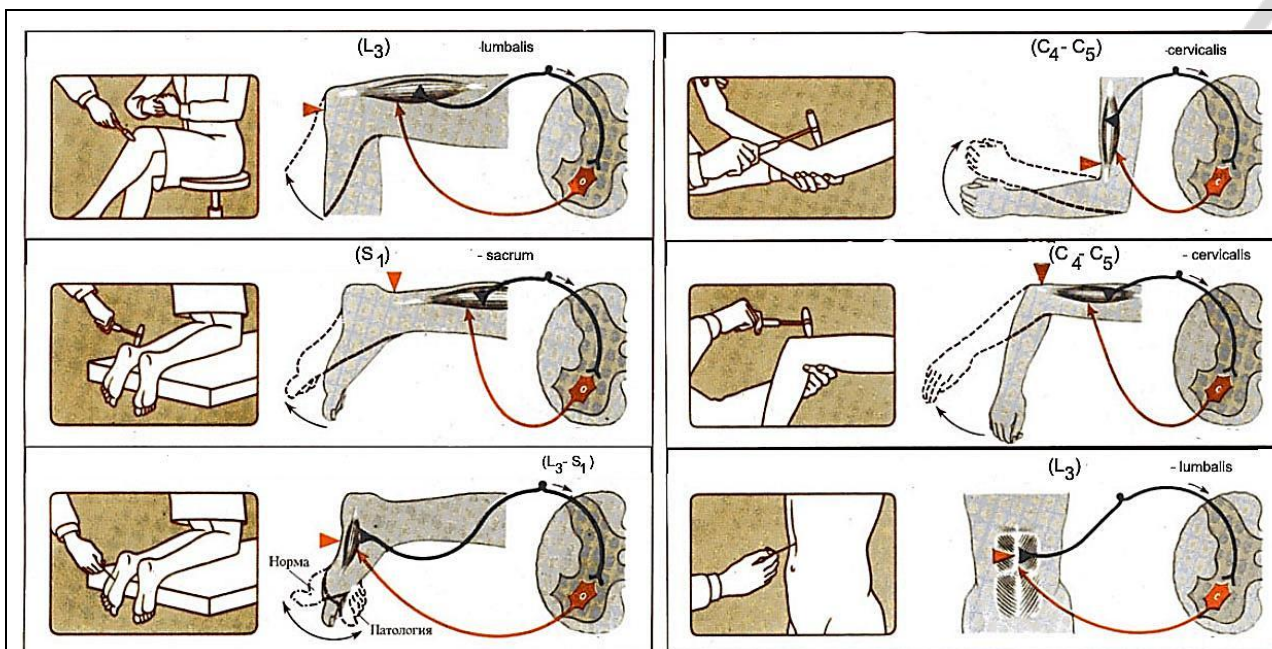


Figure 10.1. Myotatic reflexes of spinal cord [17]

Myotatic (tendon) reflexes — muscle stretch reflexes (fig. 10.1). Rapid stretching of a muscle just a few millimeters mechanical blow to its tendon causes contraction of the whole muscle and motor responses. The implementation of these reflexes would have been impossible, if simultaneously with the contraction the muscle does not relax the muscles-antagonists.

A the stretch reflex is common to all muscles, but the muscles-extensors, they are well marked and easily retrieved. The study myotatic (tendon) reflexes are widely used for assessment of the functional state of the CNS and topical diagnosis of lesions with injuries or diseases of the Central nervous system.

Materials and equipment: reflex hammer.

Progress of work. Hit the hammer on the muscle tendons (fig. 10.1) the following reflexes: Achilles', reflex flexion of the forearm, extensor reflex of the forearm. Compare reflex reaction on both feet, then on both hands.

Directions to registration Protocol:

1. Write to the presence or absence of reflexes, their expressed on both sides (legs and arms).
2. Write segments of the spinal cord reflexes in fig. 10.
3. Make a conclusion about the status (saved or absence) reflex reactions and reflex functions of the spinal cord.

PROTOCOL

1. Reflex reaction _____ (presence or absence) on _____ (one or both) legs and arms.
2. Myotatic reflexes are connect at the level of the following segments of the spinal cord: Achilles' reflex _____; reflex flexion of the forearm _____; knee-jerk _____; extensor reflex of the forearm _____; abdominal reflex _____
3. **Conclusion.** Reflex reaction and reflex functions of the spinal cord _____ (presence or absence).

Study of the motor function of some cranial nerves (CN)

Motor functions are carried out by nine pairs of CN (five pairs of (4, 5, 6, 11 and 12) — motor and four pairs of — 3, 7, 9 и 10 — mixed). Nucleus of CN are located in the brain stem. Structure and function of neurons in the motor nuclei CN — analogues of the anterior horns of spinal cord cells. Axons of motoneurons of these nuclei to form motor roots, then nerves, that innervate muscles of the face, larynx, pharynx, tongue and neck partly. In the anatomical structure of all peripheral nerves evident law gomolateral innervation of muscles, all cranial and spinal nerves are go to the muscles of his half of the body (except for the nerve block is 4 pair of CN). Research methods of motor function of CN an example 5, 7, 9, 10 and 12 pairs. Motor nucleus of trigeminal nerves (5 pair of CBN) located in tyre of the brainstem at the level of the pons and innervate the chewing muscles. Neurons in the motor nuclei of the facial nerves (7 pairs of CN), located in the pons, innervate mimic facial muscles. Motor nucleus glossopharyngeal nerve (9 pair of CN) and vagus nerve (10 pair of CN) are general and lie in the medulla oblongata, and the axons of neurons that core (nucleus) innervate the pharynx muscles, soft palate, larynx and epiglottis, as well as the vocal cords. Muscle of tongue innervated neurons by the nuclei of hypoglossal nerve (12 pairs of CN).

Materials and equipment: matches, glass with clean water.

Progress of work. See table 10.1.

Directions to registration of Protocol:

1. Compare the results with norm.
2. Make the conclusion of motor functions studied CN.

Table 10.1

A study of the motor function 5, 7, 9, 10 and 12 pairs of CN

Researched pairs of CN	Technique
5 pairs of CN	Open and close your mouth, then do some chewing movements. The hands of the researcher are on masticatory muscles tested by determining the degree of tension. In norm no offset lower jaw, the muscles tense with both sides equally.
7 pair	a) raise your eyebrows up (the creases on the forehead must be expressed from both sides equally); б) close, and then close the eyes greatly (normally they close equally); в) smile and inflate the cheeks (movements must be identical on both sides); г) blow out the flame of a match (when the lips are stretched forward).
9 and 10 pairs of CN	a) Open your mouth and say «а» (tongue soft palate located on the midline); в) drink a few mouthfuls of water (swallowing should be free).
12 pairs of CN	Sticking out tongue (normally, the tongue must be located in the midline).

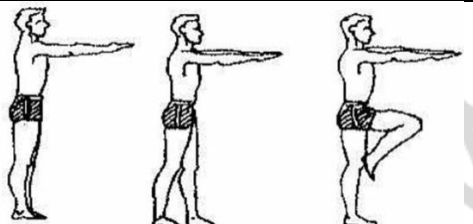
PROTOCOL

1. The examinee _____ (performed, not performed) all jobs, the obtained results _____ (match or not) in norm.

2. **Conclusion.** Motor function studied (5, 7, 9, 10 and 12 pairs) CBN _____ (broken, no broken).

Study of cerebellum control of motor activity

Table 10.2

Cerebellum control of skeletal muscles motor activity		
Type of experiment	Technique	
Romberg's pose (coordination assessment of movements or static ataxia test)	The examined stand with feet together, semi-tandem, tandem and hands stretched forward, at first with open for 10 seconds then closed for 10 second in each position. In norm the person keeps the balance in Romberg's pose (i.e. the static ataxia test is negative)	
Gait (assessment of movements coordination or dynamic ataxia test)	The examined to walk about the room forward with open and closed eyes. In norm the gait of a healthy person is usual, without swaying to the sides and broad placing his feet (i.e. the dynamic ataxia test is negative)	
Dysmetria test	The examined take from the table and put back some object (a book, a glass). In norm the person puts the subject to the same place with an error ± 2 cm (i.e. the dysmetry test is negative)	
Speech (dysarthria test)	The examined repeat some difficult for pronunciation words (earthquake, aircraft building, administrating etc.). Note, if there is delay, proluxity in a speech.	
Finger-nose test (for dysmetry and tremor)	The examined touch the index finger (at first of the left and then of the right hand) to the tip of his nose with open and closed eyes. In norm the person touches his nose tip (with accuracy of ± 1 cm) without tremor of fingers (i.e. the test for dysmetry and tremor is negative). When the cerebellum is impaired person misses the nose tip and his fingers tremble while reaching the nose	

Efferent signals from the cerebellum regulate neuronal activity of vestibular (Deiters') and red nuclei, the thalamus nuclei, and through them the activity of peripheral (α - and γ -motor neurons of the spinal cord and nuclei of cranial nerves) and central (cortical) motor neurons. Through these pathways efferent signals from the cerebellum regulate strength of muscle contractions ensuring the ability for prolonged tonic muscle contraction, relate the volume of a voluntary movement with the distance to the aim of this movement, and quickly change flexing to extending and vice versa. The cerebellum provides the synergy of contractions in complex movements. Cerebellum functions disorder is manifested by: decrease of muscle contraction force (asthenia); loss of the ability to prolonged muscle contraction that makes standing, sitting difficult (astasia); involuntary change of muscular tone (dystony); finger trembling at rest (tremor); movement impairment revealed as excessive or insufficient movement (dysmetry); coordination impairment (ataxy) that is manifested in "drunk" (swaying) gait and etc.; speech motor disorders (dysarthria); swinging rhythmic twitching of eye-balls (nystagmus); impairment of interchanging opposite movements (adiadochokinesis),

Equipment and materials: glass, book.

The progress of the work. The person makes movements and exercises shown in table 10.2.

Study of cerebellum control of motor activity (continued)

Praxis — the correct sequence of operations when performing complex automatic movements of domestic or professional nature. Correct execution of subjects all jobs, contained in the works 10.3 and 10.4, would show lack of violations of the Praxis, one of the highest integrative (including motor) functions of neurons in the cortex.	PROTOCOL 1. Have the test person: - samples for ataxia (negative or positive), as in the Romberg pose, he (saved or not) balance, and gait (plain or “drunk”); - samples for dysmetria and tremor were (negative or positive); - dysarthria (not detected or identified). 2. Conclusion. Control of cerebellum of motor activity in the tested (norm or broken).
--	--

Study computer programme “Lesson 10”

Work 10.5

(Internet Explorer → Pharmprogramme → Study programme → Lesson10)

Work progress. Student independently loads the programme “**Lesson 10**” and examines the teaching material in detail.**Control computer programme “Pharm faculty Lesson 10”**

Work 10.6

(Testing → Tests for self (independent) control → Pharm faculty Lesson 10)

Work progress. Student independently loads the programme “**Pharm Faculty Lesson 10**” and then answers questions.**PROTOCOL**

1. Score on test _____. 2. Score on lesson _____.

AUTONOMIC NERVOUS SYSTEM: STRUCTURE, FUNCTION, AND MANAGEMENT MECHANISMS FOR THE FUNCTIONING OF INTERNAL ORGANS. AUTONOMIC REFLEXES

Lesson 11

Date: _____ 20____

Questions to prepare for the lesson:

1. The concept of systemic regulation of autonomic functions.
2. Morfophysiological characteristics of autonomous (vegetative) nervous system (ANS). An overview of the structure of ANS.
3. Autonomic reflexes. Structure of arc of vegetative reflex (involving the spinal cord, brain, ganglia). Autonomic reflex: afferent, central and efferent links.
4. Topography of autonomic centers. The highest autonomic centers. The concept of visceral brain.
5. Peripheral division of autonomic nervous system. Microstructure of ganglia, pre- and postganglionic fibers. Transfer of excitation in ganglia, it mechanism.
6. Mechanism of transfer excitation with postganglionic fibers to the working organs. Neurotransmitters and receptors of effector cells. Localization of α - and β -adrenoreceptors, cholinergic, serotonergic, purinergic receptors.
7. Structure and physiological features of the parasympathetic part of ANS. Physiological effects caused by excitation of n-and m-cholinoreceptors.
8. Structure and physiological features of the sympathetic part of the ANS. Physiological effects caused by excitation α - and β -adrenoreceptors.
9. Interaction sympathetic and parasympathetic periphery influences.
10. Structure and physiological characteristics of metasymphathetic part of the ANS. Autonomic plexus thoracic and abdominal cavities.
11. The concept of how to regulate the functional activity of organs and tissues, innervated by ANS.

LITERATURE

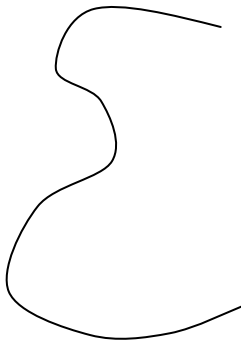
Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Basic terms and concepts

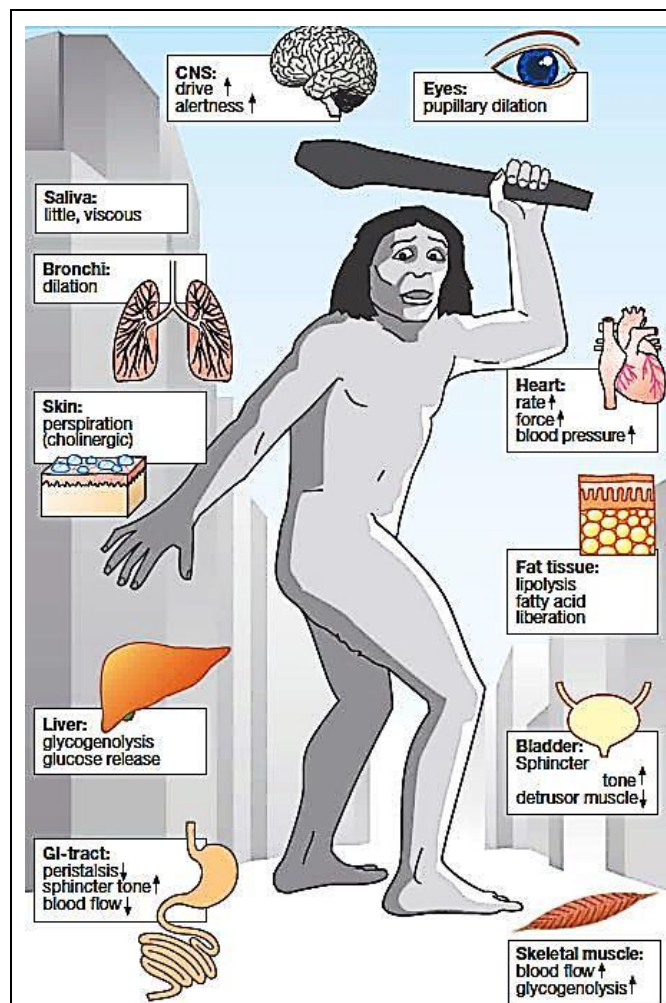
Autonomic nervous system (ANS) is	Norepinephrine _____ work of heart, _____ bronchi, _____ peristalsis, _____ metabolism and body temperature.
Vegetative reflex is	Kraniosacral division of ANS is _____ division of ANS, its preganglionic neurons located in the vegetative nuclei _____ pairs of cranial nerves and sacral nerves of spinal cord segments at the level of _____ before _____.
Peripheral division of ANS (level I) is	
Preganglionic neurons ANS (II level) is	Acetylcholine is the main mediator _____ division of ANS. It acts (operates) on cells working organs through _____ receptor.
Premotor neurons ANS (level III) is	Acetylcholine work of heart, _____ bronchi, _____ peristalsis and the secretion of digestive juices, _____ pupil.
Name three division of ANS: 1) 2) 3)	Centers of metasympatetic division of ANS are located in _____ ganglia outside the CENTRAL NERVOUS SYSTEM.
Neurotransmitter preganglionic neurons of ANS is _____. It excites neurons in ganglia through the _____ receptor.	In vegetative ganglia has 4 types of neurons: 1) 2) 3) 4)
Torakolumbal division of ANS is _____ ANS division, its preganglionic neurons located in the _____ the horns of the spinal cord at the level of the segments from _____ before _____ lumbar division.	Interaction sympathetic and parasympathetic divisions of ANS on ganglia level and level of target have _____ the nature of the, on the central level _____ the nature.
Norepinephrine is the main mediator _____ division of ANS. It operates through _____ and _____ adrenergic receptor.	

