MINISTRY OF HEALTH CARE REPUBLIC OF BELARUS

GOMEL STATE MEDICAL UNIVERSITY

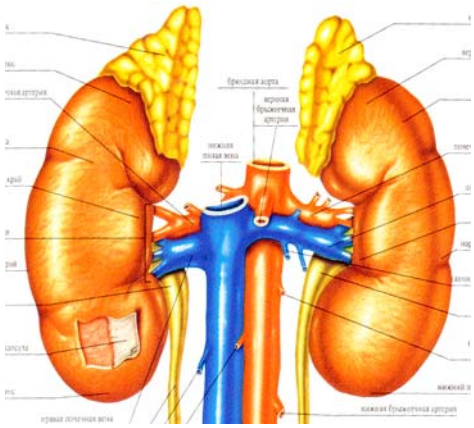
Normal Physiology Department

A.I. KIENYA, E.M. ZAIKA, V.A. MELNIK et al.

GUIDANCE IN NORMAL PHYSIOLOGY

laboratory course in normal physiology
for overseas students in English medium

Part II



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Авторы: А.И. Киеня, Э.М. Заика, В.А. Мельник, Н.И. Штаненко.

П 69 Guidance in normal physiology: laboratory course in normal physiology for overseas students in English medium = Практикум по нормальной физиологии: методическое пособие для лабораторных работ по нормальной физиологии для иностранных студентов, обучающихся на английском языке / А.И. Киеня, Э.М. Заика, В.А. Мельник, Н.И. Штаненко; под редакцией Э.С. Питкевича; пер. на англ. яз. Р.А. Карпова, В.А. Мельника. Ч. II. — Гомель: УО «Гомельский государственный медицинский университет». 2006. — 40 с.

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Представлены лабораторные работы по физиологии обмена веществ и энергии, терморегуляции, физиологии выделения, нервной системы, сенсорных систем и высшей нервной деятельности, необходимые для проведения практических занятий по данным разделам нормальной физиологии со студентами факультета по подготовке специалистов для зарубежных стран, которые занимаются на английском языке. В конце каждого раздела приведены основные константы, выраженные в Международной системе физических единиц (СИ).

При составлении и переводе данного пособия использовались материалы, опубликованного ранее руководства к практическим занятиям по нормальной физиологии под редакцией профессора А.И. Киени.

Рассмотрено и утверждено на заседании Центрального учебного научно-методического Совета УО «Гомельский государственный медицинский университет» протокол № 6 от 28 июня 2006 г.

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INTRODUCTION

The practical guidance has been developed for practical classes in normal physiology with students of the Faculty of General Medicine of Overseas Students who study medicine in English. The content of the guidance meets the Normal Physiology Program for students of higher medical schools No. 08-14/5941, approved by Ministry of Health Care of the Republic of Belarus on September 3, 1997.

Teaching normal physiology to overseas students put forward certain difficulties due to the absence of special references in English adapted for the academic program in normal physiology. Hence, one of the main concern for the staff of the Department was developing of a manual in normal physiology written in English.

The practical guidance contains laboratory tasks in physiology of metabolism and energies, thermoregulation, physiology of excretion, physiology of nervous system, physiology of sensory systems, higher nervous activity necessary for practical classes in these areas of the normal physiology. Study of techniques of laboratory tasks included into the guidance allows to improve obtained theoretical knowledge and to learn the issues of clinico-diagnostic methods of research. Each section has in the end main constants expressed in the International system of physical units (SI).

Authors will be grateful to all who will make any comments upon this guidance; these will be taken into consideration contributed into developing of a new edition of the guidance.

ВВЕДЕНИЕ

Методическое пособие предназначается для проведения лабораторных работ по нормальной физиологии со студентами факультета по подготовке специалистов для зарубежных стран, обучающихся на английском языке. Материал пособия соответствует Программе по нормальной физиологии для студентов высших медицинских учебных заведений № 08-14/5941, утвержденной Министерством здравоохранения Республики Беларусь от 3 сентября 1997 г.

При организации учебного процесса по нормальной физиологии со студентами факультета по подготовке специалистов для зарубежных стран, обучающихся на английском языке одной из трудностей является отсутствие учебно-методической литературы, адаптированной к учебной программе по нормальной физиологии. Поэтому одной из важнейших задач, стоящих перед преподавателями кафедры, явилось составление и перевод на английский язык данного пособия.

В методическом пособии представлены лабораторные работы по физиологии обмена веществ и энергии, терморегуляции, физиологии выделения, физиологии нервной системы физиологии сенсорных систем и высшей нервной деятельности необходимые для проведения практических занятий по данным разделам нормальной физиологии. Изучение методик лабораторных работ включенных в пособие позволит закрепить полученные теоретические знания и освоить некоторые важные клинико-диагностические методы исследования. В конце каждого раздела приведены основные константы, выраженные в Международной системе физических единиц (СИ).

Авторы будут весьма благодарны всем, кто сочтет возможным высказать свои критические замечания в адрес предлагаемого пособия, которые будут восприняты как выражение желания оказать помощь в его улучшении при последующим переиздании.

6. METABOLISM AND ENERGIES

Lab. work 6.1. Calculation of basal metabolism by tables of Harrison-Benedict's

The power consumption at muscular and psychological rest, at an empty stomach and at 18°C (zone of temperature comfort) is called basal metabolism. It reflects minimal level of power consumption for maintenance of vital activity of all systems of an organism. The value of basal metabolism depends on age, sex, body mass and height. Special tables help to determine the average level of human basal metabolism.

Purpose of work: to define basal metabolism with tables and to define its value in a person.

Necessary material: auxanometer, scales, tables for definition of basal metabolism. Object of research — a person.

Course of work

Place the person onto scales to define their weight. Measure their height with auxanometer. To calculate basal metabolism, use tables of Harrison-Benedict's which consider sex of the examinee since the level of basal metabolism in men on the average is 10% higher than in women.

For example, an examined is a 27 years old man, 160 cm height, 74 kg weight.

The table has two parts, A and B. In table A find body mass of the examinee and figure 1084 standing next on the right. In table B across find age (27 years), and, along, height (160 cm). On the cross of height/age columns there is figure 618. By summarizing both defined figures, obtain 1084+618=1702 kcal. Using recalculation quotient, express result in kilojoule (1702×4,19 = 7125,93 kJ).

In conclusion note the value of «due» basal metabolism of the examinee.

Table A

The table for calculation of basal metabolism in men (1 kcal = 4,19 kilojoule)

Body weight, kg	kilojoule	Body weight, kg	kilojoule	Body weight, kg	kilojoule	Body weight, kg	kilojoule
1	2	3	4	5	6	7	8
44	672	64	947	84	1222	104	1497
45	685	65	960	85	1235	105	1510
46	699	66	974	86	1249	106	1524
1	2	3	4	5	6	7	8
48	727	68	1002	88	1277	108	1552
49	740	69	1015	89	1290	109	1565
50	754	70	1029	90	1304	110	1579
51	768	71	1043	91	1318	111	1593

Body weight, kg	kilojoule	Body weight, kg	kilojoule	Body weight, kg	kilojoule	Body weight, kg	kilojoule
52	782	72	1057	92	1332	112	1607
53	795	73	1070	93	1345	113	1620
54	809	74	1084	94	1359	114	1634
55	823	75	1098	95	1373	115	1648
56	837	76	1112	96	1387	116	1662
57	850	77	1125	97	1046	117	1675
58	864	78	1139	98	1414	118	1689
59	878	79	1153	99	1428	119	1703
60	892	80	1167	100	1442	120	1717
61	905	81	1180	101	1455	121	1730
62	919	82	1194	102	1469	122	1744
63	933	83	1208	103	1483	123	1758

