FEDERAL AGENCY FOR EDUCATION

Lobachevsky State University of Nizhny Novgorod

M.A. Shabalin,

A.V. Deryugina,

M.V. Zolotova

PHYSIOLOGY OF THE RESPIRATORY AND DIGESTIVE SYSTEMS

Educational and methodical manual

Recommended by the methodological commission of the Institute of biology and biomedicine for UNN students studying in the field of training:
31.05.01 "Medicine", 31.05.03 "Dentistry", 30.05.01 "Medical biochemistry", 30.05.02 "Medical Biophysics", 30.05.03 "Medical Cybernetics", 06.03.01"Biology", 05.03.06 "Ecology".

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Reviewer C .b. s. Kravchenko G. A.

The training manual contains materials for practical work on the course of human and animal physiology and test questions on the topics of the lesson. This training manual is intended for students studying in the following areas: 31.05.01 "Medicine", 31.05.03 "Dentistry", 30.05.01 "Medical biochemistry", 30.05.02 "Medical Biophysics", 30.05.03 "Medical Cybernetics", 06.03.01 "Biology", 05.03.06 "Ecology".

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Content

INTRODUCTION

Almost all of our knowledge in the field of human physiology is based on the results of laboratory experiments, thanks to which the information presented in textbooks and lectures was obtained. The experimental approach is used to solve many of the remaining mysteries in the body's work, and only experiment makes it possible to understand physiology as a science. In addition, physiology is the theoretical basis of medicine, its foundation, and, consequently, the physiological experiment is considered an important stage of scientific clinical research. It is obvious that the laboratory workshop should be an integral part of teaching students the basics of human and animal physiology.

General objectives of the workshop:

* demonstrate how the physiological processes studied in the theoretical course actually occur in a living organism;

* give a general idea of some of the physiological methods and devices used to observe physiological phenomena and measure their parameters;

* study the mechanisms that control the physiological functions of the body.

ETHICS OF PHYSIOLOGICAL EXPERIMENT

Compliance with the rules of humane treatment of animals is a prerequisite for conducting physiological experiments. In 1984, International recommendations for conducting biomedical research using animals were approved. This document of the European research Council and the Advisory Committee on medical research sets out the most important principles for setting up a biomedical experiment.

In Russia, the procedure for using animals in an experiment is determined by a number of documents approved by the heads of all departments where this type of research can be conducted. The main document is the "Rules for working with experimental animals". This document stipulates that the researcher has the right to use animals in the experiment, but a number of provisions must be strictly observed:

* You can only conduct an experiment using animals in public institutions that have an appropriate experimental base.

* Setting up such experiments is allowed only in institutions where there is an equipped vivarium, served by the staff who serve animals.

* Only people with higher education in biological, medical, veterinary and zootechnical field can conduct experiments with animals.

* The model of the experiment must meet the requirements of humane treatment of animals and in the case of any painful manipulations, it is necessary to use anesthesia.

* Compliance with the requirements of humane treatment of animals should be noted when presenting the methodology and results of the experiment in scientific publications or compiling reports.

* Healthy animals of the appropriate species should be selected for experiments, limited to the minimum number required to obtain scientifically reliable results.

* The next in order and degree of importance of the recommendations is the requirement of ethical treatment of animals. Researchers and other personnel should always treat animals as sensitive to various types of impacts and consider it their ethical duty to treat and use animals in such a way as to minimize the inconvenience and pain caused to them.

MEASURES FOR INJURIES, CONTACT WITH BLOOD AND OTHER BIOLOGICAL MATERIALS

If contact with blood or other fluids occurred with a violation of the integrity of the skin (prick, cut), the person must do the following:

* remove gloves with the work surface inside;
* squeeze the blood out of the wound;
* wash hands under running water with soap, and then treat the damaged area with one of the disinfectants (70% alcohol, 5% tincture of iodine);
* apply a patch to the wound, put on a fingertip;
* if it is necessary to continue work - wear new gloves.

If the skin is contaminated with blood or other biological fluid without damage, you must:

* treat the skin with one of the disinfectants (70% alcohol, 3% chloramine solution);
* wash the contaminated area with soap and running water and re-treat with 70% alcohol.

If biological material gets on the mucous membranes:

* oral cavity - rinse with 70% alcohol;
* nasal cavities-drip a 30% solution of albucid;
* eyes - rinse with water (clean hands), drip a 30% solution of sulfacetamide. A 0.05% solution of potassium permanganate can be used to treat the nose and eyes.

If the biomaterial gets on the robe, clothing:

* disinfect gloves;
* remove clothing and soak it in a disinfectant solution (except for 6 % hydrogen peroxide, neutral calcium hypochloride, which destroy tissues) or place it in an autoclave bag;
* wipe the skin of the hands and other parts of the body with 70% alcohol under contaminated clothing, then rinse with soap and water and re-wipe with alcohol;
* clean contaminated shoes twice with a rag soaked in a solution of one of the disinfectants.

FIRST AID KIT FOR EMERGENCY MEDICAL CARE:

* finger pads (or gloves) at the rate of 1-2 per student per shift;
* adhesive tape - 1 coil;
* potassium permanganate in attachments of 0.05 g;
* potassium permanganate dilution tank;
* ethyl alcohol 70%;
* a tube-dropper of a 30% solution of sulfacetamide ;
* 5% iodine tincture and 3% hydrogen peroxide solution;
* rubber gloves - 3 pairs, glasses., plastic aprons, 4-layer masks;
* large plastic bag for collecting contaminated clothing;
* attachments of disinfectants: chloramine 30 g; 3 attachments (each stored separately);
* container for diluting disinfectants.

After reading the rules and receiving instructions on safety, the student signs in the "Journal of control sheets for instructing students on safety".

PREPARATION OF REPORTS ON PRACTICAL WORK

The accumulation of knowledge in any field occurs through active communication of scientists, which consists in publishing the results of experiments in scientific journals and presentations at conferences, congresses and symposiums. Therefore, the task of the workshop is not only to get acquainted with the basics of experimental work, but also to teach students the rules for presenting the results of scientific work in the form of written reports (protocols) and oral messages. The written report is proposed to be based on the same rules that are usually imposed on the publication of experimental materials by scientific journals. The report on practical classes includes the main sections that are present in the scientific article - "Introduction", "Methodology", "Results", "Discussion", "Conclusions" and "Literature".

Introduction. It contains a small amount of basic information about the problem under study, and sets out the goals of the experiment. The definition of the main physiological phenomena and concepts under study is given, and the expected results of experiments can be described. You must remember to correctly quote all the information sources used in this part of the report. Include in this part of the report only the information that is relevant to this work!

Methods (methodology). This includes a brief description of the object of research, materials, devices, equipment, substances and reagents, as well as methodological approaches used in the experiment. The description of the methods should be detailed enough for other researchers to repeat the experiment. At the same time, you should avoid excessive detail, and it is better to refer to the original literary

source, where the methodological techniques are considered in detail. If you have made any modifications to the experiment, this must be reflected in the description. Do not forget to specify the doses and concentrations of the drugs used.

Result of work. This section can be designed separately or together with the next section "discussion of results".

The results obtained in the experiment can be presented in the form of original recordings on the tape recorder, cardiograph or electroencephalograph. You must specify the speed of the tape, the parameters of the applied stimuli with accurate recording of the moment of application and termination of the stimulus (in the captions to the illustrations, appropriate explanations are given). If the registration was performed from the oscilloscope screen, on the scale of the pressure gauge, etc., then it is more convenient to present the results of the experiment in the form of a table. The table contains the obtained values of the studied parameters and their units of measurement.

If it is possible to identify the main regularities of the studied phenomena, graphs are built based on the obtained data. They should be neat and clear. You do not need to build each graph on an A4 sheet, but you should not reduce it to the size of a postage stamp. Graphs must have a title, parameter designations along the axes with units of measurement, number and explanations of the symbols used in it (legend); all experimental points and calculated parameters are entered in them.

Discussion of results. This is the most important section of the report that reveals the depth of understanding of the problem being studied and the ability to apply theoretical knowledge in explaining the results obtained in a real experiment. Discuss your results from the perspective of modern science concepts. Try to imagine the mechanisms underlying the observed phenomena. Explain the significance of the discovered method of regulation in the work of the whole organism. If the results obtained differ from the theoretically expected results, try to identify possible reasons for these discrepancies. When making assumptions, don't forget about the limitations that any measurement technique has.

Conclusions. They briefly list the main results and patterns found in the experiment. For example: "when the amplitude of the stimulus increases from ... mV to ... there is an increase in the amplitude of the muscle response. Further amplification of the stimulus does not change the muscle response." (It is not necessary to explain the mechanisms of the observed phenomena again – they are already set out in the "Discussion" section.)

Literature. At the end of the work, all the literature sources that you used in the report design and referenced in the theoretical introduction should be listed in alphabetical order.

Thus, it is clear that the laboratory report (Protocol) should be brief and objective. The key point is the completeness and consistency of the above mentioned. A thoughtful approach to explaining discrepancies between the results of the experiment and the theory is much more correct than trying to ignore them! This will teach you, as future researchers, to be accurate and critical in evaluating the results obtained.