Description of spinal reflexes of the sympathetic and somatic nervous system

PROTOCOL	
Somatic reflex diagram	Autonomous (sympathetic) reflex diagram
	
Reflex arch links of a somatic reflex:	Reflex arch links of a vegetative (sympathetic) reflex:
1. Receptor link is presented by the following receptors of skeletal muscles: 1.1 _____;	1. Receptor link is presented mainly by _____ receptors.
2. Afferent link is presented by _____, which are located in _____	2. Afferent link is presented by _____, which are located in _____
3. Inserted link _____, which are located in _____.	3. Inserted link _____, which are located in _____.
4. Efferent link is presented by _____ or _____ motor neurons, which are located in _____	4. Efferent link is presented by 2 neurons, which are located in _____ and in _____ accordingly.
5. Working organs. They are _____ and _____ muscular fibers of skeletal muscles.	5. Working organs. They are _____ muscular cells; _____; _____, _____.
6. Signal transmission rate (of action potential [AP]) is from _____ m/sec to _____ m/sec in efferent fibers, as they have _____ sheath and are referred to the type _____	6. Signal transmission rate (AP) is from _____ m/sec to _____ v/sec in efferent postganglionic fibers, as they do not have _____ sheath and are referred to the type _____
7. Neurotransmitter in neuromuscular synapse is _____, that acts upon _____ type of _____ receptors.	7. Main neurotransmitter in neuroeffector connection is _____, that acts upon _____ and _____ types of _____ receptors.

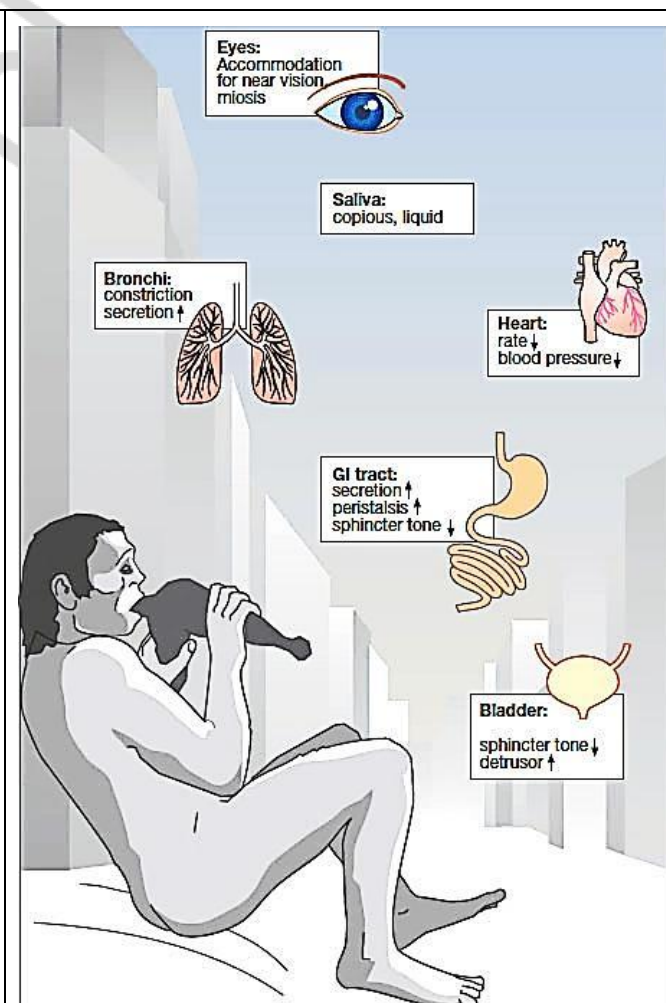
Clinostatic reflex Reflex study allows determining the functional state of parasympathetic and sympathetic centers regulating the heart function. When a man passes from standing to lying position, the heart beat rate decreases that is normally manifested by pulse retardation by 4–6 beats/min. Pulse retardation over 6 beats/min evidences the tone increase of the parasympathetic department of ANS that regulates the heart functioning. The absence of reaction or its paradox character — pulse acceleration — evidences tone dominance of the sympathetic department of ANS that regulates heart functioning. Materials and equipment: a couch, a stop-watch. Accomplishment. At first the pulse of the examined is counted, when he is standing. Then, in 10–25 seconds after the examined lay down, the pulse is counted again. Directions for recording the Protocol: 1. Put down the pulse rate in standing position and then in lying position, count the pulse difference. 2. Make a conclusion of the tone of the sympathetic and parasympathetic departments of ANS regulating the heart functioning of the examined. PROTOCOL Pulse rate in standing is _____ beats/min. Pulse rate in lying _____ beats/min. Pulse difference [PR lying - PR standing] _____ beats/min. Conclusion:	Orthostatic reflex Reflex study allows determining the functional state of sympathetic and parasympathetic centers regulating the heart functioning. When a man passes from lying to standing position, the heart beat rate increases normally by 6–24 beats/min. Pulse acceleration over 24 beats/min evidences the tone dominance of the sympathetic department of ANS, under 6 beats/min — that of the parasympathetic department of ANS. Materials and equipment: a coach, a stop-watch. Accomplishment. The pulse of the examined is counted when he is lying (the man is lying quietly for 4–6 min before the count starts). Then he is asked to stand up and his pulse is counted in 15–25 sec again. Directions for recording the Protocol: 1. Put down the pulse rate (PR) in lying and standing position, calculate the pulse difference. 2. Make a conclusion of the tone of the sympathetic and parasympathetic departments of ANS regulating the heart functioning in the examined. PROTOCOL Pulse rate lying _____ beats/min. Pulse rate standing _____ beats/min. PR difference [PR standing – PR lying] _____ beats/min. Conclusion:
Hering's respiratory-cardiac reflex Reflex study allows determining the functional state (tone) of the parasympathetic center regulating the heart functioning. When respiration is held on after a deep inhalation, the tone of nuclei n. vagi and heart beat rate decreases normally by 4–6 beats/min. Pulse retardation by 8–10 beats/min and over evidences the tone increase of the ANS parasympathetic department, under 4 beats/min — tone decrease. Materials and equipment: a stop-watch. Accomplishment. The pulse is counted when the examined is sitting, then he is asked to make a deep inhalation and hold on the breath and the pulse is counted again.	Directions for recording the Protocol: 1. Put down the pulse rate (PR) before the breath is held on and when breath is held on during inhalation. Calculate the pulse difference. 2. Make a conclusion about the tone of the ANS parasympathetic department regulating the heart function in the examined. PROTOCOL Pulse rate before breath holding (BH) _____ beats/min. Pulse rate (PR) during BH on inhalation _____ beats/min. Pulse difference (PR on inhalation - PR before BH) _____ beats/min. Conclusion:

Examples of the influence of the autonomic nervous system in the organism



Write to the mechanism of action of norepinephrine: NE + ____ adrenoreceptor or ____ cholinoreceptor, (7TMS, 1TMS, LGchannel, nuclear or cytosolic)

Write to the mechanism of action of acetylcholine: Ach + ____ adrenoreceptor or ____ cholinoreceptor, (7TMS, 1TMS, LGchannel, nuclear or cytosolic)



Study computer programme “Lesson 11”

Work 11.5

(Internet Explorer → Pharmprogramme → Study programme → Lesson 11)

Work progress. Student independently loads the programme “Lesson 11” and examines the teaching material in detail.

Control computer programme “Pharm faculty Lesson 11”

Work 11.6

(Testing → Tests for self (independent) control → Pharm faculty Lesson 11)

Work progress. Student independently loads the programme “Pharm Faculty Lesson 11” and then answers questions.

Work 11.7

Assessment of neuro-mediator mechanisms of the effect of sympathetic and parasympathetic departments of ANS on the heart functioning (demonstrative computer work)							
Accomplishment. The program “Physiol 2” is used; it allows performing various experiments on rats. Directions for recording the Protocol: 1. Fill in the table. Abbreviations: HR — Heart Rate, BP_{syst} — Systolic Blood Pressure, BP_{diast} — Diastolic Blood Pressure, BP_{mean} — Mean Hemodynamic Blood Pressure. 2. Than choose Help → Preparation. 3. Help → Drugs 4. Drugs — injected or stimulation 5. New Rat 6. Make a conclusion about the character of the effect of the ANS sympathetic and parasympathetic departments on the force and heart beat rate as well as about neurotransmitter mechanisms realizing these effects.		PROTOCOL					
		Effects of the heart		HR	BP _{sys}	BP _{diast}	BP _{mean}
		1	New Rat — Initial data (baseline)	161	98	53	66
		2	Stimulation Symp. Nerves to heart T ₁	210	130	95	106
		3	New Rat + Injection of noradrenaline, 5 µg/kg	212	130	95	133
		4	New Rat + Phentolamine(α-adrenoblocker), 100 mg/kg	161	98	53	66
		5	New Rat + Phentolamine (α-adrenoblocker), 100 mg/kg + Stimulation Symp. Nerves to heart T ₁	210	114	98	106
		6	New Rat + Propranolol (β-adrenoblocker), 100 mg/kg	161	98	53	66
		7	New Rat + Propranolol (β-adrenoblocker), 100 mg/kg + Stimulation Symp. Nerves to heart T ₁	170	99	65	75
		8	New Rat + Stimulation Vagus Nerve to heart	112	42	30	40
		9	New Rat + injection of acetylcholine, 5 µg/kg	115	31	19	28
		10	New Rat + Atropine (M-cholineblocker), 10.0 mg/kg	161	98	53	66
		11	New Rat + Atropine (M-cholineblocker), 10.0 mg/kg + Stimulation Vagus Nerve to heart	161	98	53	66
Conclusion: _____							

GENERAL CHARACTERISTIC OF THE STRUCTURE AND FUNCTIONS OF ENDOCRINE SYSTEM. STRUCTURE AND FUNCTION OF CENTRAL ORGANS OF ENDOCRINE SYSTEM: HYPOTHALAMUS, PITUITARY. PINEAL GLAND: STRUCTURE, TOPOGRAPHY, FUNCTIONS

Lesson 12

Date: _____ 20____

Questions to prepare for lesson:

1. Morphofunctional organization of the endocrine system. Central and peripheral organs of the endocrine system. The functions of the endocrine glands, diffuse elements, intercellular communication methods involving chemical signals (paracrine, autocrine, endocrine and neuroendocrine).
2. Hormones: origin and chemical nature. Classification. Transportation forms, ways of metabolism, and excretion of inactivation of hormones.
3. Factors determining the concentration of hormones in the blood. Physiological rhythms of neuroendocrine secretion.
4. Mechanisms of action of hormones. Synergism and antagonism of hormones action on the target cell.
5. Neural and humoral, direct and inverse (positive and negative) connection in the regulation of the activities of the endocrine glands.
6. Evaluate methods the condition of functions of endocrine system in humans.
7. Hypothalamus, its hormones: releasing factors (liberens) and inhibiting hormones (statins), their biological effect. Vasopressin and oxytocin — hormones hypothalamus, their biological effect. Pathways hypothalamic hormones in the pituitary gland (anterior and posterior pituitary).
8. Pituitary gland. The topography, structure, departments and their main hormones: tropic (TSH, ACTH, FSH and LH) and effector (GH, prolactin, MSH, ADH and oxytocin). Relationship with the hypothalamus and the value in the regulation of peripheral endocrine glands. Regulation of pituitary endocrine functions.
9. Pineal gland. Topography and microscopic structure. The endocrine function of the pineal gland and its regulation.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Work 12.1

Main terms and concept

The hormone is	Oxytocin is
Central organs of endocrine system is a	Name of hormones endocrine axis:
List hormones control the pituitary gland:	Hypothalamus → pituitary gland → sex glands → → (female) → → (male)
Liberens is a	Chemical classification of hormones: 1) _____; 2) _____; 3) _____; 4) _____.
Statins is	The mechanism of action of steroid — through _____ receptors
Tropic hormones is	Mechanism of action ACTH, TSH, FSH, LH, MSH, dopamine, melatonin — through _____ receptors
List the tropic hormones anterior pituitary:	Growth hormone is a
ADH is a	Prolactin is a
Name of hormones endocrine axis:	
Hypothalamus → pituitary gland → thyroid gland → →	MSH is
Hypothalamus → pituitary gland → adrenal glands → →	Melatonin is

Study computer programme “Lesson 12”

Work 12.2

(Internet Explorer → Pharmprogramme → Study programme → Lesson 12)

Work progress. Student independently loads the programme “Lesson 12” and examines the teaching material in detail.

Control computer programme “Pharm faculty Lesson 12”

Work 12.3

(Testing → Tests for self (independent) control → Pharm faculty Lesson 12)

Work progress. Student independently loads the programme “Pharm Faculty Lesson 12” and then answers questions.

Human height evaluation

Human height is one of basic development characteristics. Linear height is an irregular process. Maximum growth rate is noted in newborns and infants and then it considerably decreases. Some increase of growth rate is noted in girls from 9 to 14 years and in boys from 11 to 16 years, then it decreases again. By 16 years in girls and by 18 years in boys the body growth is practically completed and in norm it does not exceed 1 cm/year. Complete ossification occurs by 20–23 years in a female organism and by 21–25 years in a male organism. The height of an adult of 130–200 cm in males and 120–190 cm in females is considered normal. Men smaller than 130 cm and women smaller than 120 cm are dwarfs. People-giants are women higher than 190 cm and men higher than 200 cm. Height is an integral factor of the effect of genetic, hormonal, tissue and external factors on the bony and other tissues of the organism. The height genetic program is realized through the humoral endocrine system including all known hormones (thyroid, insulin, calcium-regulating, adrenal, sex), but the most important is hypothalamic and hypophyseal growth regulation, the central link of which is somatotropin. Somatotropin (GH — somatotropic hormone or GH — growth hormone) is a basic hormone stimulating linear growth. GH stimulates growth of bones in length, growth and differentiation of internal organs, development of muscular tissue. A basic effect of GH at a bony tissue level is its stimulation of cartilage growth, protein synthesis and cellular mitosis induction. GH effects are mediated by insulin-like growth factors (IGF-I, IGF-II) or comedians that are synthesized under the influence of this hormone mainly in the liver and kidneys. The linear human growth is completed, when growth zones have become closed under the effect of sex hormones. The most simple and accessible method of studying the somatotropic function is anthropometrics, i.e. the human height is evaluated versus its predicted height calculated on the basis of an average height of his parents. To determine the final height range the following formula is used:

Predicted final height of a male = (father's height + mother's height + 13 cm) : 2

Predicted final height of a female = (father's height + mother's height – 13 cm) : 2

The measured height of an adult must coincide with a predicted height or deviate from a calculated value no more than 2 standard deviations (SD), i.e. ± 10 cm from a calculated height value. Deviations of the measured height exceeding 2 SD from a calculated height value evidences a pathologically low or high human height. In this case it is necessary to perform detailed studies of the hypophysis somatotropic function to clear up the cause of growth impairment, as well as to study the state of other glands (first of all sex and thyroid glands).

Materials and equipment: a height meter.

To perform the work one should know the heights of the parents.

Accomplishment. Height measurement is performed in standing position with the height meter. The examined should stand without shoes (in thin socks) in the right position: arms down; heels together; heels, buttocks and scapulae are pressed to the board of the height meter. The head is in position of "Frankfurt's plane", i. e. the lower edge of the eye and the external hearing passage should lie on one horizontal line. Measurements are performed on exhalation. The plank of the height meter is lowered to the level of the head of the examined. Measurements are performed with precision of 0.5 cm.