Table B

Men (age)

Height, cm	17	19	21	23	25	27	29	31	33	35	37	39	41
140	553	528	–	–	–	–	–	–	–	–	–	–	–
144	593	568	–	–	–	–	–	–	–	–	–	–	–
148	663	608	–	–	–	–	–	–	–	–	–	–	–
152	673	648	619	605	592	578	565	551	538	524	511	497	484
156	713	678	669	625	612	598	585	571	558	554	531	517	504
160	743	708	659	645	631	618	605	591	578	564	551	537	524
164	773	738	679	665	652	638	625	611	598	584	571	557	544
168	803	768	699	685	672	658	645	631	618	604	591	577	564
172	823	788	719	705	692	678	665	651	638	624	611	597	584
176	843	808	729	725	718	698	685	671	658	644	631	617	604
180	863	828	759	745	732	718	705	691	678	664	651	637	624
184	883	848	779	765	752	738	725	711	698	684	671	657	644
188	903	868	799	785	772	758	745	731	718	704	691	677	664
192	923	888	819	805	792	778	765	751	731	724	711	697	684
196	–	908	839	825	812	898	785	771	758	744	731	717	704
200	–	–	859	845	832	818	805	791	778	764	751	737	724

Table A

The table for calculation of basal metabolism in women (1 kcal = 4,19 kilojoule)

Body weight, kg	kilojoule	Body weight, kg	kilojoule	Body weight, kg	kilojoule	Body weight, kg	kilojoule
44	1076	64	1267	84	1458	104	1650
45	1085	65	1277	85	1468	105	1659
46	1095	66	1286	86	1478	106	1669
47	1105	67	1296	87	1487	107	1678
48	1114	68	1305	88	1497	108	1688
49	1124	69	1315	89	1506	109	1698
50	1133	70	1325	90	1516	110	1707
51	1143	71	1334	91	1525	111	1717
52	1152	72	1344	92	1535	112	1726
53	1162	73	1353	93	1544	113	1736
54	1172	74	1363	94	1554	114	1745
55	1181	75	1372	95	1564	115	1755
56	1191	76	1382	96	1573	116	1764
57	1200	77	1391	97	1583	117	1774
58	1210	78	1401	98	1592	118	1784
59	1219	79	1411	99	1602	119	1793
60	1229	80	1420	100	1611	120	1803
61	1238	81	1430	101	1621	121	1812
62	1148	82	1439	102	1631	122	1822
63	1258	83	1449	103	1640	123	1831

Table B

Women (age)

Height, cm	17	19	21	23	25	27	29	31	33	35	37	39	41
132	123	114	–	–	–	–	–	–	–	–	–	–	–
136	139	130	–	–	–	–	–	–	–	–	–	–	–
140	155	146	–	–	–	–	–	–	–	–	–	–	–
144	172	162	–	–	–	–	–	–	–	–	–	–	–
148	187	178	–	–	–	–	–	–	–	–	–	–	–
152	201	192	183	174	164	155	146	136	127	117	108	99	89
156	215	206	190	181	172	162	153	144	134	125	116	106	97
160	229	220	198	188	179	170	160	151	142	132	123	114	104
164	243	234	205	196	186	177	168	158	149	140	130	121	112
168	255	246	213	203	194	184	175	166	156	147	138	128	119
172	267	258	220	211	201	192	183	173	164	154	145	136	126
176	279	270	227	218	209	199	190	181	171	162	153	146	134
180	291	282	235	225	216	207	197	188	179	169	160	151	141
184	303	294	242	233	223	214	204	195	186	177	167	158	149
188	313	304	250	240	231	221	215	203	193	184	175	165	156
192	322	314	257	248	238	239	220	210	201	191	182	173	164

Lab. work 6.2. Calculation of the deviation of size of the basic metabolism by Read's formula and the nomogram

Based on the interrelation between heart rate, arterial pressure and heat formation in an organism it is possible to estimate the percent of deviation of values of basal metabolism from the «standard». It is estimated with the Read's formula.

Purpose of work: to estimate deviation of basal metabolism value from the standard and to define this parameter in the examined person.

Necessary material: sphygmomanometer, phonendoscope, stop-watch. Object of research — a person.

Course of work

Test pulse rate, arterial pressure (by Korotkov's) at least 3 times with intervals of 1–2 minutes following, if possible, conditions necessary for definition of basal metabolism (12 hours after eating, laying relaxed, at temperature of 18°C).

The deviation percent (DP) from the norm is defined with Read's formula:

$$DP = 0{,}75 \times (HR + PP \times 0{,}74) - 72,$$

where: DP — deviation percent of the basal metabolism from the norm;

HR — heart rate;

PP — pulse pressure (difference of systolic and diastolic pressure in mm Hg).

Calculate using simple average of 3 measuring of heart rate and arterial pressure.

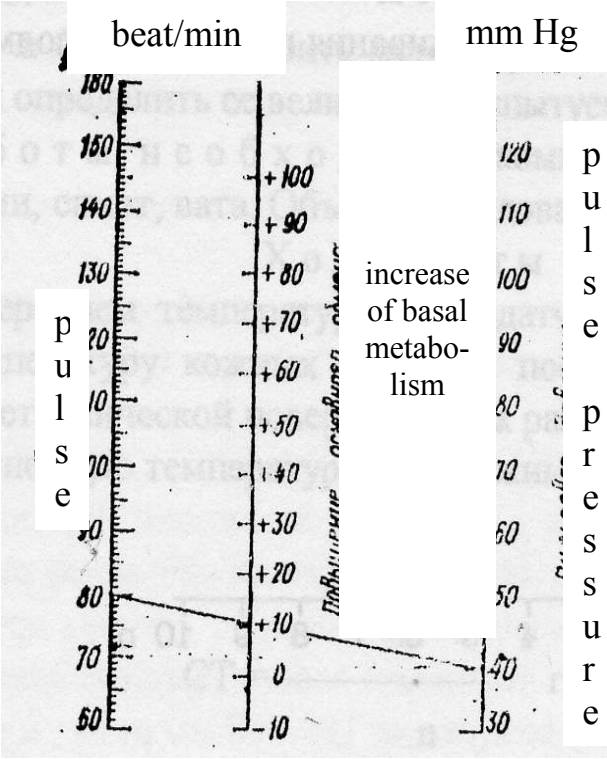

Fig. 1. Nomogram for Read's formula

Estimation of deviation value of basal metabolism is simplified at the use of specific nomogram (Fig. 1). Figures at the cross of the line drawn through the parameters of pulse rate and pulse pressure with the middle line show the deviation percent of basal metabolism from the norm.

The allowable variation of basal metabolism deviation from the standard makes 10%.

In conclusion note the deviation value of basal metabolism from the norm.

Lab. work 6.3 Taking the human body temperature

Physiological mechanisms of thermoregulation constantly maintain the human body temperature at a definite level. Change of body temperature is an important parameter of health state of the person.

Body temperature is measured with a medical mercury thermometer or an electrothermometer at axilla, oral cavity or rectally. With this, it is necessary to hold the exposure time of the thermometer in the measuring point.

Purpose of work: to define the minimal measuring time of temperature at axilla.

Necessary material: the mercury medical thermometer, antiseptic solution, stop-watch. Object of research — a person.

Course of work

Shake the thermometer and place it at the axilla for 1 minute. In a minute, note its indications, shake again and place at the axilla.