Tools for dissection

The following set of tools can be used to perform the work described in the workshop (Fig. 1):

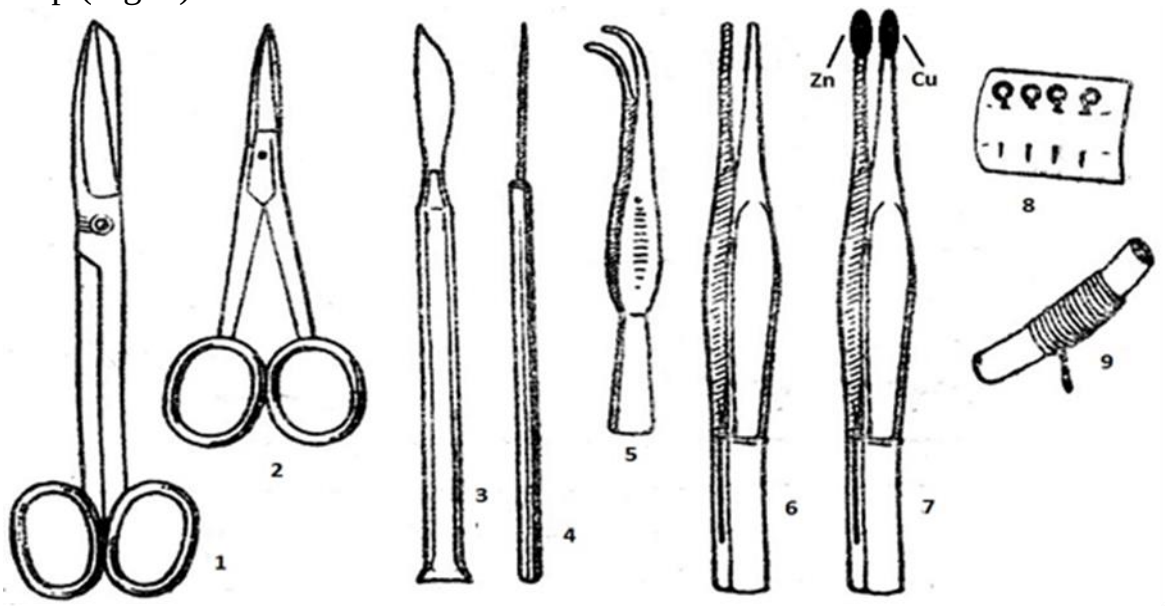


Fig. 1 Tools for dissection (explanations in the text)

Scissors are large with straight ends, one of which is sharp (1).

Small (eye) scissors for fine preparation, necessary for most work on the physiology of the nervous system and the physiology of blood circulation (2).

Tweezers: anatomical (6), ocular (5).

Preparation needle (4). Pins (mainly for attaching a frog to a plate). They should be at least four, and it is better not to scatter them in a box, but to give them fixed in a paper substrate (8).

The scalpel (3) is issued only for certain works, for example, for opening the eye, for operations to the experiment of Sechenov braking. Knife for Stripping contacts, electrodes, wires, etc.

Ligature or thread (9) (for convenience, wound on a rubber tube).

Galvanic tweezers (7) the Tweezers are made of surgical tweezers with cu and Zn plates on the branches.

Various clips and cannulas (issued when performing the relevant work and are not included in the permanent set of tools).

It is recommended that each student be given a set of tools that is necessary for this laboratory task.

Methods of immobilizing a frog

In conducting a physiology workshop, it is necessary to immobilize the frog either by destroying the brain and spinal cord, or by anesthesia. Destruction of the frog's brain and spinal cord can be performed in the following ways:

Destruction of the brain and spinal cord (Fig.2). Take the frog in your left hand with your hand back up, so that your thumb is on its back. Place your index finger on the frog's upper jaw and tilt its head down. In this position, the location of the

occipital fossa is clearly visible. Through the fossa between the occipital bone, insert the needle into the skull cavity and destroy the brain. Then turn the needle in the opposite direction with the spine and insert it into the spinal canal, destroying the spinal cord with several turns of the needle. The General relaxation of the frog's muscles and the lack of reflex reactions indicate complete destruction of the brain and spinal cord. With this method of immobilizing the frog, very little blood is lost.

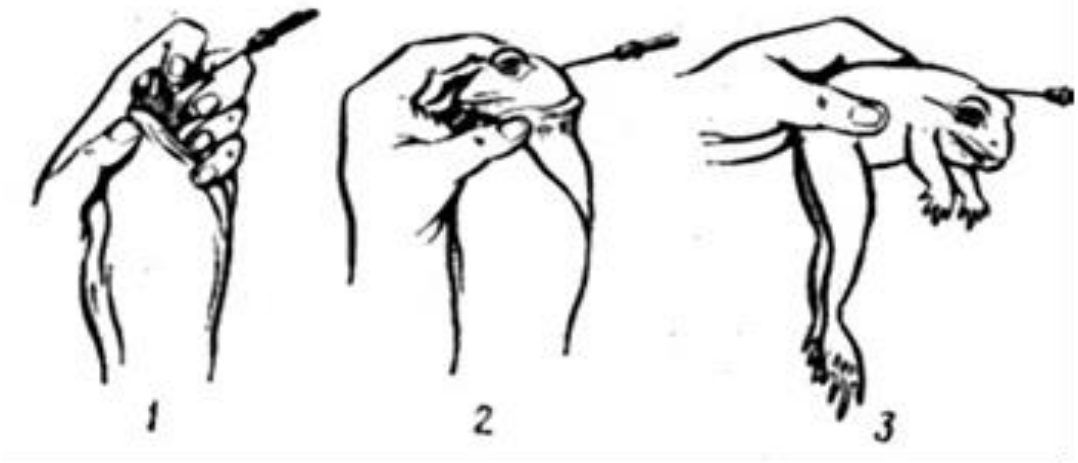


Fig. 2 Scheme of destruction of the brain and spinal cord

Decapitation followed by destruction of the spinal cord. Take the frog in your left hand, and with your right one, insert the lower blade of the scissors as deep as possible into the mouth under the back of the upper jaw behind the eyes. With a quick movement, cut off the upper jaw at the level of the rear end of the eardrums (save the lower jaw). Insert a dissecting needle into the opening of the spinal canal and destroy the spinal cord.

The use of anesthesia (ether, alcohol, urethane). Anesthesia is rarely used in the training workshop. To anesthetize the frog, a 10% solution of alcohol or a 2% solution of ether is used. The frog is released into the solution for 10-15 minutes. Muscle relaxation and lack of motor activity are good indicators of sufficient anesthesia action.

Fixing a frog

In a number of works, the spinal preparation of a frog is used - a frog whose brain is destroyed and the spinal cord is preserved. When preparing the corresponding nerves and muscles and conducting research, the spinal frog must be fixed to the plate motionless. It is best to fix it on a cork (or paraffin) plate with a size of 20x10 cm.

When fixing a frog on a plate, it is important to stretch its limbs well so that they are stationary and do not interfere with the recording of responses. Pins must be inserted in the direction opposite to the movement of the limb: otherwise, the legs slide on the pin, and fixation is not provided.

TOPIC 1. PHYSIOLOGY OF THE RESPIRATORY SYSTEM

Control questions on the topic of the lesson:
1. The structure of the respiratory system.
2. Functions performed by the respiratory system.
3. Ventilation of the lungs.
4. Diffusion of oxygen and carbon dioxide through the aerohematic barrier.
5. Transport of respiratory gases by blood.
6. Indicator of the oxygen capacity of hemoglobin.
7. Protective functions of the respiratory tract.
8. Qualitative and quantitative indicators of respiration.
9. Features of breathing at altitude.
10. Features of breathing at depth.
11. Methods of external respiration research.

Practical work №1. The model of Donders. Demonstration of the mechanism of external respiration

The intake of air into the lungs is due to changes in the volume of the chest cavity and the corresponding pressure fluctuations in the pleural fissure. With the contraction of the respiratory muscles, the chest increases in volume, followed by the lungs increase in volume, the pressure in them decreases, and according to Boyle Marriott's law, atmospheric air enters the lungs – an inspiration is carried out. When exhaling, the volume of the chest decreases, followed by the volume of the lungs decrease, the pressure in them increases and the air leaves the lungs. The movements of the chest are carried out due to the contractions of the respiratory muscles. In this case, muscle contractions can move the ribs, thereby changing the volume of the chest. On the other hand, the volume of the chest can change due to the contraction (flattening) and relaxation of the diaphragm. In practice, both of these mechanisms work to some extent, but their severity is not the same. If the movements of the diaphragm predominate, then they speak of an abdominal type of breathing, which is more typical for men. If the movement of the ribs is dominated by the intercostal muscles or auxiliary inspiratory muscles, then they speak of the chest type of breathing, which is more typical for women. In the implementation of external respiration, three anatomical and functional formations take part, on the properties of which the biomechanism of respiration depends. These formations include: 1. Stretchable airways. 2. Elastic lung tissue. 3. Dense bone-cartilage framework of the chest, as well as its ligaments and muscles.

This process can be clearly demonstrated on the Donders model. This is a device for demonstrating the role of intrapleural pressure in the respiratory act, which is a preparation of the lungs with the trachea enclosed in a transparent

chamber. When the pressure in the chamber decreases relative to the pressure in the lungs, "inhale" occurs, and when it increases, "exhale" (Fig. 1).