PROTOCOL

1. Height of the examined is _____ cm. Sex of the examined _____.

2. Parents' height of the examined: mother's _____ cm; father's _____ cm.

Calculation of predicted height of the examined (PHE)

PHE = (father's height + mother's height $\pm$ 13 cm) : 2 = _____ cm.

3. **Conclusion.** Height of the examined is _____ (in norm, pathologically high, pathologically low).

4. Excess of growth hormone in childhood or adolescence or insufficiencies of sex hormones may result in pathologically _____ height.

Insufficiency of growth hormone in childhood and adolescence or excess of sex hormones may result in pathologically _____ height.

Human endocrine system

In figure 12.1 sign the name of the major endocrine glands and specify, which ones belong to the Central and the peripheral organs of the endocrine system.

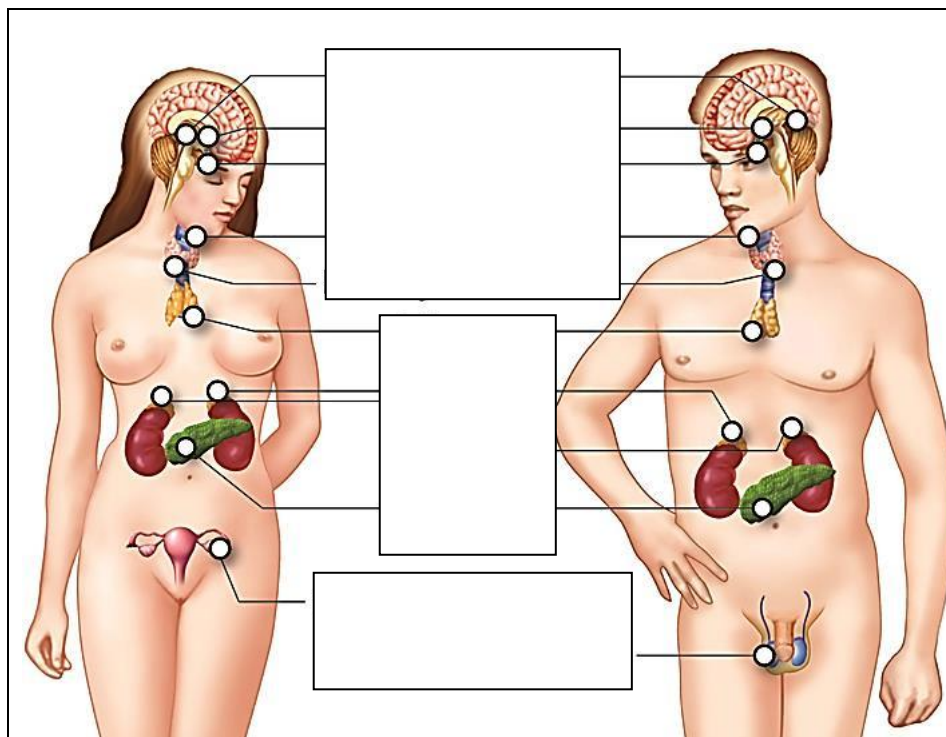


Figure 12.1. Human endocrine system

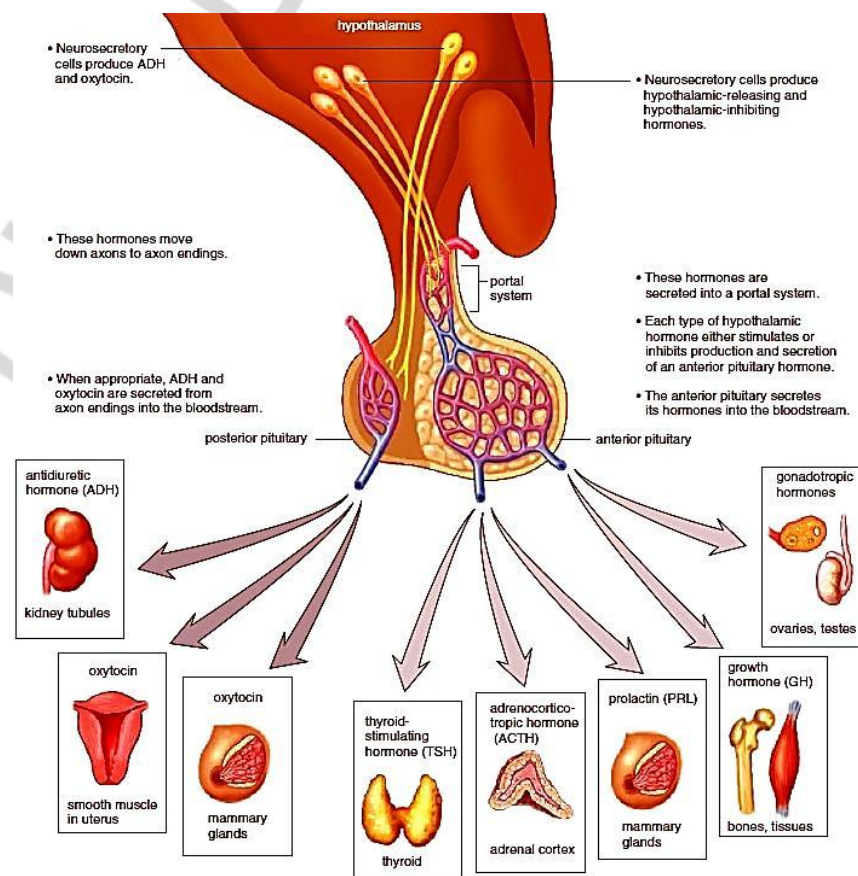


Figure 12.2. The hypothalamic-hypophyseal portal system and its functions

**STRUCTURE, TOPOGRAPHY AND ENDOCRINE FUNCTION
OF THE THYROID GLAND, PARATHYROID GLANDS,
ADRENAL GLANDS, ENDOCRINE CELLS OF THE PANCREAS.
THE CONCEPT OF THE DIFFUSE ENDOCRINE SYSTEM**

Lesson 13

Date: _____ 20____

Questions to prepare for lesson:

1. The thyroid gland. Topography, macro-and microscopic structure. Thyroid hormones and their biological activity. Regulation of functions of thyroid gland. Hyper-and hypothyroidism. Calcitonin.
2. Parathyroid gland. Topography, microscopic structure. Parathyroid hormone, its biological effects.
3. Adrenal glands. Topography, macro-and microscopic structure. The cortical and medulla hormones, their biological effect. The concept of hypothalamic-pituitary-adrenal system.
4. Stress: concept, types, phases, mechanisms. Adrenal glands function by stress.
5. Endocrine pancreas apparatus. Topography, microscopic structure. Hormones, their biological effect.
6. Physiological mechanisms of self-regulation of glucose in blood.
7. The concept of diffuse endocrine system. The concept endocrine functions of the liver (somatomedin, angiotensinogen, trombocytopoetin, 1(OH)D₃), heart (atriopeptid), kidney (erythropoietin, calcitriol), GIT (gastrin, histamine, somatostatin, secretin), paraganglions (catecholamine's).
8. Regulation of calcium and phosphate homeostasis in organism. The role of calcitonin, parathyroid hormone and calcitriol.
9. The concept on the endocrine function of thymus.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia: Nova Knyha, 2016. 728 p.

Work 13.1

Main terms and concepts

Follicular cells of the thyroid gland secrete hormones: _____; parafollicular cells _____	Insulin and glucagon is a hormone _____ gland, which regulates the level _____ in blood. Insulin _____ the level of glycemia, and glucagon — _____
Hypothyroidism in children can lead to the development of _____, adults — to _____	What hormones (adrenaline, cortisol, GH, IGF-I (Insulin-like Growth Factor-1), insulin, glucagon) hyperglycemia _____, hypoglycemia _____
Main hormones, that regulation the exchange of Ca^{2+} and P in the organism and blood — is 1) _____; 2) _____; 3) _____	Stress is _____
The adrenal glands are composed of _____ parts and secrete _____ a group of hormones: 1) _____; 2) _____; 3) _____; 4) _____	Systems that implement stress: 1) _____, 2) _____, 3) _____ Systems that limit stress: 1) _____, 2) _____, 3) _____
Important adrenal hormones are _____, which regulates the level of _____ in the organism and the amount of _____ blood pressure.	Hormones of the liver _____, heart _____, the kidneys _____.

Study computer programme “Lesson 13”

Work 13.2

(Internet Explorer → Pharmprogramme → Study programme → Lesson 13)

Work progress. Student independently loads the program “Lesson 13” and examines in detail the study material presented in it.

Control computer programme “Pharm faculty Lesson 13”

Work 13.3

(Testing → Tests for independent control → Pharm faculty Lesson 13)

Work progress. The student independently loads the program “Pharm Faculty Lesson 13” and answers the questions.

PROTOCOL

1. Score on test _____. 2. Score on lesson _____.

Analysis of the effect of catecholamine's as hormones (adrenal medullar substance) and as neuro-mediators (ANS sympathetic department) on cardio-vascular system factors (demonstrative computer work)

Accomplishment. The program "Physiol 2" is used, it allows performing virtual experiments on rats.

Directions for recording the Protocol:

1. Fill in the table. Abbreviations: HR – Heart Rate, BP_{syst} – Systolic Blood Pressure, BP_{diast} – Diastolic Blood Pressure, BP_{mean} – Mean Hemodynamic Blood Pressure.
2. Make a conclusion, what is the difference between the action of catecholamines as mediators of sympathetic nerves and as hormones of the adrenal medullar substance. Indicate, by what types of adrenoreceptors the effect of noradrenalin and adrenalin on the cardio-vascular system is predominantly realized.

PROTOCOL

Effect on the heart	HR	BP _{syst}	BP _{diast}	BP _{mean}
Initial factors				
Stimulation Symp. Nerves to heart T ₁				
Stimulation Symp. Nerves to adrenals T ₆₋₈				
Phentolamine (α -adrenoblocker), 100 mg/kg + stimulation Symp. Nerves to heart T ₁				
Propranolol (β -adrenoblocker), 100 mg/kg + stimulation Symp. Nerves to heart T ₁				
Propranolol (β -adrenoblocker), 100 mg/kg + stimulation Symp. Nerves to adrenals T ₆₋₈				
Injection noradrenaline, 5 μ g/kg				
Injection adrenaline, 5 μ g/kg				

Conclusion: _____

Evaluation of a dental formula

The teeth are arranged, that their crowns form an arc or a number on the upper and lower jaws.

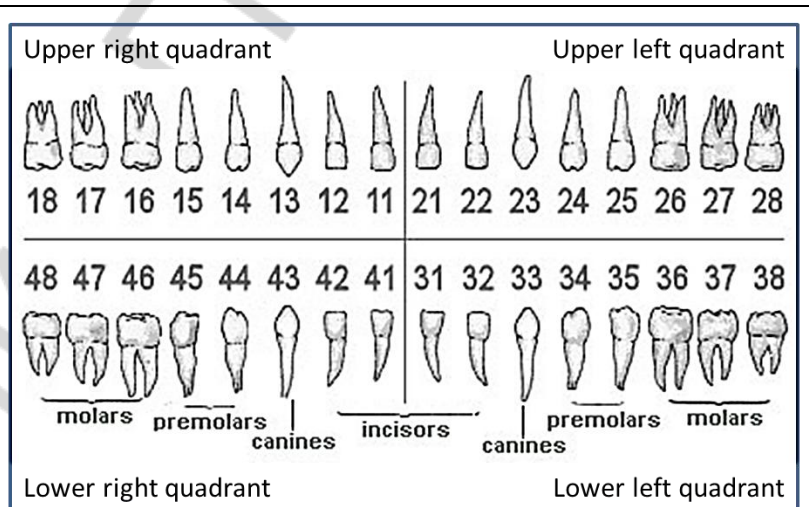
Dental row consists of 10 temporary (milk) teeth (4 incisors, 2 canines and 4 molars) in children and of 16 permanent teeth (4 incisor, 2 canine, 4 small (premolars) and 6 large (molar) teeth) in adults. In humans, the total score: temporary 20 teeth and permanent — 32. Teething milk teeth begins at 6–8 months and ends to 2.5–3 years, and loss begins in 6–7 years and is completed by 11–13 years. Teething of permanent teeth starts at 6–7 years and is completed by 17–22 years (table 13.1).

Table 13.1

The time of the teething of permanent teeth

JAWS	Teeth							
	Incisors		Canine	Premolars		Molars		
	1 Central	2 lateral	3	4 first	5 second	6 first	7 second	8 third
upper	7–8	8–9	10–12	10–11	10–12	6–7	12–13	17–25
lower	6–8	7–8	9–11	10–12	11–14	6–7	11–13	17–22

Materials and equipment: dental mirror (preferably an individual (personal) each student), a glass of potassium permanganate. **The progress of the work.** Ask the examinee to maximally open mouth and inspect the presence and location of teeth with (or without) a dental mirror.



Specify the Protocol:

1. Write a dental formula for person.

PROTOCOL

Dental formula for permanent teeth

Upper jaw right	1.8, 1.7, 1.6, 1.5, 1.4, 1.3, 1.2, 1.1	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8	Upper jaw left
Lower jaw right	4.8, 4.7, 4.6, 4.5, 4.4, 4.3, 4.2, 4.1	3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8	Lower jaw left

Dental formula for permanent teeth for person (age _____).

Upper jaw right			Upper jaw left
Lower jaw right			Lower jaw left

THE REPRODUCTIVE SYSTEM OF MEN AND WOMEN. THE ENDOCRINE FUNCTION OF SEXUAL GLANDS

Lesson 14

Date: _____ 20____

Questions to prepare for lesson: 1. Genotypic and phenotypic characteristic of sex. 2. Male reproductive system. The concept of macro-and microscopic structure of male genital organs. Characteristic of functional activity of sperm. 3. The testicles. Topography, macro-and microscopic structure. Androgens and their biological effect. Spermatogenesis, its regulation factors. 4. Female reproductive system. The concept of macro-and microscopic structure of external and internal genital organs. 5. The ovaries. The topography of their macro-and microscopic structure. 6. Estrogens, their role in the development of sexual characteristics. Oogenesis. Phases of ovarian-menstrual cycle. Corpus luteum hormones (progestins), their biological value. 7. Fertilization. Pregnancy, childbirth. The concept on the endocrine function of the placenta. Lactation: its mechanisms and ways of its regulation. 8. Changes in male and female organism at different stages of life: stage of puberty, stage of puberty and menopause.	LITERATURE <i>Main</i> 1. Lecture material of the department of normal physiology. 2. <i>Physiology</i> : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
---	---

Work 14.1

Main terms and concepts

Genetic characteristics of sex is	List female genital organs:
Phenotypic characteristics sex is	Estrogens and progestins is _____, produced female _____ and _____, male _____ and _____
List the men's genitals:	
Name the secondary sexual characteristics in men	Name the secondary sexual characteristics in women
Androgens is _____, produced in men _____ and _____, women in _____ and _____	The endocrine function of sexual glands are controlled by _____ system using hormones _____
Hormones to prevent early puberty children is	

Study computer programme "Lesson 14"

Work 14.2

(Internet Explorer → Pharm programme → Study programme → Lesson 14)

Work progress. Student independently loads the programme "Lesson 14" and examines the course material in detail.

Control computer programme "Pharm Faculty Lesson 14"

Work 14.3

(Testing → Tests for independent control → Pharm Faculty Lesson 14)

Work progress. Student independently loads the programme "Lesson 14" and answers the questions.