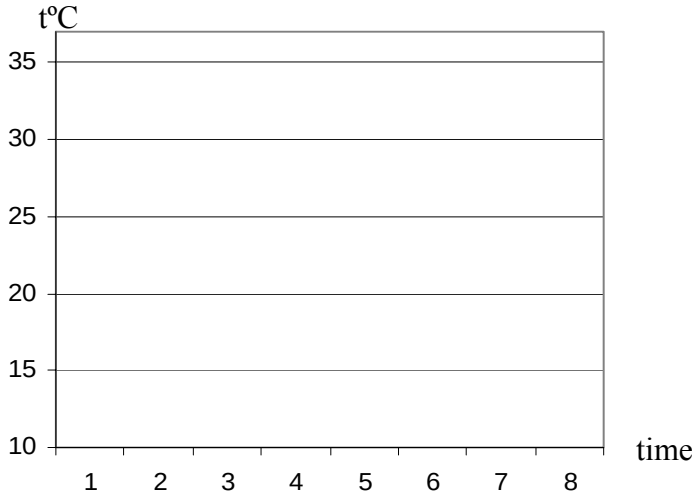

Fig. 2. Dependence of thermometer indications on its exposure time

Measure the temperature in similar way within 2, 3, 4, 5 minutes, etc., till the indication of the thermometer remain constant.

Using results of the test make a diagram (Fig. 2) of indications of the thermometer depending on time of measuring.

In conclusion note the shortest time of keeping the thermometer in the axilla for measuring of the body temperature.

THE BASIC CONSTANTS METABOLISM AND ENERGY

Biological value of proteins:	
animal origin	70–95%
vegetable origin	60–65%
Daily need:	
Proteins	70–80 g (of them 30% are animals)
Fats	70–80g (of them 75–80% are animals)
Carbohydrates	400–450 g
Water content in an organism	
Men	61%
Women	51%; (compare 53,5%)
Neonatal	75%
Formation of water in an organism at oxidation:	
100 g of carbohydrates	55 ml
100 g of proteins	41 ml
100 fats	107 ml
Daily balance of water	near 2,5 l
Food value:1 g of fats	9,3 kcal (39,0 kilojoule)
1 g of carbohydrates	4,1 kcal (17,1 kilojoule)
1 g of proteins	4,1 kcal (17,1 kilojoule)
Respiratory coefficient at oxidation in an organism	
Carbohydrates	1
Fats	0,7
Proteins	0,8
The basic metabolism:	
Men	7117 kilojoule (1700 kcal) a day
Women	6410 kilojoule (1530 kcal) a day
temperature	
axilla	36,5–36,9ºC
in oral cavity	36,4–37,2ºC
rectum	36,8–37,6ºC
daily temperature fluctuation	0,5–0,7ºC
Max	at 4–6 p.m.
Min	at 3–4 a.m.
hyperthermia	body temperature > 37ºC
hypothermia	body temperature < 35ºC

7. EXCRETION

Lab. work 7.1. Definition of protein in urine

Purpose of work: to study the technique of protein detection in urine.

Necessary material: 20% solution of salicyl-sulphonic acid, protein-containing urine, and normal urine. Object of research — a person.

Course of work

To 1 ml of urine in the tube add 3 drops of 20% salicyl-sulphonic acid (green). With the presence of protein in the urine, white sediment or mud is formed the amount of which depends on the concentration of protein in urine.

By results of work define the urine containing protein.

Lab. work 7.2. Definition of sugar in urine

Principle of method. As the result of interaction of sugars in the urine with Heines' reagent, valence of copper changes. This ensures decolourization of the medium.

Purpose of work: to learn the technique of sugar detection in urine.

Necessary material: Heines' reagent, tubes, pipettes, bain-marie, sugar-containing urine and normal urine. Object of research — a person.

Course of work

Into a tube add 2 ml of Heines' reagent and 4 drops of urine. Keep the content for 5 minutes in the boiling bain-marie. If there is sugar in the urine, the content will stain pink. Significant concentration of sugar results in formation of red crystals.

Intensity of pink color depends on the concentration of sugar in urine. At absence of sugar in urine the reagent remains its dark blue color.

By results of work define the urine which contains sugar.

Lab. work 7.3. Combined express-diagnostic test for definition certain physico-chemical properties of urine

Final result of kidney activity is the urine which represents complex biological fluid. It contains more than 150 chemicals of organic and inorganic substances. Reaction of urine (pH) is determined by concentration of free hydrogen ions in it. In physiological conditions pH fluctuations depend both on feeding and many other factors. Sugar (glucose) in the urine of the healthy person is absent, except for cases of slight glucosuria at the excessive carbohydrates intake with food. Ketone bodies appear in the urine at the number of diseases (diabetes, diseases of liver, etc.). At pathology urine can have blood as undestroyed erythrocytes (hematuria) or dissolved bloody pigment (hemoglobinuria). The hemoglobinuria is met rarely, for example, at transfusion of incompatible blood. Hematuria appears at affection of kidney or urinary ducts. There is minimal amount of protein in the urine of the healthy person.

The combined express-test allows to define values of the most important physico-chemical properties of the urine.

Purpose of work: to study the procedure of express-diagnostic test of physico-chemical properties of urine sample.

Necessary material: test-strips, scale for comparison of parameters with norm, support with tubes, filter paper, forceps, stop watch. Object of research — a person.

Course of work

Add 10 ml of the examined urine into the tube. Put test-strip into tube for a few seconds. Then take the test-strip with forceps and put it onto the filter paper, dry out. Compare the results with the scale on the pack.

Write down the obtained results into the table.

glucose	bilirubin	ketone bodies	density	erythro-cytes	pH	protein	urobilin	nitrite	leuco-cytes

In conclusion write down if the results of the urinalysis correspond to physico-chemical parameters in norm.

CONSTANTS OF EXCRETORY SYSTEM

Efficient filtration pressure	20 mm Hg
General filtration surface of glomuluses	1.5–2 m^2
Renal blood flow	of 1200 ml/minutes
Renal plasma flow	650 ml/minutes
Amount of initial urine a day	150–170 l
Amount of final urine a day	1,5 l
Relative density	1,012
Color	from amber-yellow to stramineous
Transparence	transparent
pH	5,0–7,0

8. EXAMINATION OF HUMAN PHYSIOLOGICAL FUNCTIONS INFLUENCED BY VARIOUS FACTORS AND FUNCTIONAL ACTIVITY DEFINITION OF HUMAN WORKING CAPACITY

At the complex analysis of health and physical development of a person the definition of his physical working capacity (PWC) is one of the most informative parameters. The advantage of the given parameter in comparison with others consists that it in complex reflects physical development of the person, functional state and interrelation between his functional and physiological systems (cardio-respiratory, neuromuscular, endocrine, etc.) and power ability of an organism.

PWC is calculated by the parameter of PWC_{170}, determined by the step-test or veloergometry which reflects the power of work a person can do at a pulse rate 170 beat/minutes.

Lab. work 8.1. PWC definition by step-test method

Purpose of work: to learn the technique of PWC definition by step-test method and to detect its value in a person.

Necessary material: height adjusted step, metronome, stop-watch. Object of research — a person.

Course of work

At first the person approves the order of instep on step and descents from it under rhythm of metronome. With the first impact of metronome on step instep the left leg, with the second — right, with the third - the left leg descents on floor, with the fourth — right.

Set the step to 30 centimeters height. Calculate power of the first and the second exercise with the formula:

$$N = 1{,}20 \times P \times h \times n ,$$

where: N — power of work, kgm/minute;
P — body weight of the person, kg;
h — height of step, m;
n — number of ascents onto the step per minute
1,20 — the coefficient which considers the work at descent from the step (for children it is 1,33).