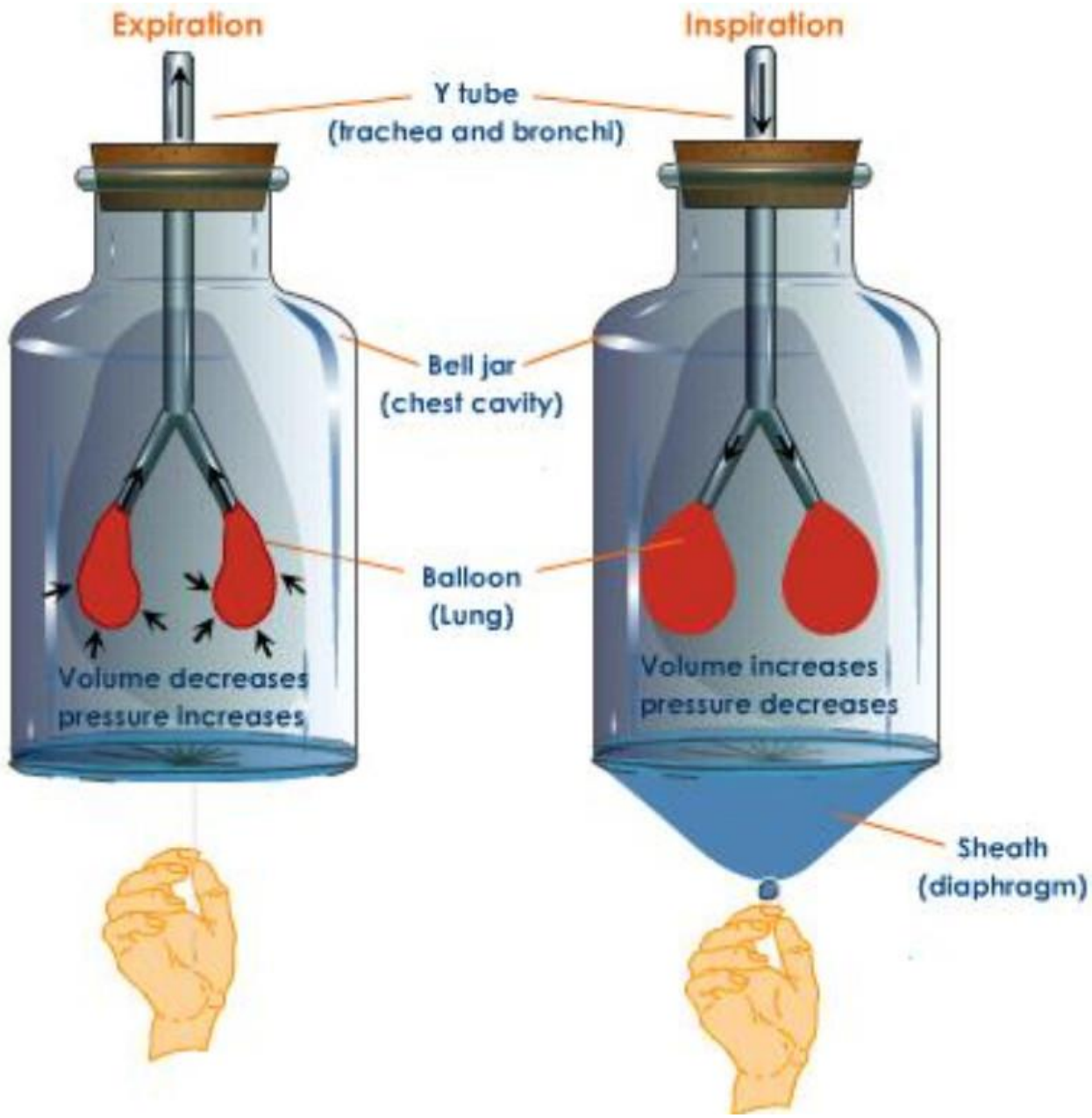


Fig. 1. Model of Donders

The model is a glass vessel with a rubber membrane instead of a bottom. A cannula is inserted into the test tube of the vessel, on which the preparation of the isolated lungs of the laboratory animal is strengthened. A vessel with a rubber bottom simulates a sealed pleural cavity. The rubber bottom allows you to change the volume of this cavity. The lungs can communicate with atmospheric air through a cannula, as is the case in animals. By pulling or pressing on the rubber bottom of the model, you can simulate the process of air exchange in the lungs.

Purpose of the work: to study the mechanism of external respiration in vertebrates.

To work, you need: a vessel with a rubber bottom, a frog, a set of surgical instruments, a saline solution.

The progress of work: The immobilized frog is fixed on the board with its belly up. Remove the lower jaw and find the glottis. Place the ligature loop around the cartilaginous larynx. The cannula is inserted into the glottis and fixed with a ligature.

Open the chest cavity and remove all surrounding tissue, completely isolate the lungs. Secure the isolated lungs to the cannula, place them in a container with a rubber bottom, and close the stopper tightly. (At the moment of strengthening the lungs, the rubber bottom is slightly pressed into the vessel. After the plug is closed and the bottom returns to its normal position, a "negative" pressure occurs inside the vessel and the lungs are straightened).

Alternately pull down and push the rubber bottom of the device into the vessel. There are changes in the volume of the lungs when "inhaling" and "exhaling". Draw a diagram of these processes.

Make a conclusion.

Methods of external respiration research:

Various methods are used to assess the ventilation function of the lungs and the state of the respiratory tract.

Pneumography-registration of chest movements during respiratory movements. It is performed by converting changes in the linear movements of the chest into a mechanical or electrical signal. The pneumogram allows you to estimate the number of respiratory movements per unit of time, but the method does not allow you to estimate the volume and capacity of the lungs.

Spirometry-registration of primary lung volumes and vital capacity of the lungs. Spirography. Spirography allows you to evaluate the main indicators of the respiratory system

The assessment of the functional state of the external respiratory system is carried out in order to determine its participation in the energy, heat and water exchanges of the body, i.e. in the physic-chemical components of thermoregulation to maintain, mainly, gas and thermal homeostasis. There are qualitative (rhythm) and quantitative (frequency, depth, minute volume of breathing, etc.) indicators of breathing.

There are four primary lung volumes:

The RVI/E-respiratory volume of gas inhaled or exhaled during each cycle in a calm state, (400-500 ml);

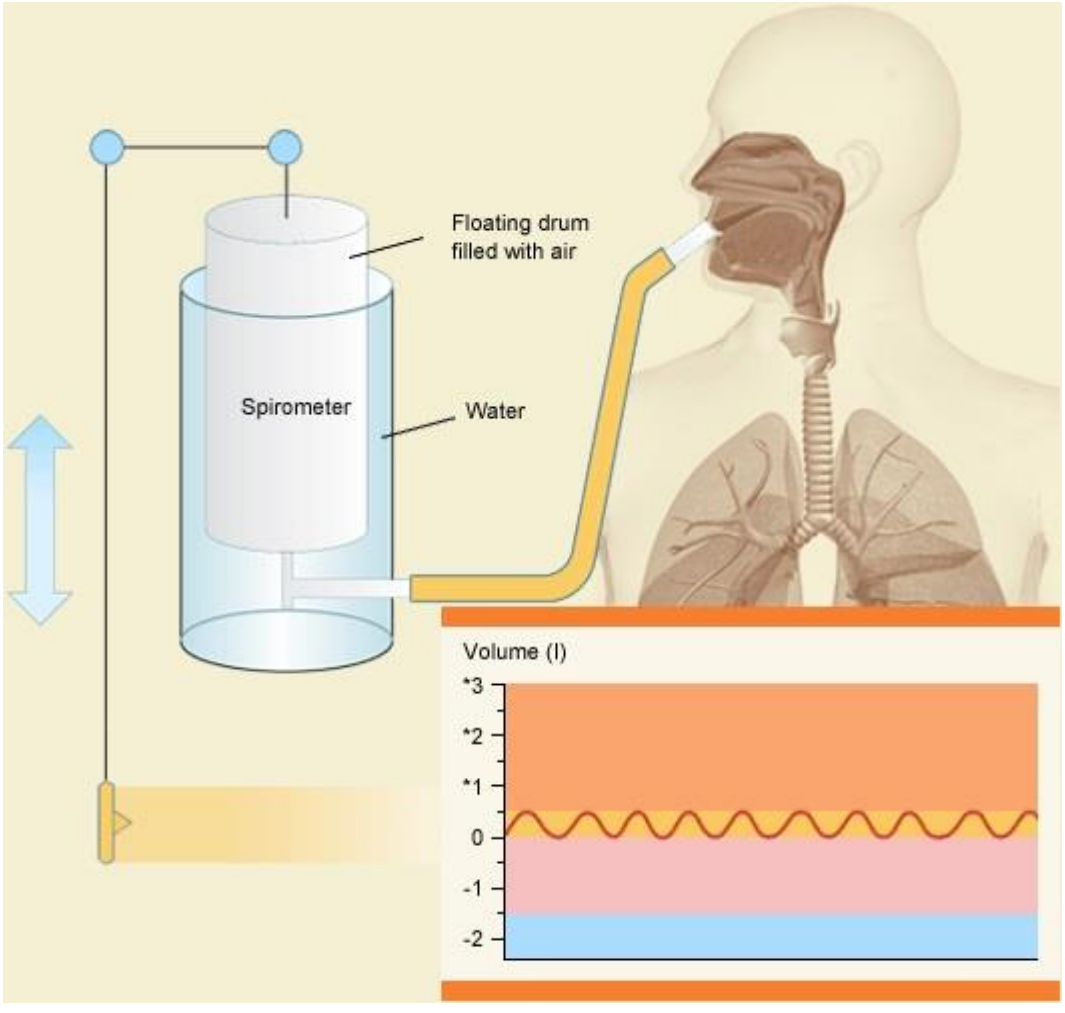
RVI-reserve volume of inspiration. The maximum amount of air that can be inhaled additionally after a normal inhalation, (1900-3000 ml);

RVE-reserve volume of exhalation. The maximum amount of air that can be exhaled after a normal exhalation, (700-1000 ml);

RV-residual volume. The amount of gas remaining in the lungs after the maximum exhalation. The volume of residual air is 1100-2000 ml.

In addition, there are also four lung capacities, each of which includes two or more primary volumes:

TLC – total lung capacity. The amount of gas in the lungs at the end of the maximum breath. Under normal conditions, it consists of 50% of the RVI + 11% RVE + 15% ROV + 24% RV. This value in adults is 4200-6000 ml;
VCL – vital capacity of the lungs. The largest volume of gas that can be exhaled after the maximum inhale. Represents the amount: UP
RVI/E + RVI + RVE. In adults, the VCL is 3300-4800 ml;
IC – inhale capacity. Maximum air that can be inhaled after a calm exhalation; consists of RVI/E to + RVI. Normally, IC is about 75% of the VCL, and RVE is 25% of the VCL;
FRC – functional residual capacity. The amount of gas remaining in the lungs after a calm exhalation is equal to the sum of RVE + RV.
It should be kept in mind that the RVE is a very variable value, changing significantly even in the same person.
Description of devices: A water spirometer is a bell immersed in water and balanced by a load thrown over the block (Fig. 2, A). The exhaled air is brought under the bell through a metal tube, the diameter of which, as well as the diameters of the rubber tube and the mouthpiece, should be about 2 cm, so that there is no noticeable resistance to breathing. The air coming under the bell causes it to float. The height of the float, determined by the scale and indicator, is calibrated for the volume of incoming air.



A

B

Fig. №2. Water spirometer (A), dry-air spirometer (B)

Currently, portable spirometers with the ability to connect to a computer or printer are used (Fig. 3). Such devices allow us to conduct breath tests, the results of which are directly read from the spirometer display, printed out with the calculation of all the main parameters and indices.

Fig. №3. Portable electronic spirometer

Make a conclusion.