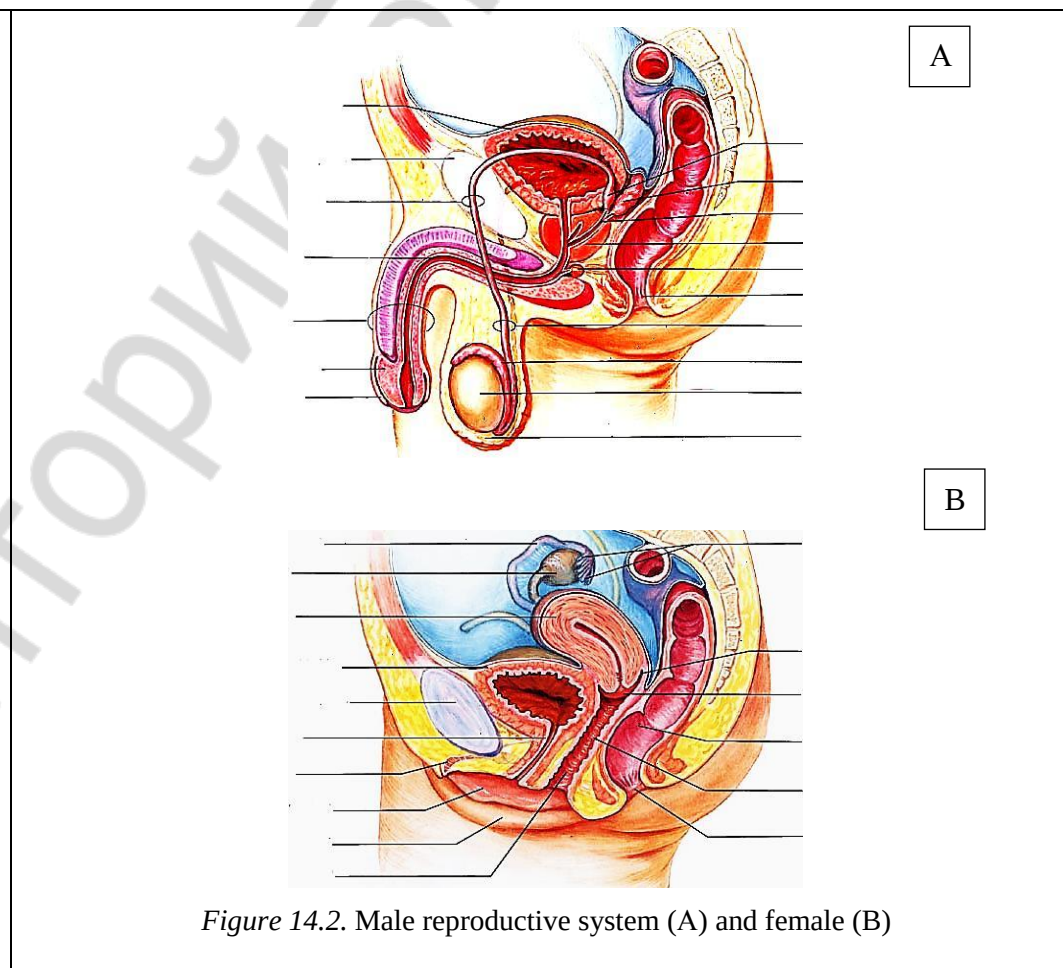
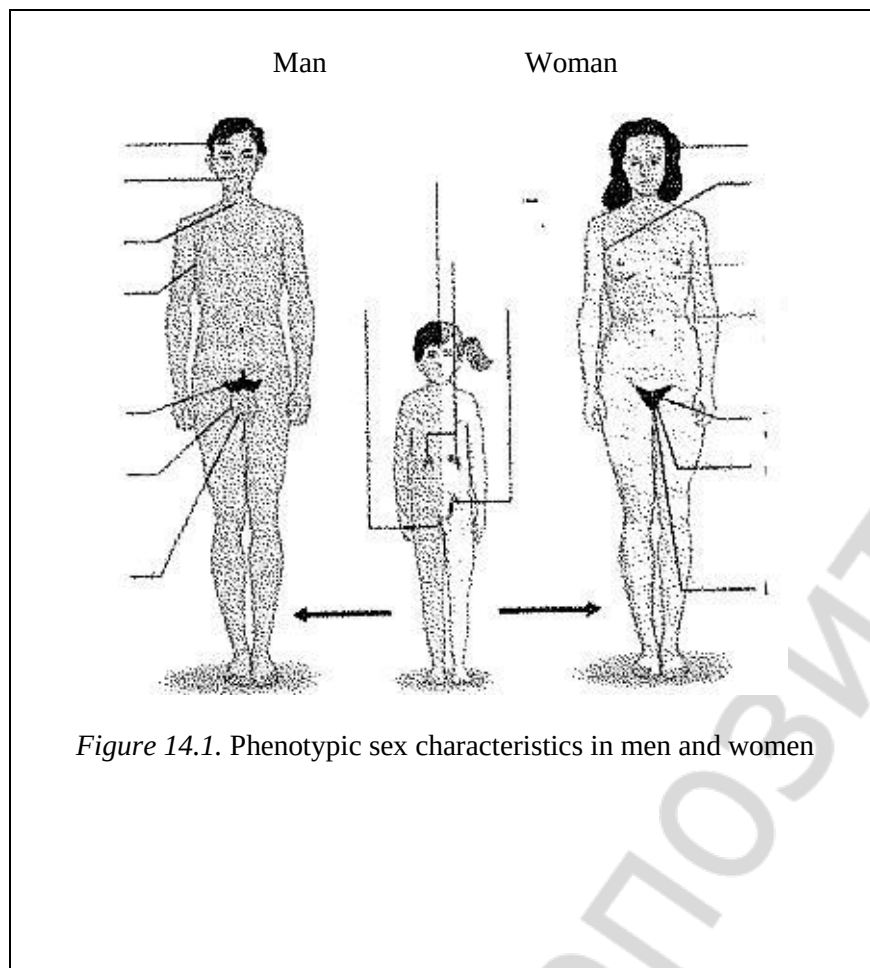
PROTOCOL

1. Score on testing _____. 2. Score on lesson _____.

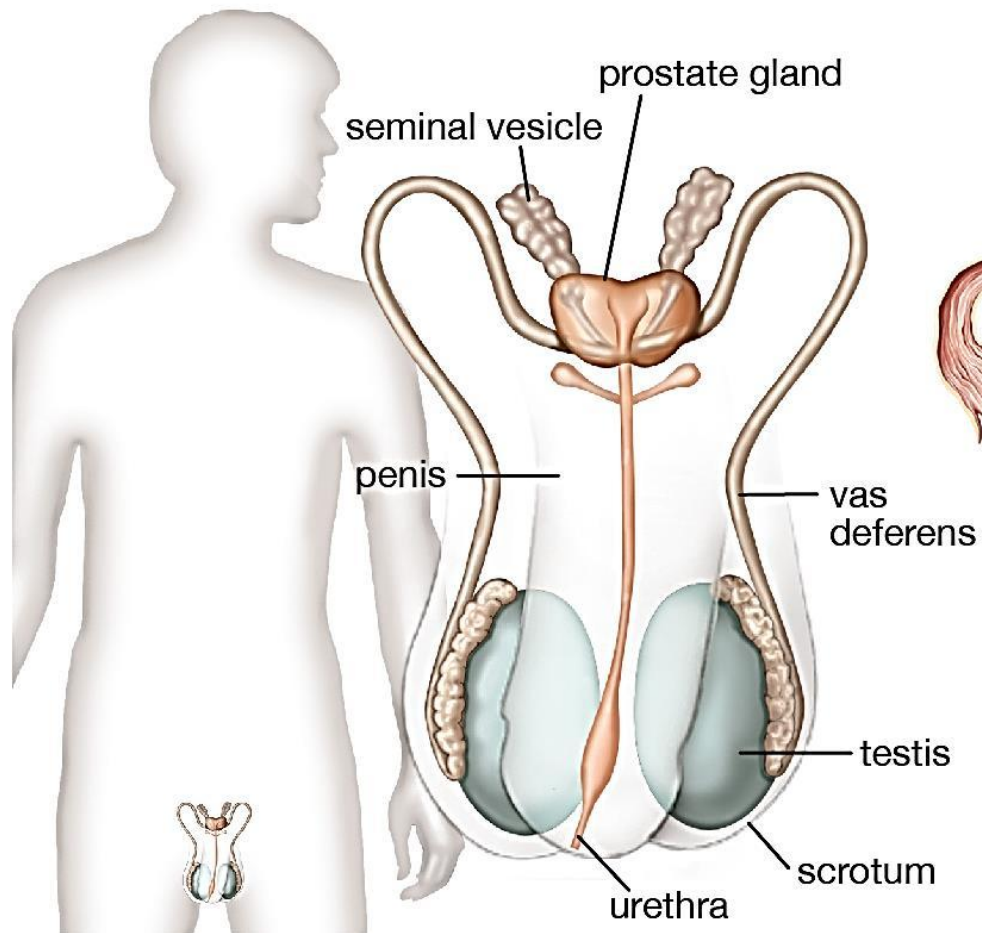
Primary and secondary sexual characteristics

In figure 14.1 label a primary and secondary sexual characteristics in men and women.

In figure 14.2 sign all organs of male (A) and female (B) sexual systems.



Male Reproductive System



Female Reproductive System

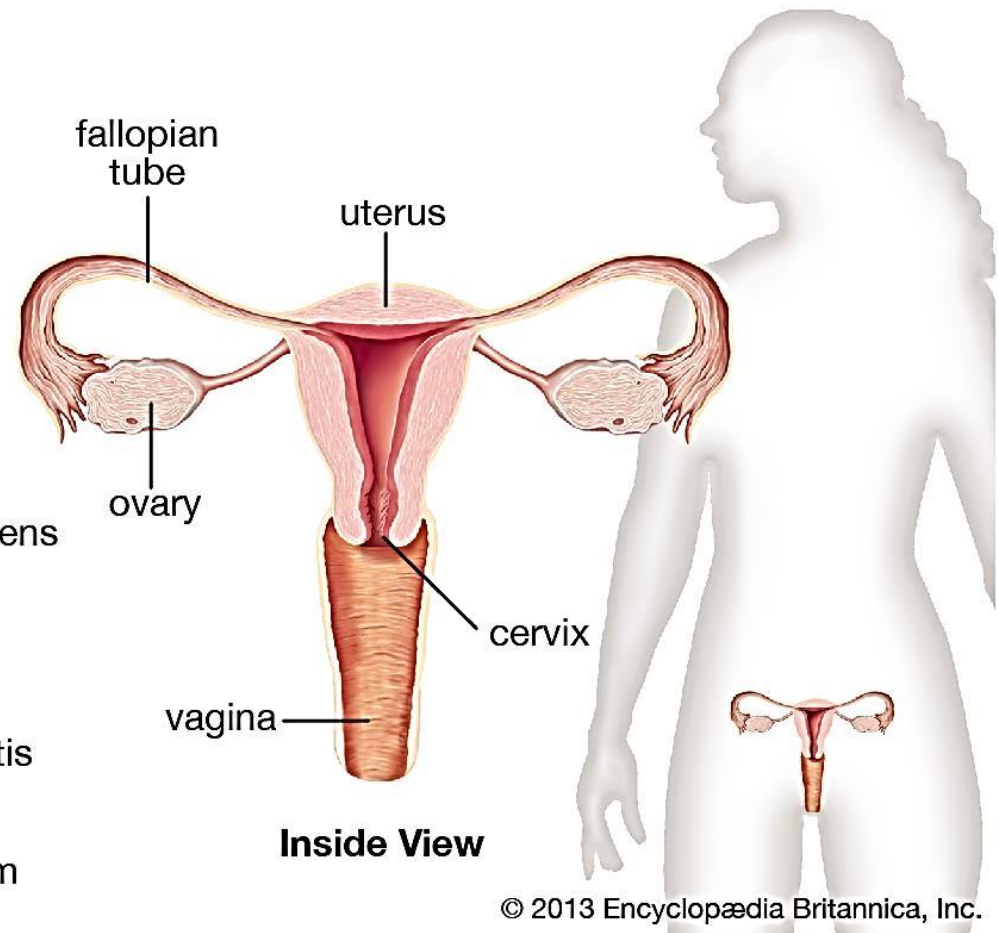


Figure 14.3

Androgens, male sex hormones, have an anabolic action on the organs and tissues, especially, skeletal muscles. The muscles of the chest and shoulder are sensitive to androgen (A. I. Kubarko, 2010). There are gender differences in the weight and strength of skeletal muscle in men and women.

Equipment: dynamometer.

Progress of work. Measure the strength of muscles of hands of all students in the group using hand dynamometer.

Directions to registration of protocol:

1. Write down the values of the strength of muscles of the hands of all students.
2. Calculate the average force the hands of men and women in each group.
3. Compare results and make conclusion.
4. From any of these differences depend on hormones.

PROTOCOL

1) The strength of men hands

--	--	--	--	--	--	--	--	--	--

2) The strength of women's hands

--	--	--	--	--	--	--	--	--	--

3) The average value of hand strength for women _____,
for men _____

4) Hand strength is higher in _____

Names of hormones _____.

THE FINAL LESSON ON THE SECTION “MORPHOLOGY AND PHYSIOLOGY OF THE NERVOUS AND ENDOCRINE SYSTEMS. REPRODUCTIVE SYSTEM”

Lesson 15

Date: _____ 20____

Questions for preparation to the final lesson:

1. Spinal cord: localization, structure, shell (оболочки), functions. Microstructure of a segment of the spinal cord, gray and white matter. The nerve cells of the dorsal, ventral and lateral horns, their functions. The composition and functions of the anterior and posterior roots. The concept of spinal cord pathways.
2. Spinal reflexes, their types and value. The concept of motor units. The structure of the “arc” somatic reflex.
3. The brain, the main structure. The brain: morphofunctional organization, vital centers, function. The concept of the cranial nerves: number, localization of nuclei, functions.
4. Reticular formation: morphofunctional organization. Characteristics of ascending and descending influences the reticular formation.
5. The cerebellum: morphofunctional organization. The role of the cerebellum in motor functions.
6. Diencephalon. Thalamus: morphofunctional organization (specific and nonspecific nuclei, their function).
7. Hypothalamus: morphofunctional organization; the main centers; connection with other divisions of the brain.
8. Cerebrum. Cortex of cerebrum: basic gyrus and sulcus. Afferent, efferent, and associative field and their relationships.
9. Localization of function in cortex. The right and left hemisphere. The concept of cerebral asymmetry and dominance of the hemispheres.
10. Limbic system: morphofunctional organization. The role of the limbic system in the formation of emotions, motivation, memory.
11. Basal nuclei and their functions.
12. The concept of systemic regulation of autonomic functions.
13. Morphophysiological characteristics of autonomous (vegetative) nervous system (ANS). Total overview of the structure of ANS.
14. Autonomic reflexes. Structure of arc of vegetative reflex (involving the spinal cord, brain, ganglia). Autonomic reflex: afferent, central and efferent links.
15. Topography of autonomic centers. The highest autonomic centers. The concept of visceral brain.
16. Peripheral division of autonomic nervous system. Microstructure of ganglia, pre-and postganglionic fibers. Transfer of excitation in ganglia, its mechanism.