The person with the body weight of 65–70 kg performs the first exercise for 3 minutes with the frequency of 15 ascents per minutes (at the metronome's frequency of 60 strokes per minute). Once the exercise is over, count the person's pulse rate (P_1) during the first 10 seconds. After 3 minute's break the person performs the second exercise multiplied, in comparison with first one, in 2 times (30 ascents on the step at the metronome's frequency of 120 strokes per minute). Count the pulse rate again (P_2).

Calculate PWC with Karpman's formula:

$$PWC_{170} = N_1 + (N_2 - N_1) \times \frac{170 - P_1}{P_2 - P_1},$$

where: N_1 and N_2 — power of the first and the second loads (kgm/min);

P_1 and P_2 — pulse rate at the end of the first and the second exercises (beat/min).

Table of PWC evaluation of an adult person

Evaluation	PWC_{170}, kgm/min		PWC_{170} for 1 kg of body weight, кgm/min	
	Men	Women	Men	Women
Above average	1200	750	17,0	12,0
Average	1000–1200	650–750	15,0–17,0	10,0–12,0
Below average	1000	650	15,0	10,0

In conclusion compare the data obtained with the norm using the table.

Lab. work 8.2. Dynamometry. Measuring of human power

One of parameters of physical development of an organism is muscle power. The power of a person is evaluated by dynamometry method (hand and torso) which allows to define the maximal muscle power, power parameter, level of work capacity of muscles and the parameter of its diminution.

1. Hand dynamometry

Purpose of work: to learn the technique of hand dynamometry. To define muscle power of hand, power parameter, level of work capacity of muscles and parameter of its diminution in the person.

Necessary material: hand dynamometer, stop-watch. Object of research — a person.

Course of work

a) Definition of the maximal muscle power.

Measuring of the maximal muscle strength is made in standing position. The person takes the dynamometer into his right hand and stretches it under the right angle towards the body, another hand is down relaxed. The dynamometer is pressed three times with the maximal force without jerk, first with the right, then with the left hand. The largest indication of the dynamometer's arrow shows the maximal power of hand muscles.

b) Definition of muscle power (MP). To calculate the MP, use the data of the previous measuring.

MP is calculated with the formula:

$$MP = \frac{MSH}{BW} \times 100,$$

where: MSH — muscle strength of hand (kg);

BW — body weight (kg).

The results obtained:

- Muscle power of right hand (kg).
- Parameter of muscle power (unit).
- Muscle power of the left hand (kg).
- Parameter of muscle power (unit).

A satisfactory parameter of muscle power of the hand is for:

- Women — 50 units
- Men — 55 units

c) Definition of the working capacity level of muscles (WCLM).

The person makes 10 maximal efforts as above with the frequency of 1 time per 5 sec. Calculate the average level of working capacity of hand muscles with the formula:

$$WCLM = (f_1 + f_2 + f_{3...} + f_n) / n,$$

where: WCLM — level of work capacity of muscles;
f_1, f_2, etc. — dynamometer indications (kg) at separate muscles efforts;
n — number of attempts.

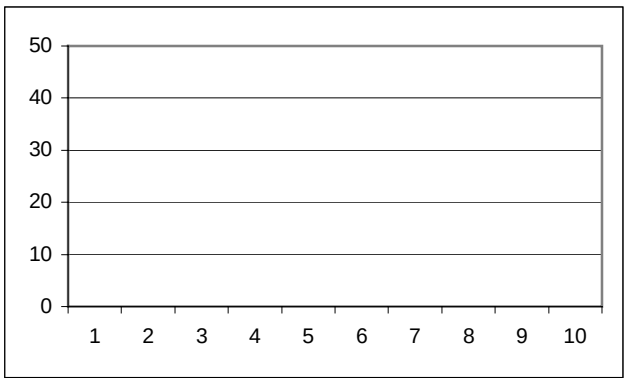

Fig. 3. Dynamics of changes of the power persistence level during 10 muscular efforts.
Y axis — muscles power (kg); X axis — consequence of muscular efforts (n)

In conclusions evaluate muscle power of the person. Using results of 10 muscular efforts draw a diagram which demonstrates the decrease of the working capacity of muscles: mark numbers of muscular efforts on X axis, and dynamometer's indications for each effort on the Y axis (Fig. 3). Compare the results of several persons.

d) Definition of the parameter of working capacity decrease.

Calculate the latter with the formula using the previous data:

$$S = [(f_1 - f_{min})/f_{max}] \times 100, \text{ where;}$$

S — parameter of the working capacity decrease;
f_1 — initial muscular power volume
f_{min}— the minimal muscular power;
f_{max} — the maximal muscular power.

2. Torso dynamometry

Torso dynamometry allows to assess the power of extensor muscles of the back.

Purpose of work: to learn the technique of torso dynamometry and to define the power of back muscle of the person.

Necessary material: torso dynamometer. Object of research — a person.

Course of work

The person stands on leg support. The hook of the dynamometer is connected to the support through the connecting rod depending on the body height. The person must keep legs straight in knees and lean his body to approximately 30° from vertical. To define the torso power, the person tends to straight the body upright and, therefore, pulls the handle upwards with all his might.

The exercise is made 3 times and the maximal size (kg) is used. To assess the torso power, calculate the ratio of the extensors muscle power of the back to the body weight of the person.

Results:

The power of muscles-extensors of back, kg

Torso force is more than body weight of the person in time.

A satisfactory parameter of the power of muscles — extensors of back is the parameter of the torso power which exceeds the body weight:

For men — in 2 times;

For women — in 1,5 times.

In conclusion compare the received data with the norm.

Lab. work 8.3. Veloergometry. Definition physical work capacities by PWC_{170} test

Purpose of work: to learn the technique of the definition of physical work capacities with a veloergometry method by PWC_{170} test and to define its size in the person.

Necessary material: veloergometer, stop-watch, medical scales. Object of research — a person.

Course of work

Count the pulse rate of the person at rest in sitting position. Then during 5 minutes he makes the first exercise (N_1), the value of which depends on his body weight (see the Table).

Power of the first exercise depending on the body weight of the person

Body weight, kg	Power, кgm/min	Notes
59 and less	300	To convert кgm/min into watts, divide кgm/min parameter by 6,12
60–64	400	
65–69	500	
70–74	600	
75–79	700	
80 and more	800	

Convert the power of the load in Watts found in the Table into nanometers and enter it on the veloergometer's panel:

1,6–10 watt	24–150 watt
4,0–25 watt	28–175 watt
8,0–50 watt	32–200 watt
12–75 watt	48–300 watt
16–100 watt	64–400 watt
20–125 watt	

The frequency of pedals rotation is tachometer-controlled and is kept constant at 60 RPM. Count the pulse rate (BPM) — F_1 — during the last 30 seconds of the exercise. After 3 minutes' break the person does the second exercise (N_2), also for 5 min. The power of the second exercise depends on the size of the first one (F_1) and the heart rate (HR) after the first exercise (see the Table). Count the pulse rate again during the last 30 seconds (BPM).

Power of the second exercise depending on HR during first exercise

Power of work at the first exercise, кgm/min	Power of work at the second exercise, *кgm/min*				
	HR during first exercise, *beat/min*				
	80–89	90–99	100–109	110–119	120–129
400	1100	1000	900	800	700
500	1200	1100	1000	900	800
600	1300	1200	1100	1000	900
700	1400	1300	1200	1100	1000
800	1500	1400	1300	1200	1100

After both exercises are over, calculate the physical work capacity with the formula:

$$PWC_{170} = N_1 + (N_2 - N_1) \times \frac{170 - F_1}{F_2 - F_1},$$

where: PWC_{170} — power of exercise, кgm/min;

N_1 and N_2 — power of the first and the second exercise (kgm/min).

P_1 and P_2 — pulse rate at the end of the first and the second exercise (beat/min).