Practical work № 2. Determination of vital capacity, primary lung volumes using the device

The purpose of the work: To determine the lung volume of a person.

Materials and methods: Spirometer, alcohol, cotton wool.

Progress of work:

1. Determine simultaneously the vital capacity of the lungs (VCL). Set the instrument scale to "0". Take the maximum breath, take the mouthpiece in your mouth, hold your nose and make the maximum exhalation in the spirometer. Record the reading and set the instrument scale to "0".

2. Determine the vital capacity of the lungs by nanogram (Fig. 4), knowing the age of the subject in years and his height in centimeters.

3. Compare, give explanations.

Determination of primary lung volumes. To determine the respiratory volume (RV), after a calm inhale, make a calm, normal exhalation in the spirometer. Then take the meter reading and set the instrument scale to "0".

To determine the reserve volume of exhalation (RVE), make a calm normal exhalation into the atmosphere, then make the maximum exhalation into the spirometer. Record the instrument reading and set the scale to "0". The value of the reserve volume of inspiration (RVI) is determined by the formula

RVI = VCL – (RV+RVE.).

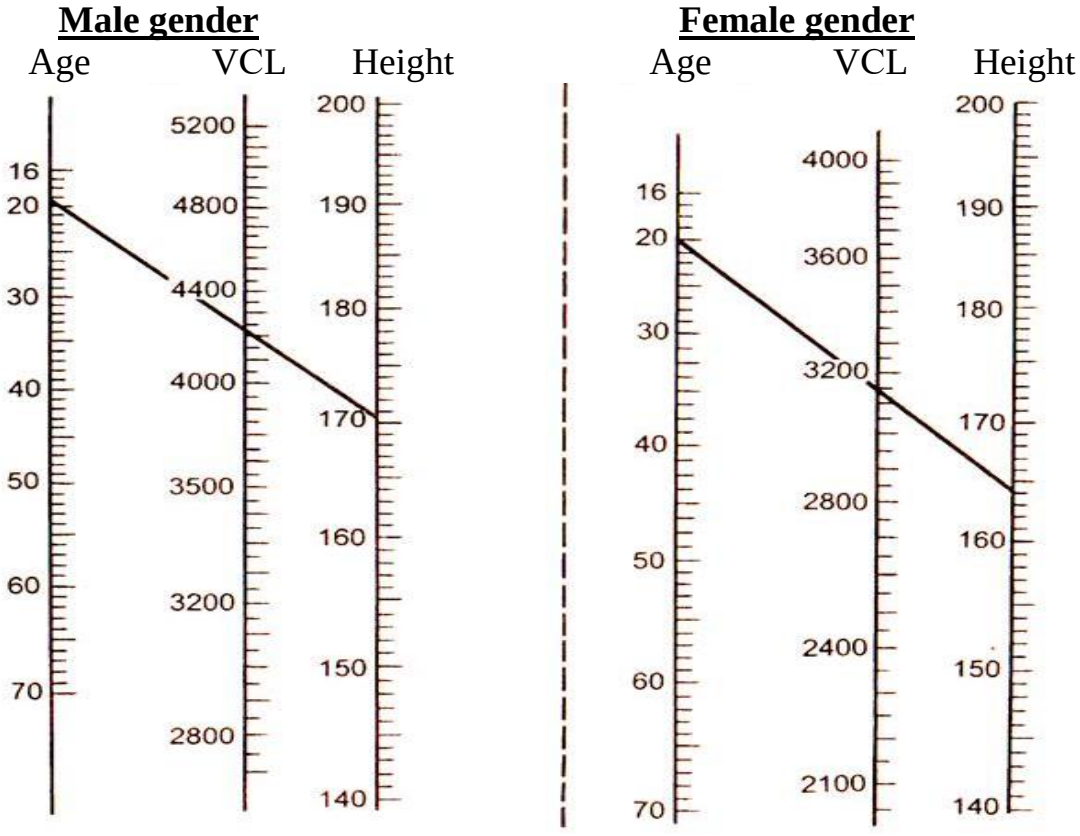


Fig. 4. Nomogram for determining the vital capacity of the lungs

Make a conclusion.

Practical work №3. Analysis of the state of the respiratory system

The amount of air passing through the lungs when inhaling and exhaling depends on the volume of the chest, the mobility of the diaphragm, ribs, the state of the respiratory muscles and the lung tissue itself – its elasticity, the degree of blood filling, etc.

***The purpose of the work*:** is to get acquainted with the methods of analyzing the state of the human respiratory system.

Materials and methods: spirometer, alcohol, cotton wool, calculator.

Progress of work: Using a spirometer, determine the value of the respiratory volume (RV), vital capacity of the lungs (VCL), reserve volume of exhalation (RVE).

Calculate the following values using the formulas:

Reserve volume of inspiration RVI = VCL - (RV + RVE)

Inspiratory capacity IC = RVI + RV

Residual volume RV = 33 * VCL/100

Functional residual lung capacity FRL = RVE + RV

Calculate the proper vital capacity of the lungs using the formulas:

VCL = (L*0.052) - (B*0.022) - 3.60 for men
VCL= (L*0.041) - (B*0.018) - 2.68 for women,
Where L - is height in cm, B - is age in years.

Make a conclusion.

Practical work №4. Functional breath-holding test (test Shtange)

The time during which a person can hold his breath, overcoming the desire to inhale, is individual. It depends on the state of the external respiratory system and the circulatory system. Therefore, the duration of an arbitrary maximum breath hold can be used as a functional test. The ability of a person to hold his breath for a long time indicates the presence of significant reserves in the body. In healthy people, the time of holding the breath after a calm inhalation is 50-60 s, after a calm exhalation it is less-30-40 s.

The purpose of the work: Determine the time of maximum breath retention on the inhale and exhale.

Progress of work: A. The subject breathes calmly for 3 to 4 minutes, then after a normal exhalation takes a deep breath or a deep exhalation and holds the breath for as long as possible. Using a stopwatch, determine the time from the moment of holding your breath until it resumes. In both cases, to determine the maximum breath retention, use the data of three attempts and take the arithmetic mean. Make a table based on the sample (Table. 1) and record the results

Determine the time of maximum breath retention at rest, after a dosed load and after rest. Dosed load – 20 squats for 30 s. After that, you need to quickly sit on a chair, hold your breath and measure the time of maximum breath retention on the inhale. Calculate the percentage of the obtained results of experiments "B" with the state at rest "A". Enter the obtained data in the table and compare the values with the normative data given below.

Table 1

Functional breath-holding test (test Shtange)

Categories of subjects	Breath retention, s		
	At rest (A)	After squats (B)	After rest
Healthy trained	46-60	More than 50% of A	More than 100% of A
Healthy untrained	36-45	30-40% of A	70-100% of A

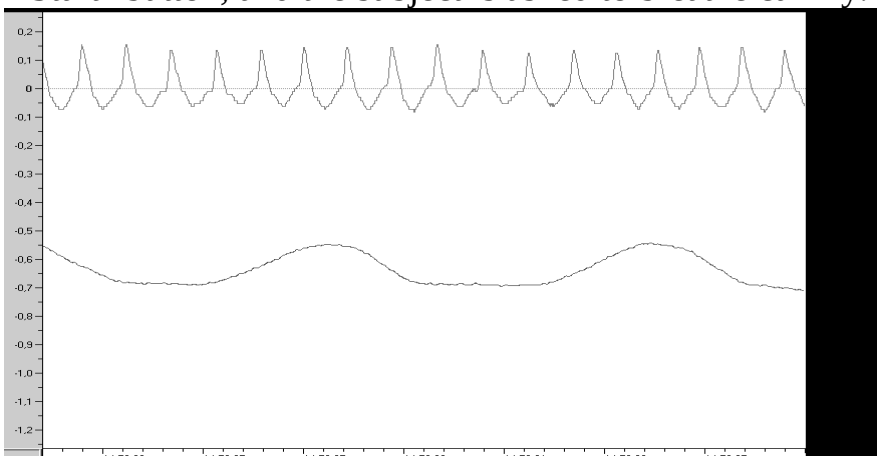
Practical work №5. Respiratory cycle in different functional states

The purpose of the work: To get acquainted with the technique of registering pneumoramas. Perform its analysis for different functional states.

Materials and methods: The device of wireless registration of biological signals " Biozhezl ® »
*DP Sensor
*Powergraph 3.3 X ® SOFTWARE»,
*A computer with Windows XP and higher, equipped with a USB port.
*Unloading system with cuff and Bio-rod retainers on the subject's body.
*Nose clip

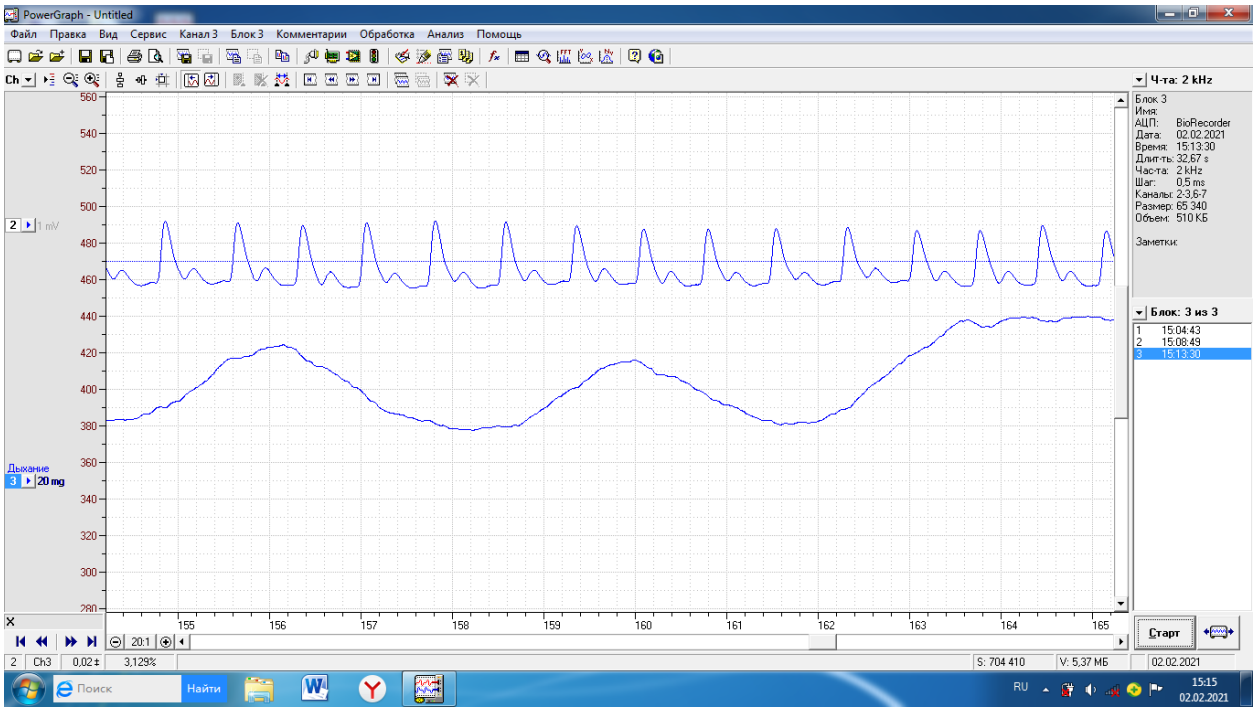
Progress of work:

1. Turn on the computer.
2. Connect the wireless signal receiver to the USB port.
3. Connect the DP sensor to the body of the Bio-rod.
4. Over the clothing, on the chest of the subject, put on the unloading system, as shown in Fig. 1.1 and 8 of the introductory section, fix the Bio-rod on the unloading straps in front with a label with a flashing indicator in front, fixing it on both sides with ring-shaped retainers.
6. In the radial region of the middle phalanx of the ring finger, palpation finds a pulsating artery, where a piezoelectric sensor is installed, which is fixed by wrapping the finger together with the sensor with a band-aid strip.
7. The subject takes a comfortable position, sitting on a chair. The pose should not change throughout the experiment.
8. The experimenter launches the "Powergraph Pro" program, in the "Select" menu.
ADC " selects "Biorecorder".
9. After starting the program, in the "File" menu, select: "Load settings" - "Breath-holding samples", which will result in a field for two-channel recording.
10. The first fragment is breathing at rest. The experimenter presses the "Start" button, and the subject is asked to breathe calmly.



11. The second fragment is breath retention and hyperventilation. The subject is asked to hold his breath (as long as he can-20-40 seconds). After the resumption of breathing, involuntary hyperventilation is recorded.

12. The third fragment is the breath before and after physical activity. The experimenter presses the "Start" button, and the subject is asked to breathe calmly. Then stop recording. The subject stands up-Squat 20 (girls) 40-50 (young people). Turn on the recording after the squat.

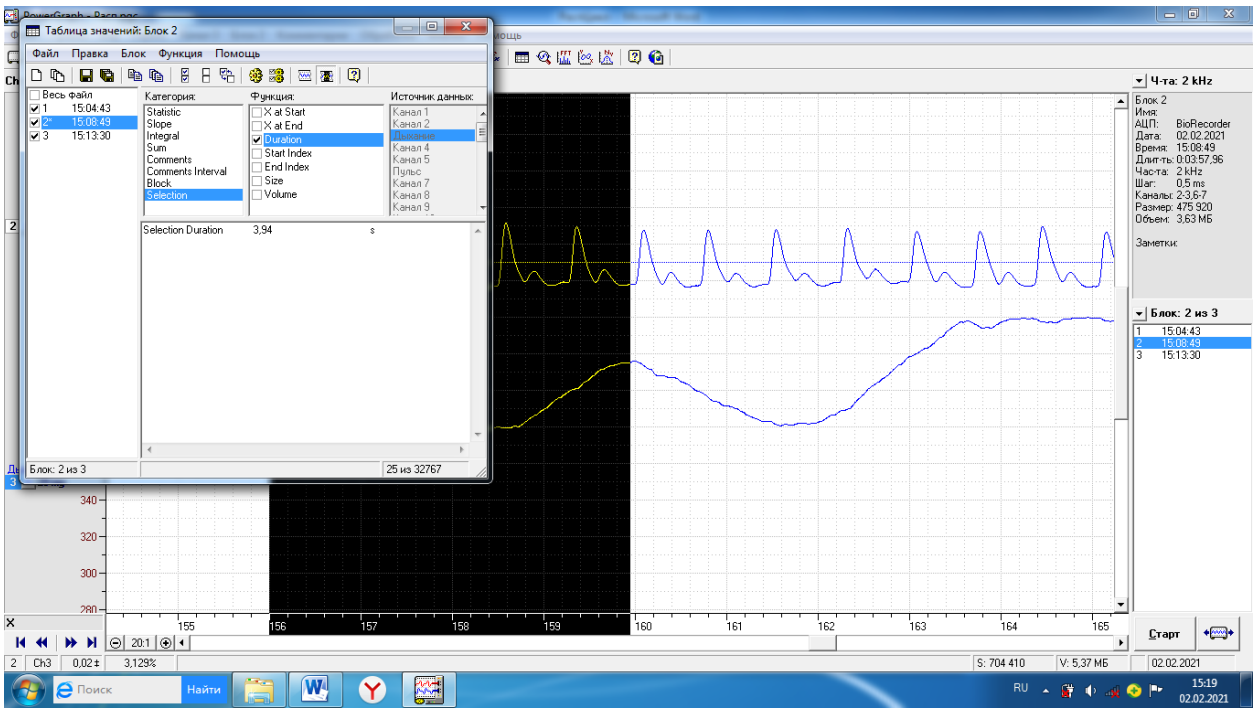


Analysis.

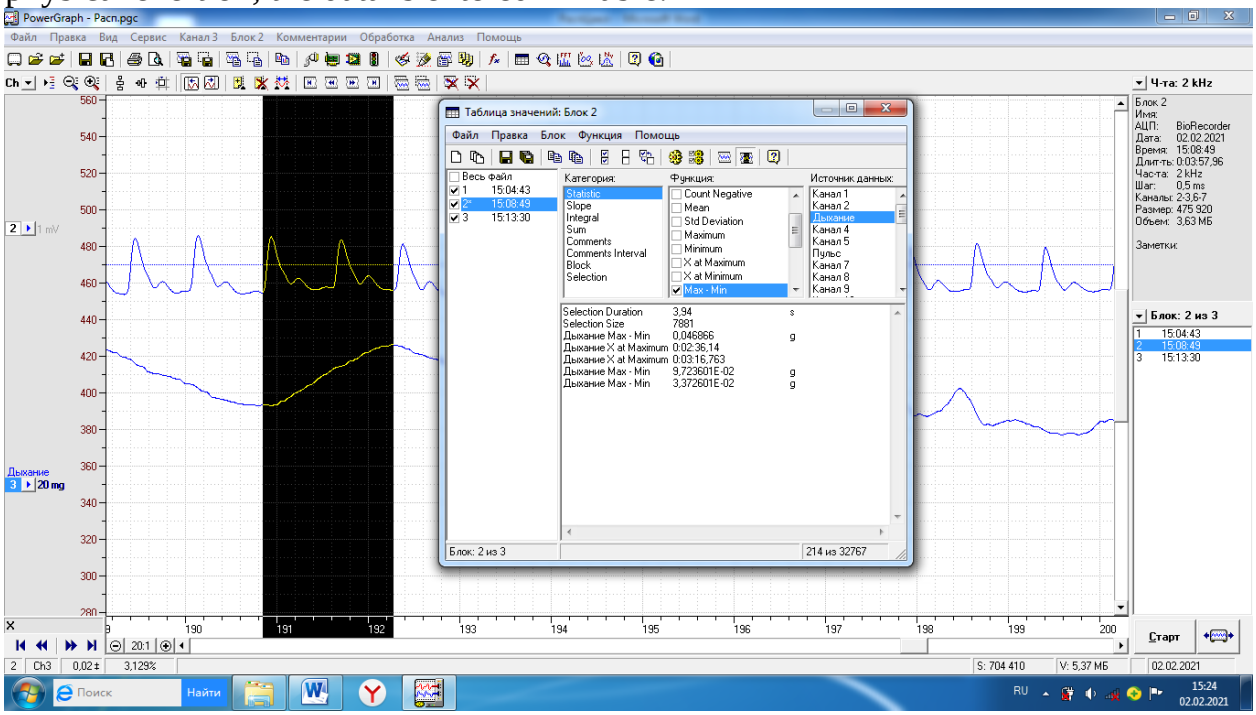
13. Click the "Stop" button, save the file (menu "File"- "Save") and start analyzing the received data.