17. Mechanism of transfer of excitation with postganglionic fibers to the working organs. Neurotransmitters and receptors of effector cells.
18. Structure and physiological features of the parasympathetic part of ANS. Physiological effects caused by excitation of n- and m-cholinoreceptors.
19. Structure and physiological features of the sympathetic part of the ANS. Physiological effects caused by excitation α - and β -adrenoreceptors.
20. Interaction sympathetic and parasympathetic periphery influences.
21. The concept of how to regulation of functional activity of organs and tissues, innervated ANS.
22. Morphofunctional organization of the endocrine system. Central and peripheral organs of the endocrine system. The functions of the endocrine glands, diffuse elements, intercellular communication methods involving chemical signals (paracrine, autocrine, endocrine and neuroendocrine).
23. Hormones: origin and chemical nature. Classification. Transportation forms, ways of metabolism, and excretion of inactivation of hormones.
24. Factors determining the concentration of hormones in the blood. Physiological rhythms of neuroendocrine secretion.
25. Mechanisms of action of hormones. Synergism and antagonism of hormones action on the target cell.
26. Neural and humoral, direct and inverse (positive and negative) connection in the regulation of the activities of the endocrine glands.
27. Evaluate methods the condition of functions of endocrine system in humans.
28. Hypothalamus, its hormones: releasing factors (liberens) and inhibiting hormones (statins), their biological effect. Vasopressin and oxytocin — hormones hypothalamus, their biological effect. Pathways hypothalamic hormones in the pituitary gland (anterior and posterior pituitary).
29. Pituitary gland. The topography, structure, departments and their main hormones: tropic (TSH, ACTH, FSH and LH) and effector (GH, prolactin, MSH, ADH and oxytocin). Relationship with the hypothalamus and the value in the regulation of peripheral endocrine glands. Regulation of pituitary endocrine functions.
30. Pineal gland. Topography and microscopic structure. The endocrine function of the pineal gland and its regulation.
31. The thyroid gland. Topography, macro-and microscopic structure. Thyroid hormones and their biological activity. Regulation of functions of thyroid gland. Hyper-and hypothyroidism. Calcitonin.
32. Parathyroid gland. Topography, microscopic structure. Parathyroid hormone, its biological effects.
33. Adrenal glands. Topography, macro-and microscopic structure. The cortical and medulla hormones, their biological effect. The concept of hypothalamic-pituitary-adrenal system.
34. Stress: concept, types, phases, mechanisms. Adrenal glands function by stress.
35. Endocrine pancreas apparatus. Topography, microscopic structure. Hormones, their biological effect.

36. Physiological mechanisms of self-regulation of glucose in blood.
37. The concept of diffuse endocrine system. The concept endocrine functions of the liver (somatomedin, angiotensinogen, trombocytopoetin, 1(OH)D₃), heart (atriopeptid), kidney (erythropoietin, calcitriol), GIT (gastrin, histamine, somatostatin, secretin), paraganglions (catecholamine's).
38. Regulation of calcium and phosphate homeostasis in organism. The role of calcitonin, parathyroid hormone and calcitriol.
39. The concept on the endocrine function of thymus.
40. Genotypic and phenotypic characteristic of sex.
41. Male reproductive system. The concept of structure of male genital organs. Characteristic of functional activity of sperm.
42. The testicles. Topography, structure, functions. Androgens and their biological effect. Spermatogenesis, factors of regulation.
43. Female reproductive system. The concept of macro-and microscopic structure of external and internal genital organs.
44. The ovaries. Topography, structure, functions. Estrogens, their role in development of sexual characteristics. Oogenesis. Phases of ovarian-menstrual cycle. Corpus luteum hormones (progestins), their biological value.
45. Fertilization. Pregnancy, childbirth. The concept on the endocrine function of the placenta. Lactation: its mechanisms and ways of its regulation.
46. Changes in male and female organism at different stages of life: stage of puberty, stage of puberty and menopause.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Instructions on the completion of the protocol:

Students sit for the final classes in the final form of a computer or written test (if required in combination with an oral examination) with the mandatory rating score.

Computer testing is the first step, which involves for the completion of control work in the computer class on the programme “Testing – Control testing – final pharm. faculty General Physiology with the basics of human morphology”. Lesson 9. Knowledge assessment involves grading from 1 to 10 points on the following scale:

99–100 % — 8 points

91–98 % — 7 points

81–90 % — 6 points

76–80 % — 5 points

71–75 % — 4 points

61–70 % — 3 points

51–60 % — 2 points

41–50 % — 1 points

21–40 % — 0 points

0–20 % — 0 point

Each student is required to calculate the rating of their academic performance, which is taken into account when placing the final score. Rating is determined by the summation of all scores obtained in each lesson and dividing this sum by the number of score.

PROTOCOL

Total number of questions _____. Number of correct answers _____. Score on testing _____. Rating _____.

Final grade for the colloquium _____ points _____;

taking into account the rating, is calculated as follows: (score on rating + score on testing) _____ + / 2 = _____ points.

SECTION III

SENSORY SYSTEMS. HIGHER NERVOUS ACTIVITY OF HUMAN

GENERAL PRINCIPLES OF STRUCTURE OF SENSORY SYSTEMS. STRUCTURE AND FUNCTION OF VISUAL, ACOUSTIC AND VESTIBULAR SENSORY SYSTEMS

Lesson 16

Date: _____ 20____

Questions to prepare for lesson:

1. The General principles of the structure of sensory systems, their classification. Role of sensory systems in brain development and cognition of the world.
2. Visual sensory system. Строеение, функции.
3. Concept of structure and functional value of retina. Photochemistry process in retinal receptors under the action of light. Function of pigment, horizontal, bipolar, amacrine and ganglion cells of the retina.
4. Transmission and processing of information in conduction pathways and central divisions of the visual system.
5. Theory of color vision. The basic form of dysfunction of color perception, importance for employment and professional selection..
6. Field of view. Visual acuity. Refraction and accommodation. Age features of view. Basics of correction of refraction.
7. The concept of eye movements, central and peripheral visual coordination mechanisms and eye movements functions.
8. Acoustic sensory system. Structure and properties apparatus, perceiving and conductive sound. The concept of the mechanisms of perception and analysis of sounds.
9. Binaural hearing. Audiometry, its value for hearing assessment. Age features of hearing. Hearing correction basics.
10. Vestibular sensory system (gravity). Structure and properties of receptor division, perception and evaluation of body position in space in statics and when you move.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Main terms and concepts

Sensory systems is	The visual system is
Organ of senses is	Eyeballs is
Analysator (I. P. Pavlov) is	Perception of photons of light by two kinds of receptors: 1) 2)
General principles of operation of the sensor systems: 1) 2) 3) 4)	The auditory system is
	Vestibular system is

Study computer programme “Lesson 16”

(Internet Explorer → Pharm programme → Study programme → Lesson 16)

Work progress. Student independently loads the programme “Lesson 16” and examines the course material in detail.

Control computer programme “Pharm Faculty Lesson 16”

(Testing → Tests for independent control → Pharm Faculty Lesson 16)

Work progress. Student independently loads the programme “Lesson 16” and answers the questions.

PROTOCOL

1. Score on testing _____. 2. Score on lesson _____.

Evaluation of visual acuity

Visual acuity is the ability to see clearly surrounding objects placed at various distances. Vision acuity is evaluated by a minimum vision angle, under which the eye is capable to discern two points as separate. A normal eye is capable to discern 2 points under the angle of vision 1' (1 angle second). It is associated with the fact, that for separate vision of two points it is necessary to have minimum one unexcited cone of retina between two excited cones. As the diameter of cone is 3 μm , the distance between images of these points on the retina must be no less than 4 μm . Such image value occurs under visual angle 1'. That is why when looking at two neighboring points under visual angle less than 1' they fuse into one point.

Materials and equipment: special tables (Golovin's or Sivtsev's) for evaluating visual acuity, a pointer, a 5-meter tape-measure.

Accomplishment. The study is performed using tables with letters of decreasing sizes. Next to each letter a distance is indicated, from which a normal eye must see letters of the given line under angle 1'. The table is hung on a well lighted wall. The examined must be at the distance of 5 m from the table. The study is performed for every eye separately. The examined covers one eye with a special shield. The examiner points to letters on the table with the pointer, and the examined must name them. Evaluation is started from the upper line and, descending, comes to the lower line, all the letters of which are clearly seen and correctly named by the examined. Then the visual acuity is calculated by the formula:

$$V = d/D,$$

where V — visual acuity (*visus*); d — distance to the table (i. e. the distance, from which the examined sees the line); D — distance, from which a normal eye must clearly see letters of the given line. Evaluate visual acuity of both eyes and compare it with the norm.

THE RULE OF VISUAL ACUITY. On medical examinations for norm take visus equal 1.0 the minimum angle of view in 1', but in the population has a certain number of people with small cones and consequently high acuity.

In another country the result of the assessment of visual acuity record as a fraction. This fraction corresponds to visus V, but it stores information about the distance. The measurement is done with 20 ft. (6.1 m), $V = 1$, $V = 20/20$ (6/6).

Directions to registration protocol:

1. Calculate the visual acuity in both eyes.
Evaluate the result by comparing it with the norm.

PROTOCOL

Visual acuity is the left eye _____, right eye _____.

Conclusion: Visual acuity is the left eye _____, right eye _____ (normal, below normal).

Sign name.

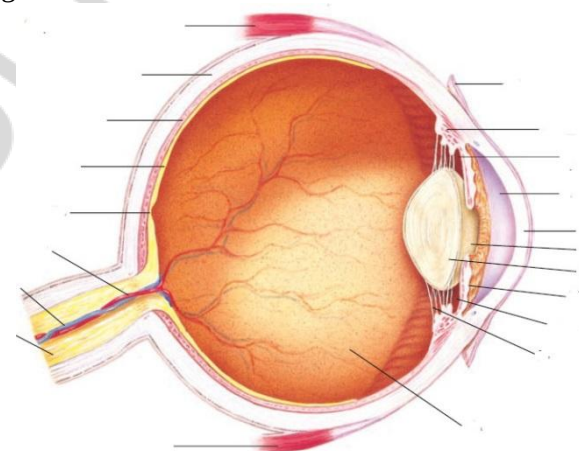


Figure 16.1. The structure of the eyeball

Sign names, using materials computer class.

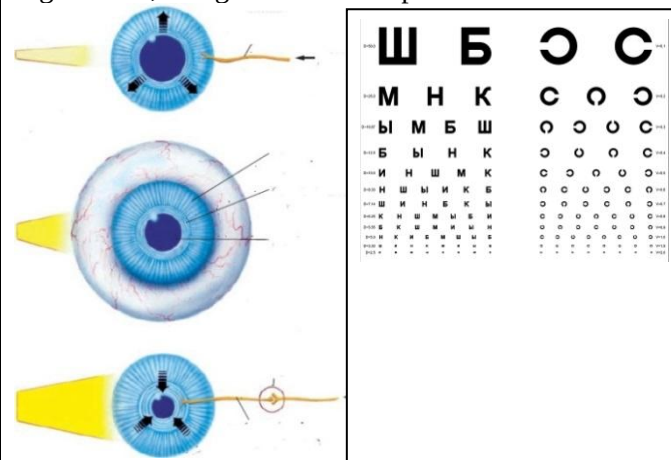


Figure 16.2. Mechanism of contractions and dilatation of pupil

Evaluation of visual field limits (perimetry)

Visual field is the space seen by a human eye, when the sight is fixed at one point. The value of visual field is not identical in different people and depends on the functional state of the retina, depth of the eye-ball, sizes and forms of superciliary arches and the nose. There are color (chromatic) and colorless (achromatic) visual fields. Achromatic visual field is larger than the chromatic one; it is due to the presence of rods located predominantly on periphery of the retina.

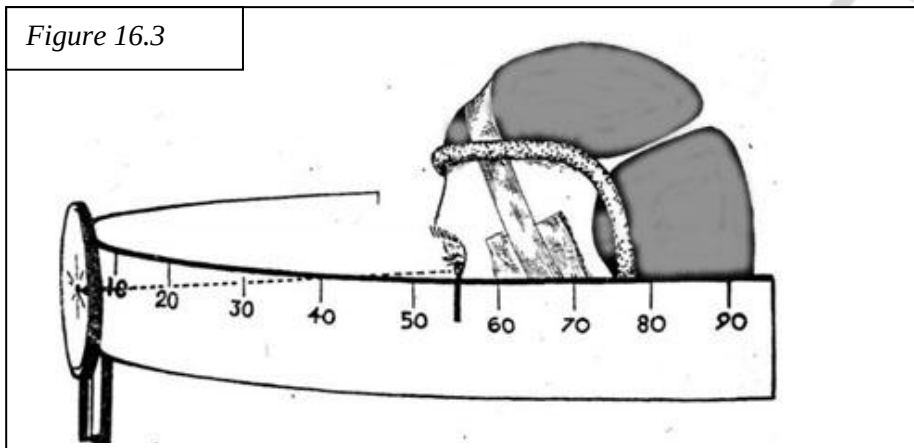
For various colors visual field is not identical either: it is the greatest for yellow color and the narrowest for green color. Approximate limits of the achromatic visual field towards outside is 100° , towards inside and upwards — 60° and downwards — 65° .

Directions to registration Protocol:

1. The results of the study record in a table.
2. Using the obtained results draw a diagram of visual fields for white and other colors.
3. Give your opinion on values in fields boundaries tested.

Materials and equipment: Forster's perimeter, objects of various colors, a ruler, colored pencils.

Figure 16.3



Accomplishment. The study is performed using Forster's perimeter that is a stand-holder with a movable calibrated (in degrees) metal arch with divisions on a lateral side. The examined must be seated with his back to light and put his chin on a rest of the stand-holder at the right (while examining the left eye) or at the left (while examining the right eye). Regulate the height of the rest so that the lower edge of the eye cavity was at the sight-plate level. During the whole experiment the sight of the examined stays fixed on a white point of the perimeter, the other eye is covered with a shield. Start the examination with a horizontal position of the perimeter. Slowly move the object (a white square or a circle 5–10 mm in diameter) along the internal arch surface from 90° to 0° ; the examined should point out the moment of appearing the object in the visual field and name its color. Repeat the study in a vertical and two oblique positions of the perimeter for objects of white, green or blue color.

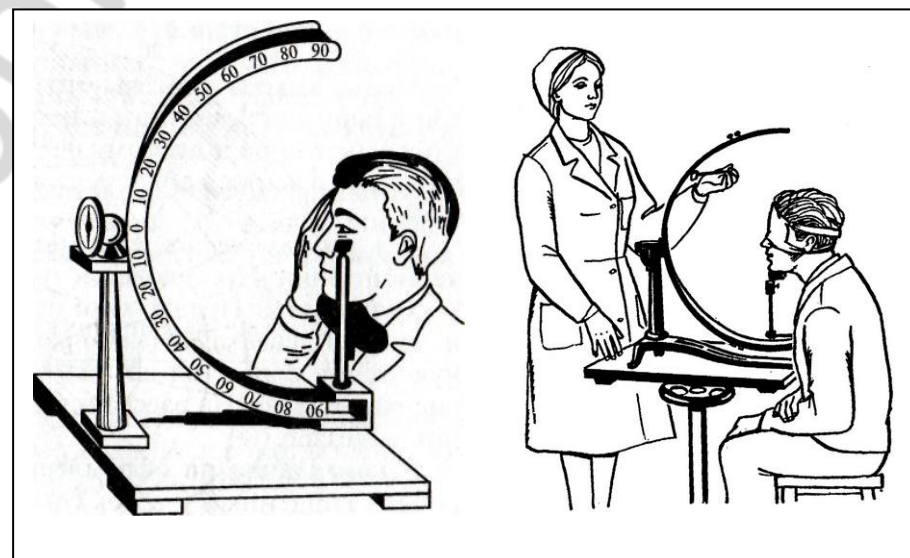


Figure 16.4

Figure 16.5

Evaluation of visual field limits (perimetry)

PROTOCOL

Table 16.1

Limit of visual field of the eye in degrees Orientation	Limit of visual field of the eye in degrees			
	for white color		for green or blue color	
	right	left	right	left
90° (upwards)				
270° (downwards)				
0° (outwards)				
180° (inwards)				
45° (outwards above)				
45° (outwards down)				
45° (inwards above)				
45° (inwards down)				

Conclusion:

Draw graphics. For right eye.