Compare the received data with the norm in Table.

Assessment of physical work capacities of an adult

Assessment	PWC_{170}, kgm/min		PWC_{170} for 1 kg of body weight, кgm/min	
	Men	Women	Men	Women
Above average	1200	750	17,0	12,0
Average	1000–1200	650–750	15,0–17,0	10,0–12,0
Below average	1000	650	15,0	10,0

Draw a conclusion about physical work capacities of the person.

Lab. work 8.4. Examination of redistributing vascular reactions of the organism by plethysmography method

Fluctuations of blood filling of organs and region of the body closely connected with the heart activity. Pulse changes of blood filling of organs are called the volumetric pulse which is registered with the help of plethysmography method.

With the plethysmogram (PTM) there are three types of waves: waves of the first order, or pulse, reflecting heart activity; waves of the second order, or respiratory, conforming to changes of the arterial pressure during breathing; waves of the third order are irregular, they reflect changes of the peripheral circulation during interaction of the organism with constantly varying conditions of the environment. Waves of the third order are recorded at temperature influences, physical work, emotions of various origin and mental work.

The method of plethysmography allows to assess peripheral blood-flow and redistributing vascular reactions in body parts, in mucous membranes, in superficial vessels under various influences.

Purpose of work: to learn the technique of plethysmography and to study peripheral redistributing vascular reactions in the person under various conditions.

Necessary material: plethysmographer, registrar (electrocardiograph), ice pack, hot-water bag. Object of research — a person.

Course of work

Registered plethysmogram at paper tape speed of 25 mm/sec, with registration of 5–7 cardiac cycles in each of the further described positions:

1. The person is sitting, his hand relaxed on the table.
2. To lift the hand with sensor up and write down PTM instantly.
3. After the amplitude of plethysmogram is reset in 1–1,5 min, put the hands with the sensor down at maximum (towards the floor). Write down PTM.
4. After the amplitude of plethysmogram is reset in 1–1,5 min, place the ice pack to the interior of the forearm. Register changes of PTM in 2–3 min and resetting of plethysmogram in 3 min after cold influence has stopped.
5. Apply hot-water bag on the interior of the forearm, write down PTM in 2–3 minutes.

Cut out and paste in small pieces of PTM into a note-book or draw it. Compare PTM written down at various conditions. Note the dependence of blood filling of the examined part of body on the temperature and other influences.

In conclusion give explanations to the observed changes on PTM.

Lab. work 8.5 Examination of reflex reactions of the person

Responses of the nervous system to various irritations proceed by reflex principle. The irritation induces a signal which goes by afferents to the nerve centers at various levels of the central nervous system. Here signals are analysed and the appropriate reaction is synthesized.

Spinal cord localizes a lot of nerve centers of the reflexes which regulate both somatic and vegetative functions. The simplest of them are tendon reflexes and myotatic reflexes.

Reflex reactions of the person are widely used in diagnostics.

Affection of certain reflexes can reflect the localization of a pathological process in the spinal cord; hypo- or hyper- excitability of nerve centers can be diagnosed. Clinical symptom of it is the difference between reflexes of the right and the left sides of the spinal cord.

Purpose of work: to learn the technique of the examination of reflex reactions of the person.

Necessary material: reflex hammer**.** Object of research — a person**.**

Course of work

McCarthy's supraorbital reflex.

Strike easily with the hammer on the external margin of the superciliary arch. The person is to close eyelids.

Reflex of upper extremity extension.

The assistant stands by the person drawing his arm up to the horizontal level. With his left hand he supports the arm of the person by the elbow so that the forearm hanged down at right angle. At easy stroke with the hammer on the elbow joint the forearm is extended.

Reflex of flexion of upper extremity (ulnar bone).

The assistant places his left palm under the elbow of the person, supporting thus his forearm in semiflexed position. Strike the tendon of the biceps, watch the flexion of the elbow joint.

A

B

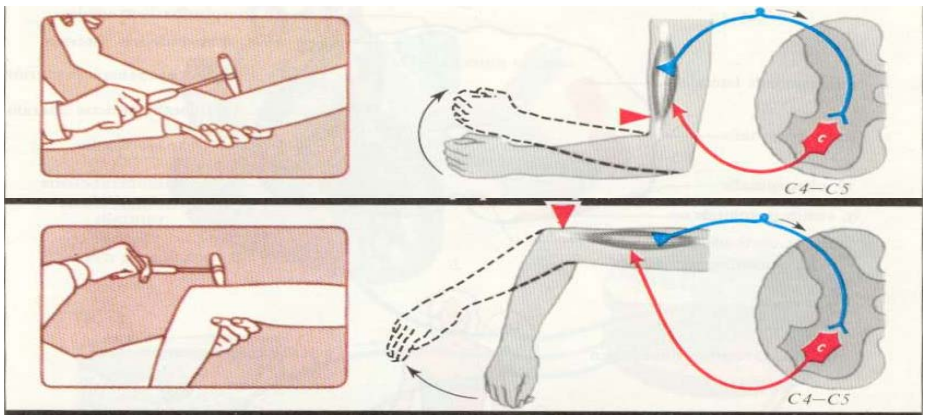

Fig. 4. A — Reflex of flexion of upper extremity,
B — Reflex of upper extremity extension.

Knee reflex.

The person sits on chair, his legs one on another. The assistant strikes the tendon of quadriceps of a leg somewhat lower of patella. There is an extension of the leg at knee-joint.

Achilles reflex.

The person stands in his knees on a chair, his feet hang down freely from the chair. Strike the Achilles' tendon. The plantar flexion of foot is observed.

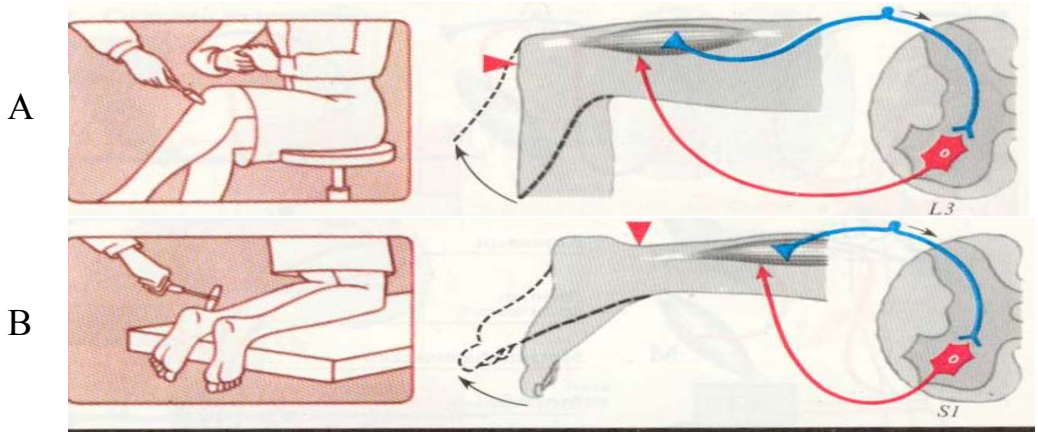

Fig. 5. A — Knee reflex, B — Achilles reflex.

Iris contraction reflex.

The pupil promotes sharp image of subjects on the retina by passing only central beams. Change of its size is caused by muscular system of the iris, thus stream of light falling into eye is regulated.

In norm at the bright light the pupil narrows, at darkening – dilates. Iris contraction reflex is used in clinics to diagnose the diseases of nervous system.

Consensual reaction of a pupil to light.

The person sits faced to light and closes one eye with the hand. The assistant watches the pupil of the opened eye which narrows at light. Simultaneously, the pupil of the closed eye is narrowing.