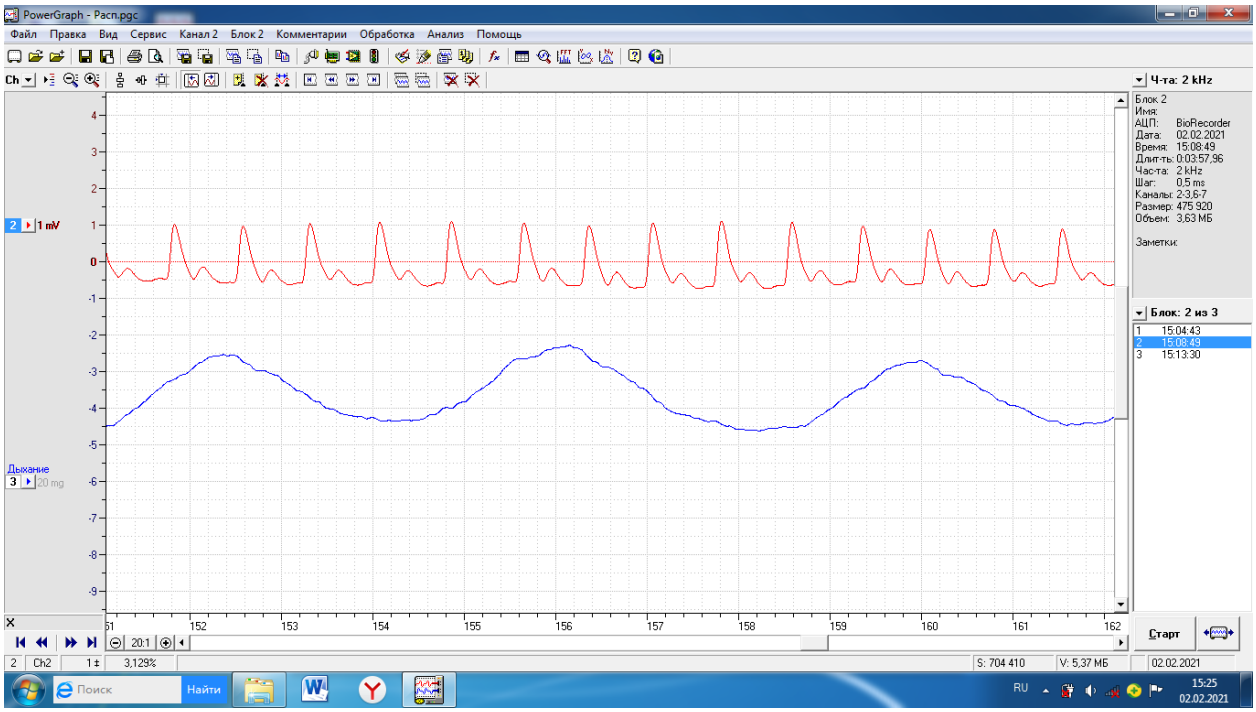
14. To determine the time of breath retention, a section of the o curve of the "Breath" channel is allocated from the moment of deep inspiration in the Shtange test (exhalation in the Gencha sample) to the resumption of breathing.

15. Open the "Analysis" menu, select "Table of values", and select the Duration function in the Selection category, click on the gear image or the F5 key. 18. The calculated value should be displayed in a free field, where the Selection duration entry with the value in seconds will appear, and the data is entered in Table.



16. The pulse rate measurement is carried out according to a similar method, calculating the data for the "Pulse" channel. For calculations, it is advisable to allocate the pulse curve in the region of two maxima. 3-4 measurements are carried out, after which the average duration of one cycle is calculated, the data is entered in Table 2.
17. Determine the heart rate. Knowing the duration of one cycle, calculate the heart rate according to the formula: heart
rate= 60/average duration of one cycle (s).
18. The analysis is carried out for the fragments rest, involuntary hyperventilation, after physical exertion, the data is entered in Table.





Formulate conclusions.

TOPIC 2. PHYSIOLOGY OF THE DIGESTIVE SYSTEM

Control questions on the topic of the lesson:

1. General principles of self-regulation of digestion. Food center, modern ideas about its localization and functions.

2. The role of reflex, humoral and local mechanisms in the regulation of secretory function of the digestive tract. Hormones of the gastrointestinal tract, their classification, mechanisms of action.

3. The role of reflex, humoral and local mechanisms in the regulation of motor function of the digestive tract.

4. Functional power system, analysis of its central and peripheral components. Food motivation. The physiological basis of hunger and satiety.

5. The basic principles of the Pavlovian approach to the study of the functions of the digestive tract. Chronic methods of studying the secretory function of the digestive tract in animals.

6. Digestion in the oral cavity. Changing food in the oral cavity - mechanical and chemical processing.

7. Digestion in the stomach. Composition, properties of gastric juice, role in digestion. Features of gastric secretion in the digestion of proteins, fats, carbohydrates.

8. Digestion in the duodenum.

9. The role of the liver in digestion. Composition and properties of bile. Bile formation, mechanisms of regulation.

10. Excretion of bile from the duodenum, regulation of the process. Methods for studying bile formation in animals and humans.

11. Secretory function of the intestine. The composition and properties of intestinal juice, the role in digestion. Cavity and membrane hydrolysis of nutrients in the small intestine.

12. Motor activity of the small intestine. Types of contractions, role in digestion, mechanisms of regulation. Intestinal-intestinal reflexes.

13. Motor activity of the large intestine. Types of contractions, role in digestion. Regulatory mechanisms. The importance of the microflora of the large intestine.

14. Methods of studying the motor function of the intestine in animals and humans.

Practical work №1. Digestion of protein by gastric juice and the importance of hydrochloric acid in this process

The purpose of the work: To make sure that acidin-pepsin breaks down protein, turning it into albumoses and peptones, as well as in the great importance of hydrochloric acid in the digestive process.

Materials and methods: albumin, acidin-pepsin solution, 0.1 N hydrochloric acid solution, bicarbonate of soda, alcohol lamp, tubes, pipettes, thermostat, indicator papers.

Progress of work: 4 test tubes are numbered. In 3 test tubes, pour 2 ml of acidin-pepsin solution (gastric juice), and in the fourth 2 ml of hydrochloric acid. Then, using the indicator paper, the presence of free hydrochloric acid in the

acidin-pepsin solution is determined. In the second test tube with acidin-pepsin, soda is poured until the hydrochloric acid is completely neutralized (pH= 7). The third tube with acidin-pepsin is brought to a boil, while the pepsin is destroyed.

In each of the 4 test tubes, add 1 small piece of albumin. And put in the thermostat at a temperature of 38 ℃. After 15 minutes, the test tubes are removed and make sure that the albumin has been digested in the first tube (there is no piece), in the second and third test tubes-digestion has not occurred. In the fourth test tube, a piece of albumin increased in size (it swelled).

Make a conclusion and answer the question 1. To what substances did albumin digest? 2. What is the value of hydrochloric acid?

Practical work №2. The work of the ciliated epithelium of the frog esophagus

The work of the ciliated epithelium of the frog esophagus is a particular manifestation of the automatic motor activity of the digestive tract. The movement of the cilia of the ciliated epithelium is controlled by the autonomic nervous system. In humans, there is no ciliated epithelium in the esophagus.

The purpose of the work: Observation of the movement of particles trapped on the ciliated epithelium, and the influence of biologically active substances on this process.

Materials and methods: Preparation kit, stopwatch, 0,6% saline solution, frog.

Progress of work: Immobilize the frog by destroying the spinal cord. After inserting a pair of scissors into the oral cavity, the lower jaw and esophagus are dissected together with all the layers of tissue before entering the stomach. The frog is fixed with its belly up on the preparation plate. Open and slightly stretch the esophagus, fixing its edges with pins. The surface of the esophageal mucosa is moistened with saline solution and a small piece of colored paper is placed closer to its front end. Measure the time of paper movement on a segment of the esophagus in 1 cm and calculate the speed of its movement along the surface of the epithelium towards the stomach. ***Make a conclusion.***

Practical work №3. Recording of the motor activity of the frog's intestine

The purpose of the work: to observe intestinal motility and the effect of acetylcholine and epinephrine on it.

Materials and methods: Preparation kit, stopwatch, 0,6% saline solution, adrenaline solution (1:1000), frog.

Progress of work: The order of the work. In an immobile frog, after cutting the anterior abdominal wall, find the stomach, intestines, rectum and cloaca. Apply mechanical irritation to the upper part of the digestive tube with tweezers or a pin.

Observe the peristaltic movement. Carefully release the rectum and a small part of the small intestine. At 1-2 cm above the beginning of the rectum, apply a surfin connected to the lever for registration on the kymograph. Record the contractions of the rectum, and then squeeze the area of the intestine with tweezers, observe an increase in tone and increased peristalsis. Without stopping the kymograph, a drop of adrenaline solution (1:1000) is applied to the surface of the intestine. Mark the moment of chemical irritation application on the kymograph paper. After recording on the kymograph, it is necessary to wash the intestine well from the adrenaline solution when the kymograph is stopped. Make a new entry (2-3 abbreviations). Then apply 1 drop of epinephrine solution to the intestine, noting the moment of application of chemical irritation. Draw up a protocol by pasting in it kymograms with different chemical effects.

To draw a conclusion about the automaticity of the intestine and the effect of adrenaline on its motility.

Practical work №4. Electrogastrography and make its analysis

The purpose of the work: Record the electrogastrography and make its analysis

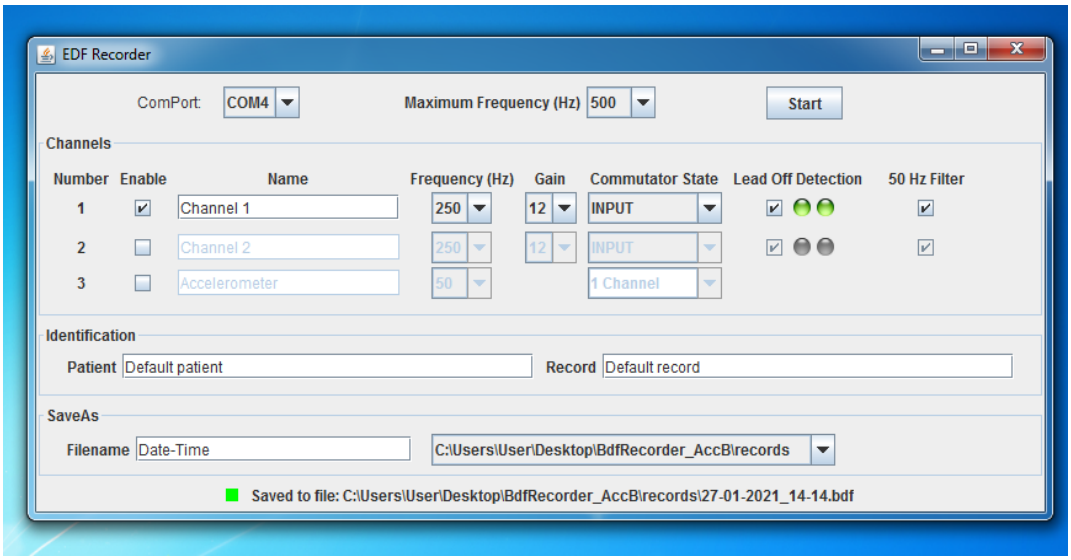
Materials and methods: computer, «Bio-rod».