Examples for left eye, all color

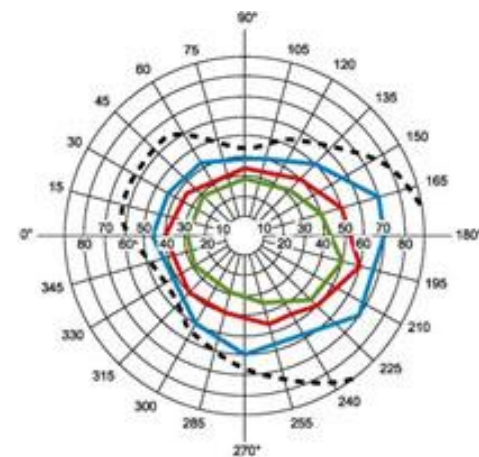
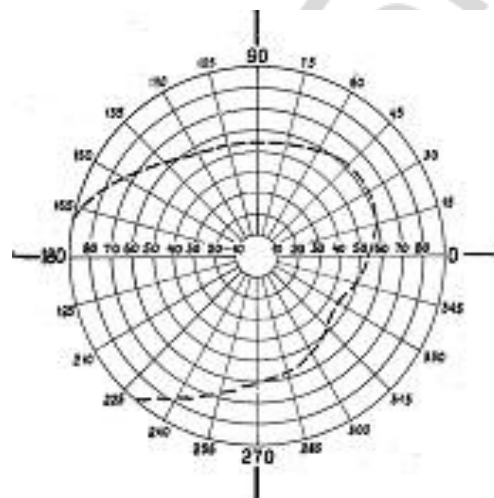


Figure 16.6. Limit of visual field

Explain the differences between fields of view for white and other colors.

Sensitivity evaluation of the retina central regions (computer work)

Sensitivity evaluation of central parts of the retina has an important significance as it determines visual acuity in many aspects. Sensitivity depends not only on neurons' functional state in this part of the retina but on the blood flow in its vessels, the state of the optic nerve, visual pathways, visual cortex and other factors. Accomplishment. The work is performed using program "Field sensitivity test". On entering the program a coordinate net appears on the screen that corresponds to angular dimensions of the retina's central region. 68 points are marked on the net; they will appear one by one on the screen at random. The work is performed after darkness vision adaptation in a semi-darkened room. Your eyes should be at the distance of 30 cm from the screen at the level of its medium part. Try to keep the head motionless. The study is performed for each eye separately. One eye should be closed. During the whole study the sight should be fixed at a cross in the center of the screen. Some time later a fluorescent point appears in the vision field. The point intensity increases gradually, and at some moment it becomes sufficient to be discerned on a dark screen. As soon as the point becomes discernable, press "Enter" immediately. As sooner you note the fluorescent point, the smaller is the brightness necessary for perception of a stimulus with the given part of the retina, i. e. the greater is its sensitivity. To start testing press "Enter" again, the coordinate net will disappear and a cross will appear in the center for sight fixation. There will be a back count of points starting with 68 in the upper left corner. Don't forget that the sight is constantly fixed at the center of the screen all the time. After the last point has appeared, the testing results will be presented as a colored distribution of points of the coordinate net in accordance with the color scale. Depending on the time needed for finding the points, the sensitivity of every part of the studied region of the retina is evaluated. Points of blue color correspond to the area of maximum light sensitivity, points of light blue, green, yellow, red and pink color — to the areas with less and less sensitivity in the central part of the retina. Predomination of blue and light-blue color evidences high sensitivity of the retina, of green and yellow color — normal moderate sensitivity. Points of red and pink color predominate, when sensitivity of the retina is reduced. A considerable impact on the results of the study produces the degree of darkening and time of preliminary darkness adaptation. But while performing the work in similar for the whole group conditions the results of different examined people can be compared even in short times of darkness adaptation. To exit from the program press "Esc".	Directions to registration Protocol: 1. Specify what colors dominate the points on the screen after the test from the test subject. 2. Give opinion on retinal sensitivity researched eyes. PROTOCOL On the screen is dominated by point _____ colors. Conclusion: Retinal sensitivity researched eyes _____ (high, medium, or reduced).
--	--

Studying color vision

The human eye can discern both shades of black, white, grey colors and all colors and shades of the rainbow. However, there occur various disorders of color perception in some people. Complete color blindness occurs extremely rare. People with this form of color vision disorder see only various shades of grey. Partial color blindness occurs more often.

Studying color vision has a particular significance for people, whose profession requires good orientation in all colors.

Materials and equipment: polychromatic tables of E. B. Rabkin, a shield for covering one eye, a centimeter tape.

Accomplishment. Every table should be set at the eye level of the examined at the distance of 1 m from him. The exposure duration of one and the same table is about 5 sec. Each eye is examined separately, the second eye being covered with a special shield.

Directions for recording the protocol:

1. Describe the results of studying color perception.
2. In case of a disorder revealing point out, to which type it is referred.

Conclusion: (if there are any color perception disorder in the examined).

PROTOCOL

Conclusion:

Structure of auditory analyzer

Sign name

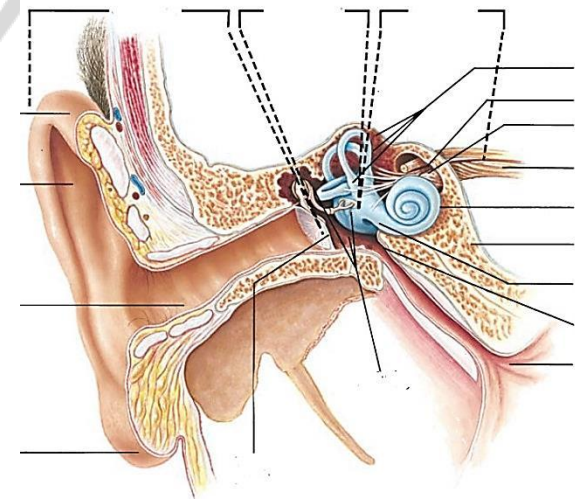


Figure 16.7

Evaluation of sound source direction

The man and animals possess spatial hearing that allows placing a sound source, the degree of its remoteness and direction of its movement as well as increases the clearness of perception. Time characteristics of spatial hearing are based on joining data received from both ears (binaural hearing). Determination of the direction to the source of the sound is based on the two factors. For **low frequencies** the basic factor is the **time difference**, and for **high frequencies** — the **intensity difference** of a sound wave reaching the left and the right ear.

Materials and equipment: a camertone, a phonendoscope with tubes of different lengths.

Accomplishment. The examined with closed eyes must determine the direction of a sound source created by tapping (e.g. with a pencil over pencil) on the right, on the left, in front of, behind the back of the examined. Then insert into the ears of the examined olives of the phonendoscope, one of the tubes of which is considerably longer than the other. The phonendoscope must be behind the examined. Repeat the experiment for determination of the sound source direction.

PROTOCOL

Conclusion: the sound seems to be biased towards more _____ (short, long) path.

Explain the reason for this phenomenon _____

Bone and air conductions (tests Veber and Rinne)**Weber's test**

There is bone conduction and air conduction. Air sound conduction is ensured by transmission of a sound wave by usual way through a sound-conducting apparatus. Bone conduction is the transmission of sound waves directly through cranial bones.

Materials and equipment: a camertone, a stop-watch, cotton pads.

Accomplishment. Apply the handle of the vibrating camertone to the top of the head in its middle line. Ask the examined if he hears by both ears the sound of the same intensity or it is heard better with one ear. In the damage of the sound-perceiving apparatus lateralization of the sound is noted to the side of a healthy ear, in the damage of the sound-conducting apparatus the sound is lateralized to the side of an damaged (that poorly hears) ear. Repeat the experiment covering the one auditory canal with cotton.

PROTOCOL

Results:

Sound intensity on the left and on the right in the initial state:

After closing the auditory canal — _____

Conclusion:

The cause of sound lateralization on closing one auditory canal:

Rinne's test (comparison of air and bone sound conduction).

Accomplishment. Apply the hand of the camertone to a mastoid bone at one side and take the time till sound perception disappears (the time of bone conduction). Then bring the same still vibrating camertone to an external auditory canal. In norm the examined must hear sound of the camertone that is still oscillating. Take the total time, during which the sound is heard (the time of air conduction). In norm the time of air conduction is greater than that of bone conduction (a positive Rinne's test). When the sound-conducting apparatus is impaired, the time of air conduction does not exceed the time of bone conduction (a negative Rinne's test). In a healthy person when using the camertone C_{128} time air conductivity averages 75 s, and bone — 35 s; when using the camertone C_{256} — about 40 s и 20 s.

PROTOCOL

Air conduction time: on the left —

on the right —

Bone conduction time: on the left —

on the right —

Conclusion: Rinne's test

Studying the dependence of auditory sensitivity on sound frequency (Demo work)

The human ear perceives sound oscillations in the range of 16–20 000 Hz. The greatest sensitivity to sound oscillations is in the range 1–3 kHz that coincides with the frequencies range of the human speech.

Sensitivity of the auditory analyzer is evaluated by a minimum value of sound pressure sufficient for a sense perception to appear; i. e. by hearing threshold. To determine this minimum sound pressure audiometers are used. They permit precisely dosing sound oscillations frequency in the range from 100 to 10 000 Hz and sound intensity in the range from 0 to 100 dB. To characterize the state of the auditory analyzer in the examined one should find hearing thresholds for every fixed frequency of sound oscillations and draw a graphic relationship of the hearing thresholds and sound frequency — an audiogram.

Materials and equipment: an audiometer, ear-phones.

Accomplishment. Using the sound generator, determine thresholds of absolute auditory sensitivity (in decibels) for the left and right ear for the following frequencies:

Instructions for execution the protocol:

1. Enter the data in a table 16.2.
2. Results build the audiogram test subject (рисунок. 16.7).
3. Make a conclusion.

PROTOCOL

Table 16.2

The auditory sensitivity

150 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz
4000 Hz	5000 Hz	8000 Hz	11000 Hz	15000 Hz

threshold, dB

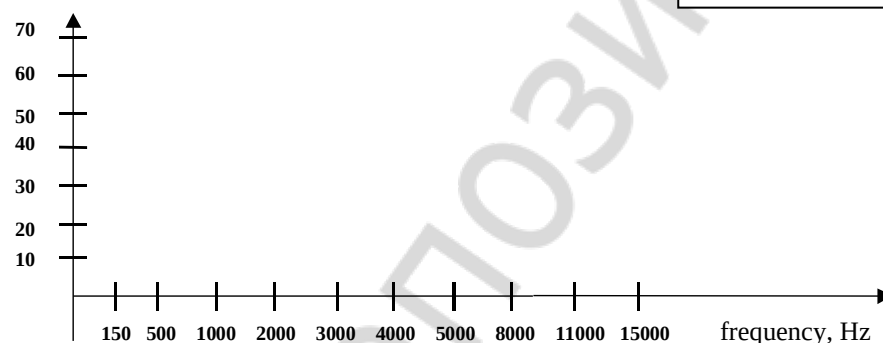


Figure 16.7. Audiogram

Conclusion:

**STRUCTURE AND FUNCTION OF THE OLFACTORY,
GUSTATORY, CUTANEOUS AND VISCERAL SENSORY SYSTEMS.
NOCICEPTION. NOCICEPTIVE AND ANTINOCICEPTIVE
SYSTEMS: STRUCTURE, FUNCTIONS AND MECHANISMS
OF FUNCTIONING**

Lesson 17

Date: _____ 20____

Questions:

1. Olfactory sensory system. Reception of smells. Conducting pathways and the central departments of the olfactory system. Classification of odors.
2. Taste system. Gustatory sensitivity. Taste bulb, structure. Conducting pathways and the central departments of the gustatory system. Perception of taste. Classification of taste sensations. Methods for determining the threshold of taste sensations and functional mobility.
3. Skin sensitivity. Types of sensory receptors of the skin and their functions. Thermoreception. Proprioceptive sensitivity. Conducting pathways and the central departments
4. Interceptive sensitivity. Receptor mechanisms. Types of visceral sensitivity. Organism reaction to the irritation of interoceptors. Interoceptive role in maintaining homeostasis.
5. Nociceptive system: nociceptive reception and conduction signals of pain sensitivity.
6. Pain: species, and biological value. Mechanisms of pain: the role of neurotransmitters, hormones and brain oligopeptide.
7. Antinociceptive system. Endogenous opioid peptides (endorphins, enkephalins), their role in the regulation of pain. The role of emotions in the regulation of pain sensitivity.
9. Principles of anesthesia.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Work 17.1

Main terms and concepts

The olfactory system is	The pain is
Vomeronasal system is	Nociceptive system is
Taste system provides a perception of the five basic taste qualities: a) _____; б) _____; в) _____; г) _____; д) _____	On the nature of pain perception influences nociceptors are divided into: 1) _____; 2) _____; 3) _____
Touch receptors in the skin are: 1) _____ 2) _____	Endorfiny, serotonin, noradrenergic, GABA-ergic subsystems are parts _____ system
Analgesic effect of aspirin was due to the blockade of the synthesis of mediators of pain —	Interoreceptive sensitivity is

Study computer programme “Lesson 17”

Work 17.2

(Internet Explorer → Pharmprogramme → Study programme → Lesson 17)

Work progress. Student independently loads the programme “Lesson 17” and examines the teaching material in detail.

Control computer programme “Pharm faculty Lesson 17”

Work 17.3

(Testing → Tests for self (independent) control → Pharm faculty Lesson 17)

Work progress. Student independently loads the programme “Pharm Faculty Lesson 17” and then answers questions.

PROTOCOL

1. Score on testing _____. 2. Score on the lesson _____.

Studying tactile sensitivity. Esthesiometry (measurement of spatial thresholds)

Tactile sensitivity is measured by esthesiometry. There is a spacial sensitivity that is characterized by a spatial threshold, and sensitivity that is determined by a power threshold. Spatial threshold of tactile sensitivity is characterized by that least distance between two points of the skin, in simultaneous touching to which a sense of two touches occurs. It characterizes the spatial discriminative ability of the skin.

Materials and equipment: an esthesiometer (Weber's compass).

Accomplishment. The examined must be seated with closed eyes. The esthesiometer with branches brought together maximally close is brought in touch with some regions of the skin. It is necessary to observe that both needles of

the esthesiometer touched simultaneously and with identical pressure. Touching is repeated with gradual increasing the distance between the esthesiometer branches (every time by 1 mm), and a minimum distance is found, when a sensation of two separate touching appears. This distance is a spatial threshold

for the given region of the skin. Evaluate the spatial threshold of skin surface on the regions indicated in the table..

Directions to registration the protocol:

1. Values found spatial sensitivity thresholds enter into a table.
2. Compare the spatial sensitivity thresholds examined skin. Explain the reasons for their differences.

Skin surface	Spatial threshold (in mm)
Internal side of the forearm	
External side of the forearm	
Tip of index finger	
Cheek	
Forehead	
Lip	

Conclusion:

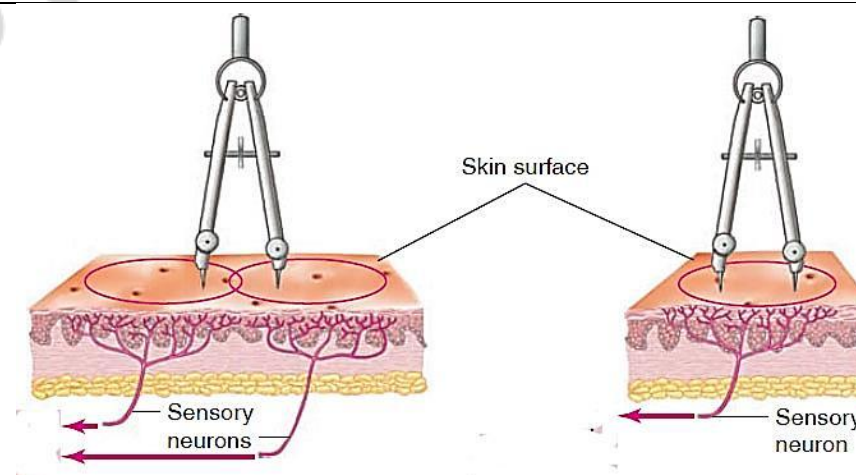


Figure 17.1

Studying taste sensitivity

Materials: Solutions of common salt, sugar, citric acid and quinine, each solution in 5 concentrations: 1 %, 0.1 %, 0.01 % and 0.001 %.

Accomplishment. The examined is given 2–3 ml of the solution of unknown to him substance with a pipette or in a test-tube starting with a minimal concentration. Having kept the solution in the mouth for 20–30 sec (without swallowing), he must identify the taste of the solution. If the examined cannot identify the taste, he is given the solution of greater concentration of the substance — until he surely identifies the taste. The solution concentration, at which the examined correctly defined the substance taste, is threshold. The less is this concentration the higher is sensitivity to this substance.