In conclusions specify results of observations.

9. PHYSIOLOGY OF VEGETATIVE NERVOUS SYSTEM

Lab. work 9.1 Definition of the state and the reactivity vegetative nervous system by method of cardiointervalography

Examination of states of regulator mechanisms is the most important for the assessment of the adaptation of an organism to the influence of the environment, and early detection of pre-clinical forms of pathology. In this plan it is important to define the state of the vegetative nervous system (VNS) and its reactivity. The initial vegetative tone (IVT) and vegetative reactivity (VR) are defined by cardiointervalography (CIG) with the use of an orthostatic sign (OS) which allows, by the parameters of cardiac rhythm, to estimate state of adaptive mechanisms of the whole organism.

Purpose of work: to learn the technique of CIG and to determine IVT and VR of the person. Object of research — a person.

Necessary material: electrocardiograph, couch, saline solution, gauze napkins, stop-watch, millimetric ruler.

Course of work

The test is made 1,5–2,0 hours after food reception. The person is made the ECG with 10–15 minutes intervals in one of 3 classical leads (usually the 2^{nd}), not less than 100 cardiac cycles in lying position, and then not less than 100 — after changing into standing position. Paper speed is 25 mm/sec. With the help of the ruler measure R-R intervals in mm and convert them into seconds.

After the duration of each R-R interval is detected, make mathematical processing of the cardiointervalography.

The following parameters are calculated:

Mo — (mode, sec) — most frequently met interval;

AMo — (amplitude of mode) — number of the intervals conforming to the mode in percents to the general number of cardiac cycles. It characterizes the state of sympathetic influences.

ΔX — (variational excursion) — difference between maximal and minimal values of R-R in the given range of cardiac cycles. It characterizes vagus influence on the cardiac rhythm.

IS_1 (index of stress) — parameter of stress of compensatory mechanisms of the organism, calculated with the formula:

$$IS = \frac{AMo}{2 \times Mo(\text{sec}) \times \Delta X(\text{sec})} \text{ unit.}$$

By the IS_1 size determine IVT (see constants of VNS).

By CIG parameters written down IS_2 calculated in standing position (similar method), which is necessary for the calculation of R.M.Baevsky's index (IS_B):

$$IS_B = \frac{IS_2}{IS_1}$$

Regarding IS_1 and IS_2 values using the Table (see constants of VNS) define the variant of the vegetative reactivity (VR).

In conclusion note the state and the reactivity of the VNS of the person.

CONSTANTS OF VEGETATIVE NERVOUS SYSTEM

Indexes of stress (IS_1) for definition of IVT: *< 30 — vagotonia;*
30–90 — eutonia (normtonia);
90–160 — sympathicotonia;
> 160 — hypersympathicotonia.

R.M.Baevsky's indexes (IS_B) for definition of vegetative reactivity

IS at rest, unit	Vegetative reactivity		
	Normal	Hypersympathicotonia	Asympathicotonia
Less than 30	1–3	>3	<1
30–60	1–2,5	>2,5	<1
61–90	09–1,8	>1,8	<0,9
91–160 and more	0,7–1,5	>1,5	<0,7

10. PHYSIOLOGY OF SENSORY SYSTEMS

Lab. work 10.1. Definition of the black spot on the retina of the eye (Mariott's experience)

The place where optic nerve inters into the retina is free from photosensitive receptors, that is why this field of the retina is light-insensitive and is called a black spot. The gap in visual field ensured by the black spot is usually not noticed as it is compensated by the activity of adjacent fields of retina. Black spot is detected with Mariott's test.

Purpose of work: to be convinced in presence of the black spot.

Necessary material: Mariott's picture (on the black background of paper two white images are drawn — a circle and a cross). Object of research — a person.

Course of work

The person closes the left eye to fix the right one on the cross located on the left side of the picture (Fig. 6). By moving the picture at the distance from 10 to 25 cm they find such position at which white circle on the right side of the picture becomes invisible as result of matching of the picture with the black spot, i.e. the field of the retina conforming to the place where optic nerve comes into it and there is no photoreceptors. In the same way the picture is looked at by the left eye with closed right eye (first, the picture should be positioned so that the cross was on the right and the circle on the left).

Fig. 6. Mariott's drawing

Lab. work 10.2. Definition of the visual field (perimeter)

The visual field is a space seen by the eye at fixation in one point. It depends on the functional state of the retina, anatomical features of the face (depth of eye location, form of eyeball, superciliary arch, nose), and also on the color of subjects. The visual field for black-and-white subjects (achromatic) is larger than for color ones (chromatic) that is caused by unequal location of rods and conuses in the center and on periphery of the retina. Chromatic visual field depends also on the kind of color (for green it is the smallest, for the yellow it is the largest). Borders of achromatic visual field are: external — 90°, upward and internal — 60°; downward — 65°.

Definition of visual field has an important diagnostic value in detection of the retina affection.

Purpose of work: to learn the perimeter technique and detect visual field of the person.

Necessary material: perimeter, white and color circles with clamps, forms of normal visual field, color pencils. Object of research — a person.

Course of work

To define visual field, Forster's perimeter (Fig. 7) is used. It represents mobile semicircle strengthened in support with graduation in angle degrees, with a white point in the middle. On the second support the chin of the person is placed.

The person is sitting with his back to the light. Definition of visual field is made separately for each eye. At horizontally positioned semicircle of the perimeter the person closes one eye with his hand, the second eye fixes white point in the middle of the perimeter arch. The experimenter slowly moves white circle on the internal surface of the arch from periphery to the center.

The person signals when the identification circle becomes seen immobile by the eye. On the scale they define the angle and note it in a standard form (see the examples in the Figure).

The same is done with another eye, the angle is noted in the form.

The data obtained reflect external and internal borders of the visual field. Then arch of the perimeter is fixed vertically and test is repeated again. First, identification circle is moved from the top to the center (for definition of the superior border of visual field), and then from the bottom to the center (for definition of the inferior border of visual field).

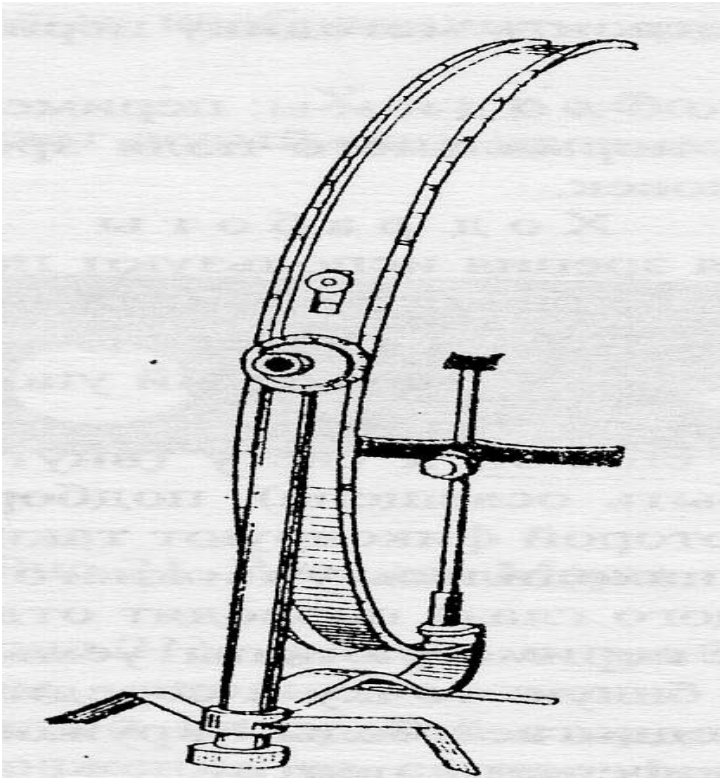

Fig. 7. Forster's perimeter

Results of are noted (Fig. 8) in the standard form. The line drawn through all marked points in the standard form reflect the visual field. Each definition is made twice.