Progress of work:

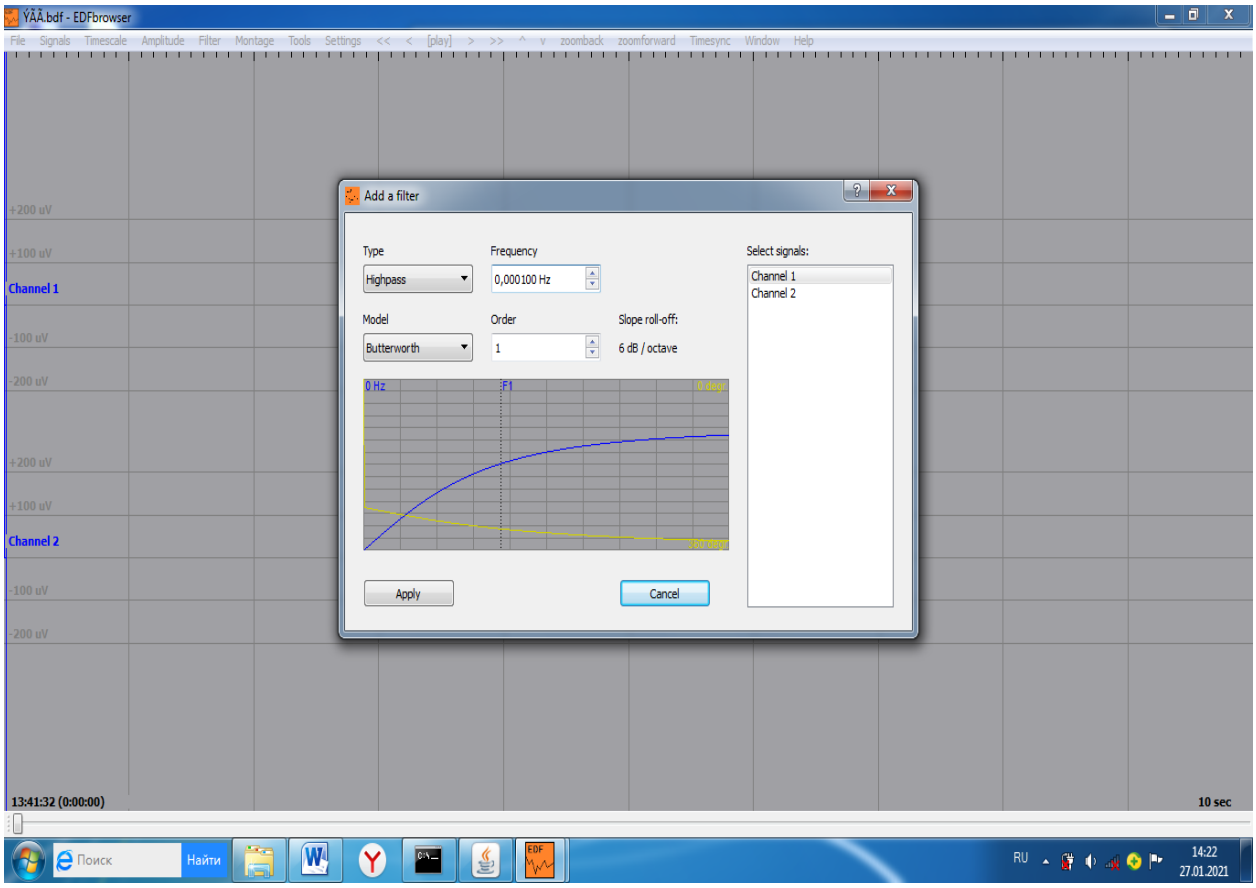
1. Turn on the computer.
2. Connect the wireless signal receiver to the USB port.
3. Connect the EM sensor to the body of the «Bio-rod».
4. If the connection is made correctly, the blue light on the amplifier housing will start to pulse intermittently.
5. The subject is placed on the couch according to the scheme in Fig. of the introductory section, ask to relax.
6. The torso is girdled with a long textile clasp at the level of the epigastrium. The bio-rod is fixed with the help of annular fixators on the anterior abdominal wall (parallel to the anterior abdominal wall, with the markup).
8. Before applying disposable electrodes, it is recommended to treat the skin areas on which the electrodes will be placed with alcohol and apply a drop of electrode gel.
9. On the limbs of the subject, disposable electrodes are glued according to the following scheme: the right forearm (connected to the positive terminal); right shin (negative terminal), left shin (ground electrode). The wire with the microphone is twisted into a ring and laid to the side.
10. The experimenter starts the program "Powergraph Pro", in the menu "Select ADC" selects the item "Biorecorder".

11. After starting the program, the menu "File" chooses "to Download settings - PAGG", resulting in their field three-channel recording: at the top - a breath in the middle heart rate (HR) bottom signal PEGG (Fig.1).
12. The experiment consists of two parts, recording is not interrupted.
13. After 15 minutes of recording 2, corresponding to Fig. 1, the experimenter presses the "Stop" button.
14. The displayed curves should correspond to Fig. 1. preliminary assessment of the quality of the recording: make sure that there are no significant bursts on the "breath" channel that are associated with the movements of the subject. In the presence of such bursts, this stage is redone, and if the curves of proper quality are obtained, they proceed to the next stage.
15. The subject is put pieces of bread in his mouth, asked to chew and swallow, drinking tea through a straw.
16. The experimenter presses the "Start" button, the gastrogram is recorded for another 10-15 minutes, then the study is completed by pressing the "Stop" button.
17. In the main menu, select: "Tools" - Channels and charts" - "Calculate all" and "File" - "Save". The record blocks are renamed, respectively: "On an empty stomach" and "After a meal".
18. Start analyzing the data. Select the section of the curve corresponding to the fasting record.
19. In the menu "Analysis" select "spectrum analyzer" (Fig.3). Configure the spectrum analyzer as follows: in the "Type spectrum" (the window on the right) choose "Power" in the "FFT size" select "16384", in the "Weight function" — "Blackman Harris", "Averaging"—"0% overlap". In the Channels window, select "PEGG". A graph of the spectral power is displayed. At the bottom of the chart
The maximum value on the spectral power graph (Max) and the frequency value corresponding to this maximum3 (Fmax, Hz) are displayed. Record the received values. Close the window of the spectrum analyzer.