Fill up in the table:

Directions to registration the protocol:

1. Define thresholds of taste sensitivity have tested using the tested solutions.
2. The received data is contribute to a table.

PROTOCOL

1. Fill in the table:

Substance	The threshold concentration of analyte (in %)
Bitter (quinine)	
Sweet (sugar)	
Salty (table salt)	
Sour (citric acid)	
Minds (monosodium glutamate)	

Conclusion:

Explore the mechanisms of gustatory receptors and complement the scheme, using the computer classroom and materials recommended textbooks.

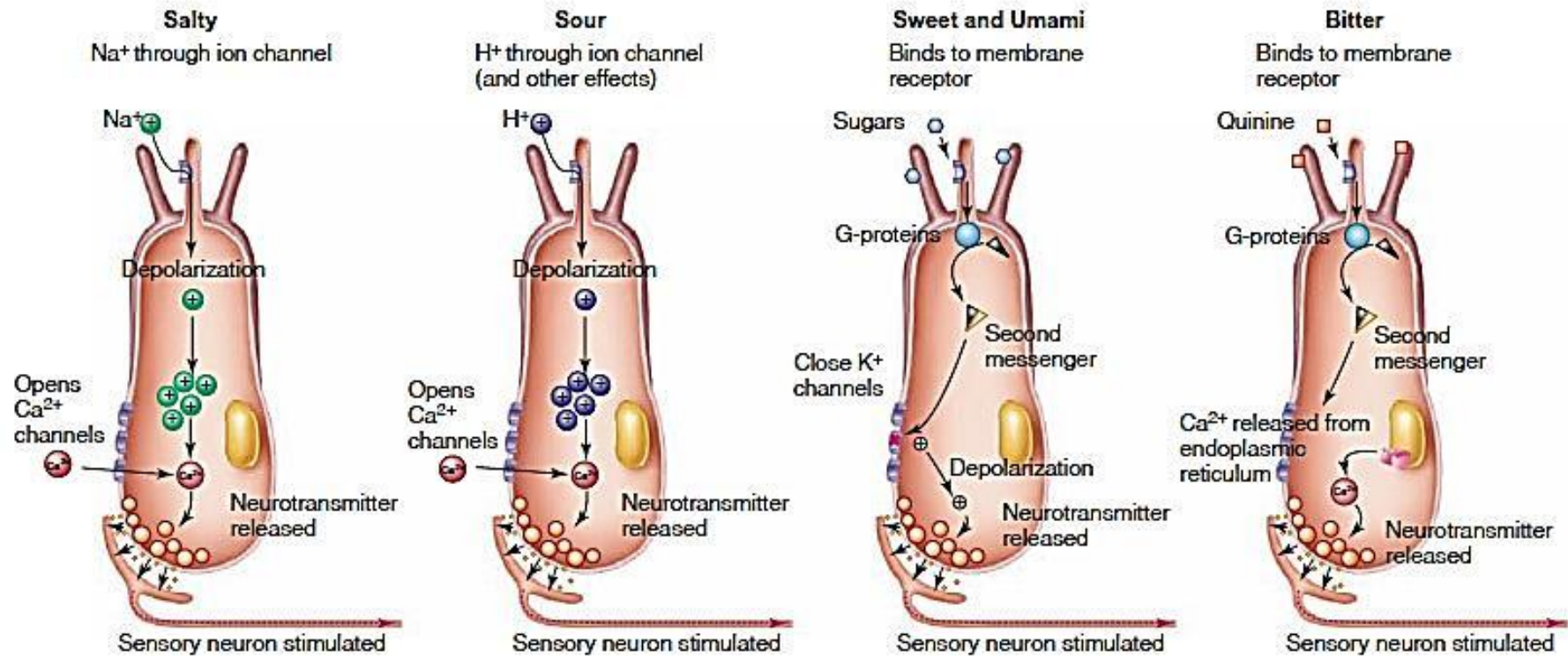


Figure 17.2

INTEGRATIVE FUNCTION OF BRAIN. CONGENITAL AND ACQUIRED FORM OF BEHAVIORS. HIGHER MENTAL FUNCTIONS OF BRAIN

Lesson 18

Date: _____ 20____

Questions to prepare for lesson:

1. Congenital forms of behavior (unconditioned reflexes and instincts), their value for adaptive activity of an organism.
2. Acquired form of behavior, their types (conditioned reflex, dynamic stereotype), the value to adaptive for animals and humans to changing conditions of existence. Classification of conditioned reflexes. Concept of the mechanisms forming of conditioned reflexes.
3. Inhibition of conditioned reflexes. Types of inhibition.
4. Types of higher nervous activity of human. The value of works of I. M. Sechenov and I. P. Pavlov for the development of the theory about mental activity human and behavior.
5. Memory: concept, types, mechanisms. The role of attention in memorizing and learning. The concept of types of memory disorders.
6. Concept on consciousness, thinking, the unconscious.
7. Systematic organization of purposeful behavior (by P. K. Anohin). Mechanisms of functional system of behavior: the afferent synthesis, adoption of decisions, forming apparatus foresight results, the efferent synthesis, reverse afferentation.
8. Motivation: species neurohumoral mechanisms of formation. The role of the hypothalamus and limbic system in forming biological motivation. The role of cerebral cortex in forming social motivations.
9. Emotions: species, neurophysiological mechanisms of formation, biological value. Emotional stress.
10. The first and second signal system. Speech. Functional asymmetry of cortex, related to the development of human speech.
11. Sleep: types, symptoms, physiological value. Neurophysiological mechanisms of sleep.

LITERATURE

Main

1. Lecture material of the department of normal physiology and related disciplines.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Work 18.1

Basic terms and concepts

Congenital forms of behavior is	Types of conditional (internal acquired) inhibition: 1) _____; 2) _____; 3) _____; 4) _____
Imprinting is a	Human types of HNA: 1) _____; 2) _____; 3) _____; 4) _____
Dynamic stereotype is	Memory is
Lower nervous activity is	Human consciousness is
Higher nervous activity (HNA) —	

Study computer programme “Lesson 18”

Work 18.2

(Internet Explorer → Pharm programme → Study programme → Lesson 18)

Work progress. Student independently loads the programme “Lesson 18” and examines the course material in detail.

Control computer programme “Pharm Faculty Lesson 18”

Work 18.3

(Testing → Tests for independent control → Pharm Faculty Lesson 18)

Work progress. Student independently loads the programme “Lesson 18” and answers the questions.

Assessment of semantic memory volume

Semantic (mediated memory) is characterized by the presence of and independent, proactive use different means of memorization, storage and playback of information. During the research, it is important to identify, can the person install semantic relationship between requirements and own notes (drawings, symbols, signs). When evaluating the results of the study calculated correctly playable words. Features of mediated memorization expressed through the quality of the drawings of a person. All images can be classified into five major types of: • Concrete — concrete subjects; • Plot oriented — visible objects, characters are combined in any situation, story or one character that performs any activity; • Abstract — in the form of lines, not designed in any way; • Sign-symbolic — as signs or symbols (<i>geometric shapes, arrows, letters, numbers, etc.</i>); • Metaphorical — images in the form of a metaphors, fiction. According to the results of the study can be to evaluate the development level of mediated (semantic) memory, as well as to the conclusion about the nature of the thought process (t. e. type of thinking) a person depending on the most frequently used types of images. Materials and equipment. Pens. Progress of work. Teacher read out the 20 concepts. The student in practical manual makes tagging (symbols or sketches, but not a Word), sketching, those associations that you cause. Example concepts: <i>coastal, loss, sweet, barrel, peak, gentle animal, dog on the straw, the sad, crunching ice, flight of the Bumblebee, a clear path, dusk, faithful companion, flame, dogs happy, evening call, light walking, lurch, destiny.</i> Through 30–60 minutes under each symbol sign all 20 concepts. Place for drawing go to p. 128.	Directions to registration Protocol: 1. Write error count 2. Count the number of points — for each correctly reproduced on your own markups (drawings, symbols, etc.) a word or phrase person gets 1 point. 3. Make a conclusion on the nature of the have a thought process of a person. 4. Compare the results with the results of other persons and norm. Normative data for the level of development of semantic (mediated) auditory memory: 20 points — very highly developed; 16-19 points — highly developed; 8-15 points — average developed; 4-7 points — low developed; 0-3 points — weak. Regulatory data to determine the nature of the thought process (way of thinking) in person. 1) Abstract and sign-symbolic types of drawings — high level of abstract-logical thinking. 2) Plot and metaphorical images make up a group of people with creative thinking. 3) A specific type of images you can suggest specific effective thinking. PROTOCOL 1. Number of errors _____. The amount of points _____. 2. Conclusion: a) the level of development of semantic memory: _____ (very high, high, medium, low, weak); б) type of thinking _____ (abstract-logical, creative, specifically the effective)
---	--

Evaluation of short-term auditory memory volume using alphabetic and numeric complexes

For the duration of the storage of information there are several types of memory. Memory, providing retention and playback of operational information, known as **short-term**. Its volume is approximately 7 ± 2 units. The main characteristic of this type of memory is short. Storage of information in short-term memory lasts seconds, minutes. To quickly determine the amount of short-term memory using alphabetic or numeric signal complexes. Set the maximum number of digital and alphabetical characters that person can master (at the hearing, or by looking at the scoreboard) from one presentation and playback.

Materials and equipment: tables with numeric or alphabetic signalling complexes, a watch with a second arrow.

Progress of work. Use two tables with signalling complexes of letters or numbers. Each table has 8 rows; the shortest first series consists of 3 characters. Read signal complexes from the table, starting with the shortest, consisting of 3 elements (e. g. 9, 7, 2 or A, Ы, О) with a speed of 3 character in 2 seconds.

After each set of do interval in 5–7 seconds. Person immediately repeats from memory heard complex in the same sequence. If a series of numbers (or letters) without errors, read next row, in which the number of items exceeds the one character (for example: 1, 4, 6, 8 or E, Ю, У, Ы). After error (skip or replace a character or change their sequence playback) read a new set with the same number of elements, but now from another table. After the successful development of this complex name the following set with a large number of items. If the error occurred again, then the work should be complete. Calculate the number of characters in the last set, signal playback correctly. This figure is an upper limit on the amount of short-term memory.

The average **3–7 characters**.

9 7 2 1 4 5 6 3 9 3 1 8 4 7 6 2 8 5 3 1 5 6 2 9 7 3 8 3 9 1 2 7 4 7 6 4 5 8 3 1 2 9 2 1 6 4 3 8 9 5 7 3	6 4 1 2 7 3 5 8 5 9 4 3 7 6 5 2 9 4 1 5 3 8 7 9 6 2 9 6 8 1 3 5 7 3 4 2 8 6 5 1 2 9 4 7 9 5 3 8 8 2 1 5
А Ы О Е Ю У Ы О У Ю Е А Ы О Е А Ю У У Е Ю А Ы О Е Ю А Е У О Ы А Ю А Ю Ы О У А Е Ы О Е У А Ы Е У Ю О А Ы	Ю А Ы У Е О А Ы О А Ю Е О Ы У Е А Ю Е У А Ю Ы Е О А Ю Ы У О А Ы У Ю Ы О А У Ы Ю Е А У Е Ю О Ы У А О Е Ы

Directions to registration Protocol:

For character

Correct _____

For character

Correct _____

Evaluation of latent period sensorimotor reaction (computer programmer)

Sensorimotor human reaction in response to a light stimulus is the simplest mental reaction. The latent period, which consists of conduction time of signals from the retina the visual centers, processing and identification of visual stimulus, the conduction of the efferent signals from the sensory vision centers in the motor cortex centers, spinal cord and the muscles. The duration of the latency period is also the extra time, associated with individual characteristics of mental processes (type of HNA). The latent period of reaction to the light stimulus is about 180–200 msec. In the life of a man forced to distribute their attention between two or more activities. Performing two or more of the activities requires the distribution of attention, increases the latency of response and increases the likelihood of erroneous actions.	Materials and equipment: a computer programmer “Reaction test”. PROGRESS OF WORK. Go to computer programmer “Eye test”, then “Reaction test”. A light triangle appears on a dark screen. It will disappear in 2–3 sec. When it appears again it is necessary to press <i>Enter</i> maximally quickly. The value of a latent period of your simple sensorimotor reaction in milliseconds will appear in the upper part of the screen. Repeat the test again. Immediately, after the triangle disappears, start mental subtraction of 7 from 200 ($200 - 7 = 183$, $183 - 7 = 176$ etc.) with maximum speed. Without discontinuation of the count and on appearing of a triangle, press <i>Enter</i> as fast as you can. Put down the obtained value of a latent period of a complex sensorimotor reaction. On the basis of the obtained latent periods compare the speeds of a simple and complex sensorimotor reaction. “Enter”. Directions to registration Protocol: 1. Enter the received data to the Protocol. 2. Compare these indicators and explain their differences.
PROTOCOL Latent period of a simple sensorimotor reaction is _____ msec. Latent period of a complex sensorimotor reaction is _____ msec. Conclusion: _____	

Work 18.7

Assessment of attention indices using a correction test

Work 18.4

Assessment of semantic memory volume

Attention is one of the main psychological processes, on characteristics of which depends the state of cognitive readiness for learning, successfulness of academic and professional activity.

Basic characteristics of attention:

- stability — the ability to keep attention on one and the same, sufficiently high level during a long period of time;
- distribution — the ability allowing to keep simultaneously a number of inhomogeneous events in the sphere of attention;
- switching — a property that is characterized by the speed of switching attention from one object to the other, the ability to distract from the first and concentrate on the second;
- attention volume — is the number of objects or events that can be simultaneously in the sphere of attention of a person.

The correction test suggested for the first time by B. Bourdon in 1895 allows assessing the ability of concentration and stability of attention.

The study is performed using special correction tables — forms with rows of randomized Landolts' rings, letters, digits, figures, etc. The work offers a letter variant of tables.

Materials and equipment: a stop-watch, a pencil, standard correction tables with rows of small letters placed randomly without intervals.

Accomplishment. The work is performed either individually or by the whole group of students. The time of accomplishment is 5 min. Standard correction tables contain 1600 signs.

Instruction for the examined. By a signal you should start looking through attentively every row of table 43 from the left to the right, find and cross out that letter, with which the line starts. The work is performed for a time with maximal speed and precision. Every minute on command "line" mark with a vertical line that place on the form, where the command caught you. The work stops on command "stop".

Place for drawing from work 18.4.