Visual field is measured for each eye in turns.

The more meridians of the visual field are detected, the better accuracy of the measuring is.

To learn the measuring technique, on the practical classes it is enough to measure two meridians (horizontal and vertical), thus detecting visual fields for each eye in outward, inward, upward and downward directions.

Having defined visual field for white identification circle, the same method is used to define its borders for the red, green, dark blue and yellow colors.

Standard forms (Fig. 8) are filled in with visual fields data for both eyes and all colors.

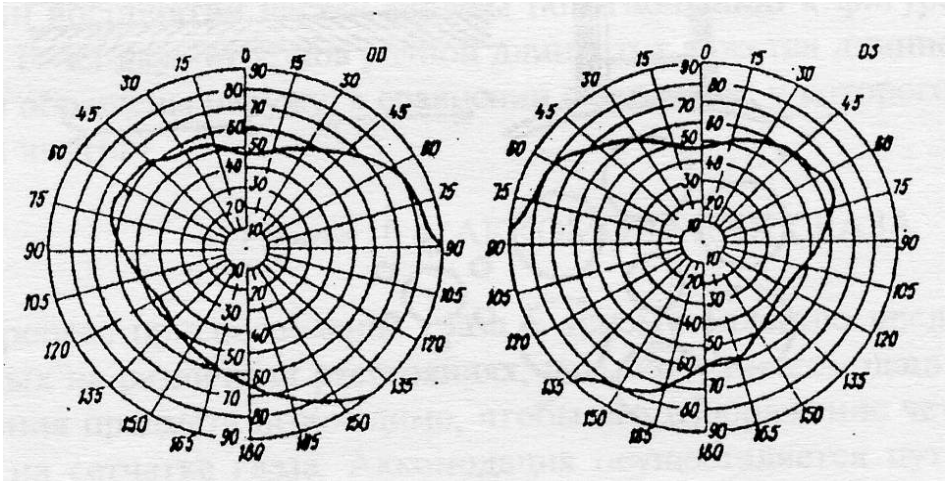

Fig. 8. Examples of a standard form for definition of visual field of the left (OS) and the right (OD) eye. The form has normal visual fields for a white object.

In conclusions compare the size of the visual field for all colors. Pay attention to the dependence of visual field on the anatomical features of face of the person.

Lab. work 10.3. Contrast phenomenon in the visual analyzer

The contrast phenomenon is revealed in increased natural difference between the two simultaneous or consecutive sensations (simultaneous and after-contrasts). As an example of simultaneous contrast is a grey area which seems more dark on a light background, more light on the black background. Simultaneous contrast is typical both for achromatic and chromatic vision. For example, grey color on a red background seems a bit greenish, on a dark blue background it acquires yellow tint. Successive contrasts arise from formation of visual negative images. For example, if to look intently at a colored subject for 15–20 sec and then to transfer the look onto white surface there arises an image of the same shape but of other color. The basis of this phenomenon are physiological mechanisms connected by inductive relations between the focuses of excitation and adjacent fields in sensory region of the visual analyzer.

Purpose of work: to detect visual contrasts depending on situation.

Necessary material: paper strips of grey color, black and white paper, special pictures (Fig. 9). Object of research — a person.

Course of work

1. Examine the tint of the white circle or paper strip on a black and grey background.

2. Examine the size of the black paper circle on a white background and white circle of the same size on the black background.

3. To examine the color intensity of the grey paper strip on the white and black backgrounds.

Different optical illusions are revealed:

a) In overestimate of vertical lines in comparison with the horizontal (Fig. 4, A — the height of the cylinder seems bigger than its width though they are equal).

b) In influence of angles on the perception of direction of their sides (Fig. 4, B — upper parallel lines seem divergent, and inferior — convergent).

c) At assessment of the dimension by the contour (Fig. 4, C — the circle between large circles seems smaller than the same circle between small circles).

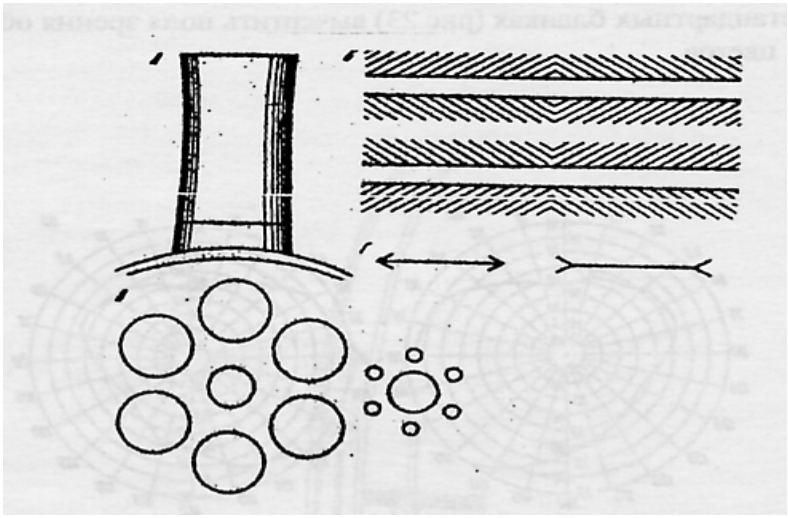

Fig. 9. Examples of visual illusions

d) At perception of parts of figure in relation to the figure on the whole (Fig. 4). D — of the two equal segments the one with outward-directed arrows seems longer than that with inward-directed arrows.

Lab. work 10.4. Eye accommodation

Adaptation of the eye to clear vision of objects located at various distances is called accommodation. For clear vision of subject it is necessary that its image was clearly focused on the retina. Contraction of unstriped muscular cells of a ciliary body decreases the traction force of ciliary zonule that increases the convexity of lens due to its elasticity. When looking at distant objects, vice versa, the ciliary body is relaxed and lens flatten.

Purpose of work: to observe the impossibility of simultaneous clear vision of distant and close objects.

Necessary material: 15×20 cm frame with gauze stretched firmly on it, typed text. Object of research — a person.

Course of work

Through the gauze stretched on the frame the person looks at the text located behind the gauze at a distance of 50 cm from eyes. At fixed look on letters threads of gauze are blurred; if to fix the look at threads of gauze, letters become blurred.thus, it is impossible to see clearly objects situated at different distance.

Write the results of the observation and to give explanation to morpho-physiologic mechanisms of accommodation and role of optical system of eye in this process.

Lab. work 10.5. Definition of acuity of vision

Acuity of vision is characterized by the smallest visual angle at which the eye can see two separate points. Normal visual acuity is an ability of the eye to distinguish between the details of surrounding situation seen at the visual angle of 1 minute. The visual angle of 1 minute is traditionally accepted in practice as a norm of acuity of vision. Macula lutea is a typical maximal acuity of vision.

Definition of visual acuity is made with special tables in which parallel lines of letters or open-ended rings located in decreasing order downwards. Each line is marked with distance in meters from which a person should distinguish letters of the line.

Purpose of work: to learn the technique and define acuity of vision in person.

Necessary material: special tables for definition of acuity of vision, pointer, the screen for eye closing. Object the research — a person.

Course of work

Mount the table for definition of visual acuity on a well illuminated wall. The person sits on a chair 5 meters from the table. Closing one eye with the screen, he says names of letters or marks on the table starting from the top and proceeding downwards. Define the final lines where letters were said correctly. This line is used to establish the acuity of vision.