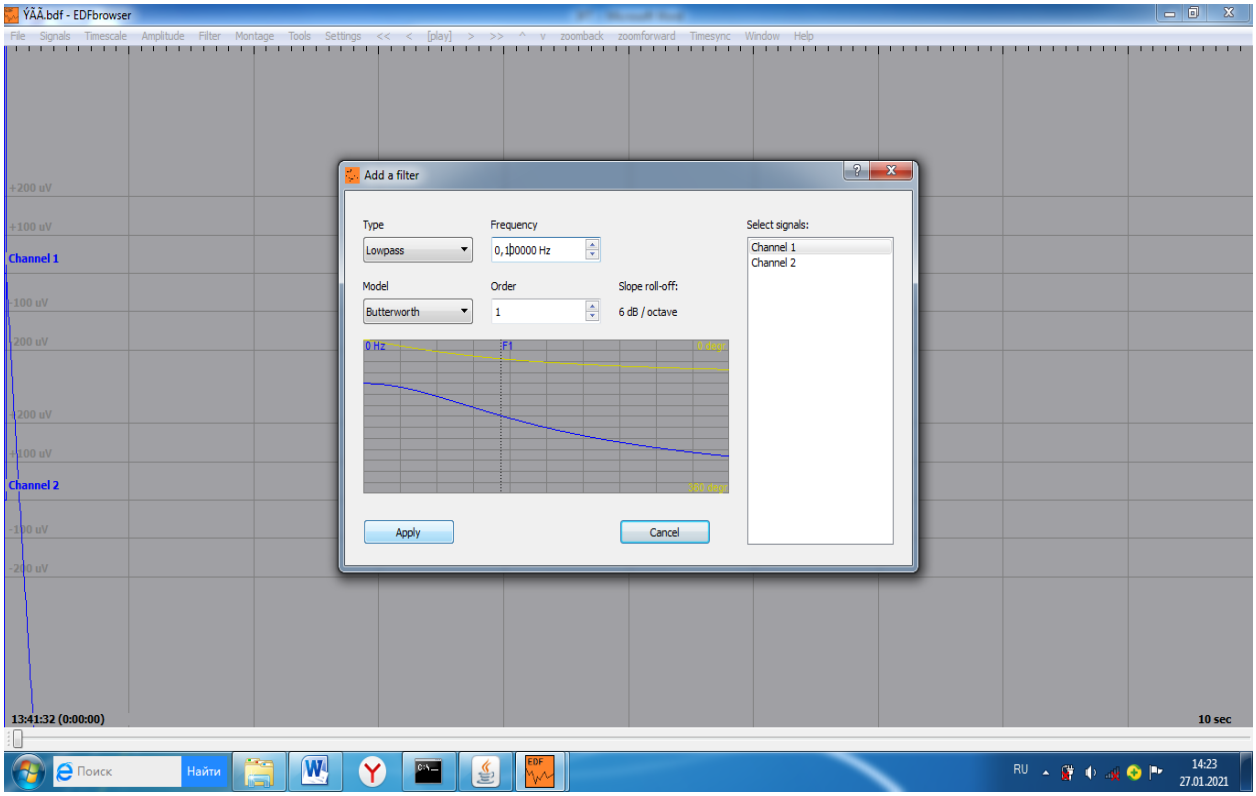
Channel Settings



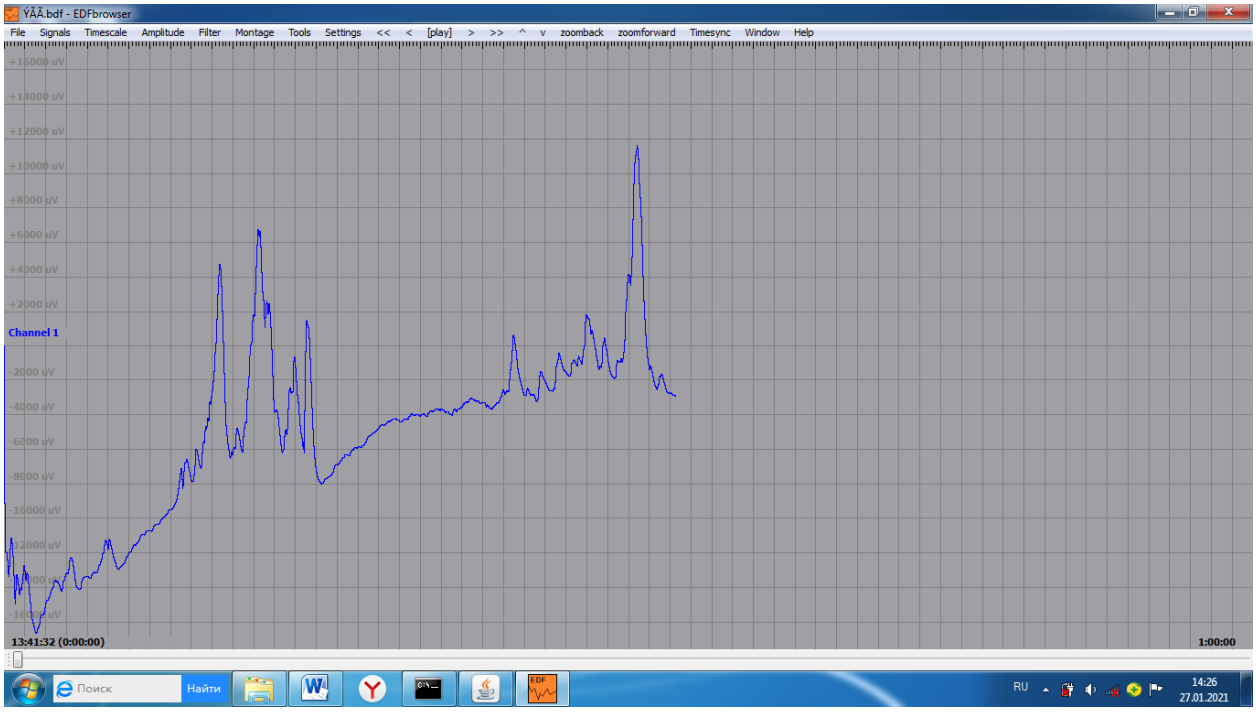
Filters



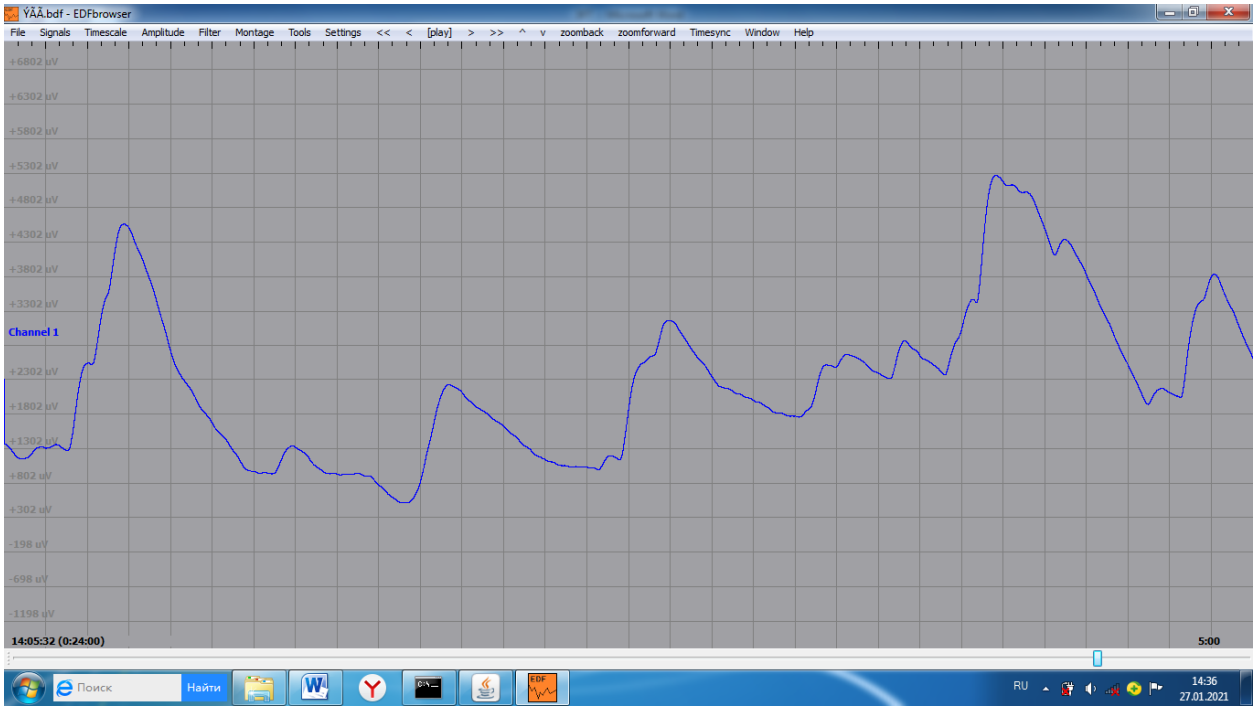
After filters



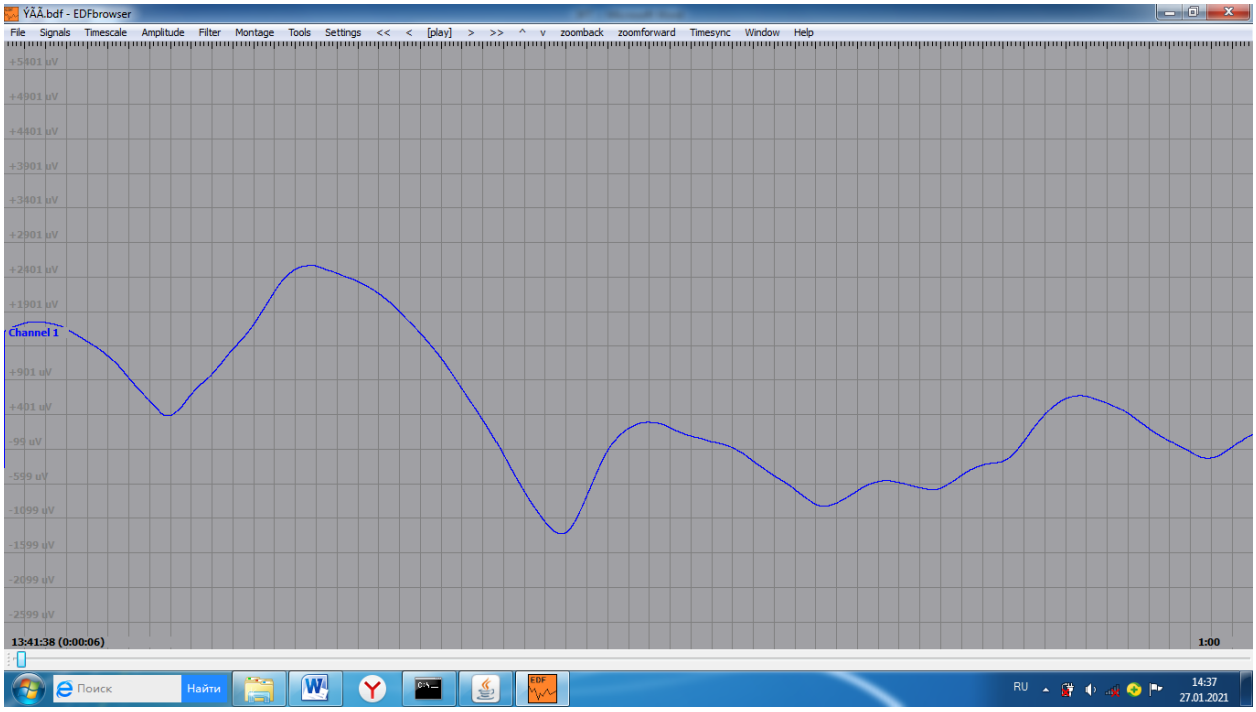
Hourly scan



5 minutes scan analysis



1-minute scan analysis



Make conclusions.

QUESTIONS FOR COLLOQUIUM № 4. «PHYSIOLOGY OF RESPIRATION, DIGESTION AND METABOLISM»

1. The concept of the respiratory cycle. The role of the respiratory muscles.
2. Pressure in the pleural cavity and pneumothorax. Elastic properties of the lungs.
3. Pulmonary volumes, ventilation of the alveoli.
4. Exchange of gases in the lungs and tissues.
5. The interaction between ventilation and blood circulation.
6. Transport of gases by blood, conditions for the exchange of gases between air and blood. Molecular basis of binding of oxygen to hemoglobin.
7. Respiratory center: structure, functions.
8. Chemoreceptors and respiration.
9. Irritant receptors.
10. Mechanoreceptors and respiration.
11. Mechanisms of periodic activity of the respiratory center. Reflex effects on the respiratory center.
12. Humoral regulation of respiration. Hyperventilation and hypoxia, asphyxia, hypoxemia.
13. Classification of digestive processes.
14. Principles of regulation of digestion.
15. Digestion in the oral cavity, regulation of salivation.
16. Digestion in the stomach, the phases of gastric juice secretion.
17. Humoral regulation of the motor and secretory activity of the stomach.
18. Digestion in the small intestine.
19. Parietal digestion. Functions of the large intestine
20. Motility of the digestive tract.
21. The suction process.
22. Liver. Bile, composition and function.
23. The main functions of proteins in the body. Protein metabolism. Regulation of protein metabolism. The concept of nitrogen balance.
24. The main functions of fats in the body. Fat metabolism, its regulation.
25. The main functions of carbohydrates in the body. Carbohydrate metabolism. Regulation of carbohydrate metabolism.
26. Principles of determining the metabolism.
27. Basic exchange and surface rule.

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PHYSIOLOGY OF THE RESPIRATORY AND DIGESTIVE SYSTEMS

Compilers:
Assistant Shabalin Mikhail Alexandrovich,
d. b. s., associate professor Deryugina Anna Vyacheslavovna
c. ph. s., associate professor Zolotova Marina Vianorovna

Nizhny Novgorod state University. N. I. Lobachevsky
National research University
23 Gagarin Avenue, Nizhny Novgorod, 603950.

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