Standard character table for correction test

СХАВСХЕВИХНИСХНВХВКМНАИСЕМВХЕНАИСНПУКСОВ
ВЕНХИВСНАВВСАВСАЕКМАХВКЕОРУМЛПНАВЫВАМПРИ
НХСРОВНВОТКНЛМЧАМОЛТВНЛМИСМГУБВННСМЛОТЛБ
ХАКИТОНВММБЛЧСХНГХАИХКМИНГСБЧХФИСБЛМОГНХ
АХВСТМОНЕУБСТГАХЫЧНАТНВЛСМНГАХВВЛГМВЕМНМ
СОРНВУЛОНСМСЛНХЧССИОЛКОМГИСМВЛХТСИМНЕПСМ
УХРАОПНИСМИОТУХНГВЛБЯШГВИМТСНУХЛОГНЦСИМУ
ИКНГАЕПВОРСМИТУХЫЖБСИНУХТЯДЛАНТСИМХВУМОЛ
БВАПМИСРОКНЕОЛЭТФОЕУБВОАЖМБНАОПМЮЭХЦШАМ
СИТНЫДАОРЕГСМИТАНЦХЭОАЛСЬМАЫЖЧТСНМКЕАВЭХ
ВАПУЕКАЧМСИТВДЛМТИНФЭЧБГКПБЯЕХЮЦАНСМВАТ
ЕКНМСИТВДЮБСЕГОВЧБЯЕХЮТГМИОУЕАВСБЮЫХЦТМА
МНГАЕЛИБЮМПВЕХФЛУЕАСМОЛВГОИБЧСМКЕНГОВМАЕ
ХВАМСИРНКЕГОМЛЭЮБСМИХВАНЕГЛХУЫМСОЛЭТЕТМГ
НГМИТГОЛХИНАПМТИНГОЛЭСВАИНРХВАЛЭЮМИНЕРПМ
АПРВМИСНКМГОАМИВТХИНВЕАПРОЛАИСЕНВХАЭВММА
БВМИЕНКЛОВМАБХМКЕНГИТМАБЛОМНГЕОЛАВТММБМ
УИМЕВАРПОТИМТИГОХЮБТИСМУЛОАНЕГИАУФВАСМИА
ТНГОРАМИСПАРВЭМТСАШНКТОВМНГАРМИСТЭХВМИМТ
ВАПНСИМОЛХЭВТОЕНГАМИСВДЛАРПНМГМИТСЮБВАХЭ
ЛНХЧССИОЛКОДЛМТИНБТИСМУЛПРОИСМЕАЛОВБИТОМ
ОРЕГСМИТАМКАХВКЕОРУМФЭЧБГГКОРМГСММИИРША
УКЕНАПМСИРВШОРАПМУЕКНГТСОЗВКЕНВУАЕПИСФМ
БЯЕХЮСМВПАЕВКЕЛВРАНГЕИМТБДЮАПОРАОШУОВЛФЕ
МТОНАПСМИВПРАОЭХШКНЕВАСМИФАВКЕНСИАРЕОТИВ
КХАПРСМИТОВПНАКМГОДЛАТСИВПАМКЕГНХЛОЫВАПК
СМММИВПАЕАНКГАРОАИПТСМВПАЕНУГКНРИМИМЕАТ
ИТОСМШВАЕАУКГНВДЛАОПЭБТСИМПВАМБЛЧСМИВАЭХ
ХВАПРСМИТСФШВХАПКЕНУИТСОЛЭВАТИСРЕВШЛАОЭМ
ЕНГАРПСМИВАПРОИТИСМПВАЕУХЭДВАПРСШМИАПКНВ
ГОВРПАШКНСИТВОГАЭШДАРСМИВАКМНЦГСИТЛВОАРО
АБСРПВАМКЕНГМТИБЛВЭСИВАЕНВЛОАРШАМИАХУФАП
ВОЛСМИАПНШУХЭВТСИАПАМНЕВРЛЕЧСАВКАИСМРАЕВ
РОВНВШТЛМТИРОТИМРШНЭХВАПРСТИМКМПВГКНЕПРА
БВАЕКУМИЦФЭЕАПРСИМХБВАЛОКЕНГМИБЭЛАЮВСМИЕ
АУКШНМИСМАВОРИТЕВВОРАМНКТЛОМИСТЦЯХЭЛАОРС
КНАЕВПСМИМРЛЭЯБСМИКШВПОЛЭХУНВЕКПРВСМИТОР
ИМАКЕНВАЭОЛМТИСПЕАНВШГФХВПАРУЛОСИМТРОАХЕ
ХКЕНИСМПВАМЧСИТВАРПОЛХГНКЕЭФЫВУКЕСИМАПХА
ТОРВМСИПЕУКНВГЛОЭХФЦУЕМСИТМОАРПНЕКХНКИШАГ

Attention volume is assessed by the number of looked through signs for 5 minutes (in norm 850 letters and over).

Attention concentration is assessed by the number of mistakes made for 5 minutes (in norm 5 and less).

PROTOCOL

1. Evaluate the number of letters looked through for every minute and for 5 minutes in total.
2. Evaluate the number of mistakes (missed or incorrectly crossed out letters) made per each minute and during 5 minutes.
3. Calculate the attention indices for 5 minutes as a whole:

Index of attention productivity and stability is calculated by the formula:

$$S = (0.5 N - 2.8 n) : t,$$

where S — index of attention productivity and stability per time unit; N — the number of signs looked through per time unit; n — the number of mistakes made per a time unit; t — time of work, sec.

Assessment of results:

S — over 3.25 = 10 scores — attention productivity and stability *very high*.

S — 3.1–3.25 = 8–9 scores — attention productivity and stability *high*.

S — 2.5–3.0 = 4–7 scores — attention productivity and stability *medium*.

S — 1.5–2.49 = 2–3 score — attention productivity and stability *low*.

S — 0.0–1.49 = 0–1 score — attention productivity and stability *very low*.

Make a conclusion on the volume, concentration, productivity and stability of attention.

PROTOCOL

For five minutes: N= _____ ; n= _____ ; S= _____

Conclusion:

Questions to prepare for lesson:

1. The General principles of the structure of sensory systems, their classification. Role of sensory systems in brain development and cognition of the world.
2. Visual sensory system. Строение, функции.
3. Concept of structure and functional value of retina. Photochemistry process in retinal receptors under the action of light. Function of pigment, horizontal, bipolar, amacrine and ganglion cells of the retina.
4. Transmission and processing of information in conduction pathways and central divisions of the visual system.
5. Theory of color vision. The basic form of dysfunction of color perception, importance for employment and professional selection.
6. Field of view. Visual acuity. Refraction and accommodation. Age features of view. Basics of correction of refraction.
7. The concept of eye movements, central and peripheral visual coordination mechanisms and eye movements functions.
8. Acoustic sensory system. Structure and properties apparatus, perceiving and conductive sound. The concept of the mechanisms of perception and analysis of sounds.
9. Binaural hearing. Audiometry, its value for hearing assessment. Age features of hearing. Hearing correction basics.
10. Vestibular sensory system (gravity). Structure and properties of receptor division, perception and evaluation of body position in space in statics and when you move.
11. Olfactory sensory system. Reception of smells. Conducting pathways and the central departments of the olfactory system. Classification of odors.
12. Taste system. Gustatory sensitivity. Taste bulb, structure. Conducting pathways and the central departments of the gustatory system. Perception of taste. Classification of taste sensations. Methods for determining the threshold of taste sensations and functional mobility.
13. Skin sensitivity. Types of sensory receptors of the skin and their functions. Thermoreception. Proprioceptive sensitivity. Conducting pathways and the central departments
14. Interoceptive sensitivity. Receptor mechanisms. Types of visceral sensitivity. Organism reaction to the irritation of interoceptors. Interoceptive role in maintaining homeostasis.
15. Nociceptive system: nociceptive reception and conduction signals of pain sensitivity.

16. Pain: species, and biological value. Mechanisms of pain: the role of neurotransmitters, hormones and brain oligopeptide.
17. Antinociceptive system. Endogenous opioid peptides (endorphins, enkephalins), their role in the regulation of pain. The role of emotions in the regulation of pain sensitivity.
18. Acquired form of behavior Principles of anesthesia.
19. Congenital forms of behavior (unconditioned reflexes and instincts), their value for adaptive activity of an organism.
20. , their types (conditioned reflex, dynamic stereotype), the value to adaptive for animals and humans to changing conditions of existence. Classification of conditioned reflexes. Concept of the mechanisms forming of conditioned reflexes.
21. Inhibition of conditioned reflexes. Types of inhibition.
22. Types of higher nervous activity of human. The value of works of I. M. Sechenov and I. P. Pavlov for the development of the theory about mental activity human and behavior.
23. Memory: concept, types, mechanisms. The role of attention in memorizing and learning. The concept of types of memory disorders.
24. Concept on consciousness, thinking, the unconscious.
25. Systematic organization of purposeful behavior (by P. K. Anohin). Mechanisms of functional system of behavior: the afferent synthesis, adoption of decisions, forming apparatus foresight results, the efferent synthesis, reverse afferentation.
26. Motivation: species neurohumoral mechanisms of formation. The role of the hypothalamus and limbic system in forming biological motivation. The role of cerebral cortex in forming social motivations.
27. Emotions: species, neurophysiological mechanisms of formation, biological value. Emotional stress.
28. The first and second signal system. Speech. Functional asymmetry of cortex, related to the development of human speech.
29. Sleep: types, symptoms, physiological value. Neurophysiological mechanisms of sleep.

LITERATURE

Main

1. Lecture material of the department of normal physiology.
2. *Physiology* : textbook / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.

Instructions on the completion of the protocol:

Students sit for the final classes in the final form of a computer or written test (if required in combination with an oral examination) with the mandatory rating score.

Computer testing is the first step, which involves for the completion of control work in the computer class on the programme “Testing – Control testing – final pharm. faculty General Physiology with the basics of human morphology”. Lesson 9. Knowledge assessment involves grading from 1 to 10 points on the following scale:

99–100 % — 8 points

91–98 % — 7 points

81–90 % — 6 points

76–80 % — 5 points

71–75 % — 4 points

61–70 % — 3 points

51–60 % — 2 points

41–50 % — 1 points

21–40 % — 0 points

0–20 % — 0 point

Each student is required to calculate the rating of their academic performance, which is taken into account when placing the final score. Rating is determined by the summation of all scores obtained in each lesson and dividing this sum by the number of score.

PROTOCOL

Total number of questions _____. Number of correct answers _____. Score on testing _____. Rating _____.

Final grade for the colloquium _____ points _____;

taking into account the rating, is calculated as follows: (score on rating + score on testing) _____ + / 2 = _____ points.

LITERATURE

1. *Physiology : textbook* / ed. by V. M. Moroz, O. A. Shandra. 2nd ed. Vinnytsia : Nova Knyha, 2016. 728 p.
2. *Кузнецов, В. И.* Анатомия и физиология человека : учеб. пособие / В. И. Кузнецов, А. А. Семенович, В. А. Переверзев ; под ред. В. И. Кузнецова. Минск : Новое знание, 2015. 560 с.
3. *Кубарко, А. И.* Физиология человека : учеб. пособие. В 2 ч. / А. И. Кубарко, В. А. Переверзев, А. А. Семенович ; под ред. А. И. Кубарко. Минск : Высш. шк., 2013. Ч. 1. 452 с.
4. *Физиология человека* : учеб. пособие. В 2 ч. / А. И. Кубарко [и др.] ; под ред. А. И. Кубарко. Минск : Высш. шк., 2014. Ч. 2. 604 с.
5. *Нормальная физиология* : учеб. / под ред. А. В. Завьялова, В. М. Смирнова. М. : МЕДпресс-информ, 2009. 816 с.
6. *Зиматкин, С. М.* Гистология, цитология и эмбриология : мультимедийные лекции : учеб.-метод. пособие для студ. лечебного, педиатрического, медико-психологического и медико-диагностического ф-тов (с прил. на компакт-диске) / С. М. Зиматкин. Гродно : ГрГМУ, 2010. 260 с.
7. *Пирс, Э.* Анатомия и физиология для медсестер / Э. Пирс ; пер. с англ. С. Л. Кабак, В. В. Руденок. Минск : БелАДИ («Черепеха»), 1996. 416 с.
8. *Кузнецов, С. Л.* Гистология, цитология и эмбриология : учеб. для мед. вузов / С. Л. Кузнецов, Н. Н. Мушкамбаров. М. : Мед. информ. агентство, 2007. 600 с.
9. *Анатомия человека* : учеб. для стом. ф-тов мед. вузов / под ред. Л. Л. Колесникова, С. С. Михайлова. 4-е изд., перераб. и доп. М. : ГЭОТАР-Мед, 2008. 816 с.
10. *Физиология человека* : учеб. пособие / А. А. Семенович [и др.] ; под ред. А. А. Семеновича. 3-е изд., испр. Минск : Высш. шк., 2009. 544 с.
11. *Гистология* : учеб. / Ю. И. Афанасьев [и др.] ; под ред. Ю. И. Афанасьева, Н. А. Юриной. 5-е изд., перераб. и доп. М. : Медицина, 1999. 744 с.
12. *Гистология, цитология и эмбриология* : учеб. / под ред. Э. Г. Улумбекова, Ю. А. Челышева. М. : ГЭОТАР-Мед, 2007. 408 с.
13. *Нормальная физиология. Краткий курс* : учеб. пособие / В. В. Зинчук [и др.] ; под ред. В. В. Зинчука. Минск : Высш. шк., 2010.
14. *Кузнецов, В. И.* Физиология человека с основами морфологии. Практикум : учеб. пособие / В. И. Кузнецов, Н. С. Новицкий, И. Ю. Щербинин, Л. С. Сахарчук. Витебск : ВГМУ, 2005. 211 с.
15. *Рафф, Г.* Секреты физиологии / Г. Рафф ; пер. с англ. М. : БИНОН ; СПб. : Невский диалект, 2001. 448 с.
16. *Уард, Дж.* Наглядная физиология : учеб. пособие / Дж. Уард, Р. Линден, Р. Кларк ; пер. с англ. Е. Г. Ионкиной, О. С. Глазачева. М. : ГЭОТАР-Мед, 2010. 136 с.
17. *Орлов, Р. С.* Нормальная физиология : учеб. / Р. С. Орлов, А. Д. Ноздрачев. М. : ГЭОТАР-Мед, 2005. 696 с.
18. *Кузнецов, В. И.* Физиология с основами анатомии человека : типовая учебная программа / В. И. Кузнецов, Н. С. Новицкий. Минск, 2008. 27 с.
19. *Физиология человека* : учеб. В 2 т. / В. М. Покровский [и др.] ; под ред. В. М. Покровского, Г. Р. Коротько. М. : Медицина, 1998. Т. 1, 2.
20. *Stuart, Ira Fox.* Human Physiology / Ira Fox Stuart. 12-е изд. New York, Mc. Grew-Hill Company, 2011.
21. *Kaplan medical.* New York, 2009.
22. *Физиология и основы анатомии* : учеб. / под ред. А. В. Котова, Т. Н. Лосевой, М. : Медицина, 2011. 1056 с.

CONTENTS

Introduction	3
Structure of the practical manual.....	4
I Introduction. General physiology with the basics of human morphology. General principles of regulation of functions	
1. Introduction. Subject and objectives of physiology, anatomy and histology	6
2. Physiological basis of life processes of humans. Concept of neural and humoral mechanism of regulation of functions	15
3. General concept about tissues. Connective tissues: types, function. Human skeleton. Role of calcium and phosphate in bone tissue and in the organism	19
4. General physiology of excitable cells. Bioelectrogenesis. Reception	32
5. General plan of the macro-and microscopic structure of nervous tissue. Structure and function of peripheral nerves, conduction of excitation along the nerve. Synapses: structure, types, functions, synaptic transmission.....	38
6. General plan of structure of the CNS. Reflex theory. Nerve centers: their properties, principles of functioning. Excitation and inhibition in the CNS, their mediator mechanisms	44
7. Muscle tissue: species, macro-and microscopic structure	53
8. Epithelial tissue: species characteristics, functions. Skin: structure and function.....	61
9. The final lesson on the section “General Physiology with the basics of human morphology. General principles functions regulation”	71
II Morphology and physiology of the nervous and endocrine systems. Reproductive system	
10. Physiology and morphology of the central nervous system, its role in the management of the movements. Somatic reflexes.	76
11. Autonomic nervous system: structure, function, and management mechanisms for the functioning of internal organs. Autonomic reflexes.....	82
12. General characteristic of the structure and functions of endocrine system. Structure and function of central organs of endocrine system: hypothalamus, pituitary. Pineal gland: structure, topography, functions.....	88
13. Structure, topography and endocrine function of the thyroid gland, parathyroid glands, adrenal glands, endocrine cells of the pancreas. The concept of the diffuse endocrine system	92
14. The reproductive system of men and women. The endocrine function of sexual glands.....	96
15. The final lesson on the section “Morphology and physiology of the nervous and endocrine systems. Reproductive system”	101
III Sensory systems. Higher nervous activity of human	
16. General principles of structure of sensory systems. Structure and function of visual, acoustic and vestibular sensory systems	105
17. Structure and function of the olfactory, gustatory, cutaneous and visceral sensory systems. Nociception. Nociceptive and antinociceptive systems: structure, functions and mechanisms of functioning.....	115
18. Integrative function of brain. Congenital and acquired form of behaviors. Higher mental functions of brain	120
19. Indicators of physiological functions. Pass.....	127
Literature	130