Repeat this procedure for another eye.

In conclusions note acuity of vision of both eyes and compare with the norm.

Lab. work 10.6. Definition of color vision

Human eye can perceive all variety of colors which can be divided into two groups: achromatic (colorless) and chromatic (having color background). According to three-components theory, color perception is provided by three types of cones with various color sensitivity. One of them is sensitive to red color, others — to green, and the third — to blue. Some people have a decreased ability of both to distinguish between color tints, and in the form of partial or com-

plete color-blindness. There are 3 kinds of partial color-blindness: protanopia (red color blindness), deuteranpia (red and green but with especially lowered ability of green color perception) and tritanopia (dark blue and violet colors). Complete color-blindness is a rare phenomenon.

Research of color vision is extremely significant for definition of professional suitability of people whose work is connected with color perception (for example, drivers).

Purpose of work: to learn the procedure of color vision detection.

Necessary material: E.B. Rabkin's polychromatic tables, screen for eye closing. Object of research — a person.

Course of work

A person stands with his back to light 1 m from polychromatic tables mounted at his eyes level. He is shown one by one the tables with digits and various figures of certain color. The background on these images are points and circles of other color.

For definition of color sensitivity the person is shown tables 1–10. Thresholds of color sensitivity is defined with tables 11–15. To define the contrast sensitivity, tables 16–20 are used. Time of examining of an image should make about 5 sec. The test is performed for each eye separately. The person should name a figure or a digit shown on each table. Trichromates distinguish images well. Errors occur at abnormality of color vision.

In conclusions describe results of color vision test.

Lab. work 10.7. Examination of air and bone conduction of sound

Sound irritation is accepted by receptor formations of the internal ear at passing of fluctuations both through the external acoustic duct (air transfer) and through bones of skull and labyrinth (bone transfer). Effectiveness of air transfer is much more higher than bone transfer.

Purpose of work: to learn the technique, to reveal the presence of air and bone conduction of sound.

Necessary material: tuning fork, hammer, cotton wool. Object of research — a person.

Course of work

A sounding tuning fork is applied with its base to the medium line of the head. Due to the presence of bone conduction the person hears sound of equal force with both ears. Close external acoustic duct of one ear with the cotton wool tampon and repeat the test. The sound will be more intensive at the tamponed ear since the tamponade reduces loss of sound energy through the external acoustic duct.

Apply the sounding tuning fork to the mastoid. The man will hear gradually weakening sound. Once the sound has disappeared, the tuning fork is applied to the ear and the sound is heard again since air conduction effectiveness is better than that of bone.

Write down the results of investigation and make conclusion.

Lab. work 10.8. Examination of tactile sensitivity. Esthesiometry

Receptors of tactile sensitivity cover all surface of human skin and some mucous membranes. They are distributed irregularly: most of them are on the fingertips, on the tip of a tongue, nose; the smallest number is on forearm, crus, back. For examination of the tactile sensitivity the method of the esthesiometry is used allowing to define threshold of spatial sensitivity, i.e. minimal distance between two points of skin at which irritation of two touches is distinguished.

Purpose of work: to learn the esthesiometry method and to define spatial sensitivity threshold in the person. Object of research — a person.

Necessary material: esthesiometer (Weber's compasses), millimetric ruler.

Course of work

The person comfortably seats in a chair with closed eyes. The assistant touches different parts of the person's skin with Weber's compasses whose legs are maximally thrown together. Touch the skin with both legs in one time with equal force. The person should answer how much points of touch he is feeling. Gradually moving legs aside, continue to touch the given area until the two touches are distinguished. Mark the minimal distance between the two points, which the person distinguishes as two touches.

This will be the threshold of spatial sensitivity.

Threshold definition can be started with the maximal distance by gradually reducing the distance between the legs of the sensimeter.

Data to be written down into the table:

Field of skin	Threshold of spatial sensitivity
Finger	
Palms	
Forearm	
Upper arm	
Back	
Neck	
Nose	
Forehead	

In conclusions compare thresholds of spatial tactile sensitivity of the investigated fields of skin and explain reasons of the revealed differences.

Lab. work 10.9. Binaural hearing definition

The person identifies position of sound source in the space with the help binaural hearing. If the medium line of the head and source of sound are located not in one line, one ear accepts sound wave a bit earlier and with bigger in comparison with another ear.

Purpose of work: to learn the method and to define the presence of binaural hearing.

Necessary material: tuning fork, phonendoscope with tubes of different length, cotton wool, alcohol. Object of research — a person.

Course of work

The person sits in a chair with his back to the assistant. The person inserts ends of rubber tubes of the phonendoscope into the ears. Strike a metal plate before the membrane of phonendoscope or place the tuning fork before the membrane. The person should define from what side he can heard sound. After that one of the tubes is replaced with longer one and the test is repeated. This time the person should identify from what side the sound comes earlier.

In conclusion specify why the source of sound seems to be displaced to the shorter way.

Lab. work 10.10. Examination of proprioception at the person

The musculoskeletal apparatus is an executive system of the organism and its receptors — proprioreceptors — play especial role among other sensitive formations.

Proprioreceptors are the mechanoreceptors sending to CNS the information on position, deformation and shifts of various parts of body. Their functioning ensures coordination of all mobile organs and tissues of the person at rest and at any motor acts. Once proprioreceptors are not working, the organism loses ability to keep natural postures, to move and react appropriately to external influences.

The person, owing to proprioreception, feels position of his parts of body. Proprioreception disorder can be compensated by other sensory systems, especially by eyes. That is why tests performed with closed eyes allow to find out disorders of proprioreception.

Purpose of work: to learn the method and to define the level proprioreceptive sensitivity.

Necessary material: dynamometer. Object of research — a person.

Course of work

Definition of the proprioreceptive sensitivity level is carry out with closed eyes:

1. Romberg's test — the person stands upright, heels together, then he is asked to raise one leg.

In norm, the person becomes to rock slightly, at proprioreception disorder rocking is more strong and the person can even fall.

2. To the person is asked to stretch his right hand aside, and then quickly to touch his tip of the nose, then to repeat this with another hand.

Fix the position of his hand and fingers, then tell him to reproduce this position in other hand.

At disorder of proprioreception the person can fail to repeat this.

3. The person is asked to compress a dynamometer first with open eyes, then with closed eyes, applying equal force.

In conclusions explain the observed phenomena.

CONSTANTS OF SENSORY SYSTEMS

Frequency of sound fluctuations heard by the person	*16–20000 Hz*
The maximum level of loudness	*1 –14 Bel*
Depth of tympanic membrane	*0,1 mm*
Frequency range of the maximal sensitivity of hearing in person	*1000–4000 Hz*
Discrimination of locating of source of sound	*1 angle degree*
Closest point of clear vision	*10 cm*
Radius of pupil at day vision on the average	*2,4 mm*
In the darkness extends to	*7,5 mm*
at bright light decreases t	*1,8 mm*
acuity visual	*1,0 and higher*

11. HIGHER NERVOUS ACTIVITY

The higher department of the central nervous system of the person is organized by the cortex of cerebrum (CC) and adjacent subcortical formations providing the individual adaptation of an organism to the environment changes.

Physiological basis of the higher nervous activity (HNA) are the conditioned reflexes formed on the basis of unconditional ones with obligatory participation of CC. Development of conditioned reflexes is e ensured by simultaneous action of conditioned and unconditioned irritants. Here, the action of the first one should precede and be powerful enough to cause the focus of excitation in the responding region of CC. If the produced conditioned reflex to not supported by the unconditioned one, its manifestation will gradually fade.

Opposite to animals, a person (for whom the development of the second signaling system is typical) learning to speak has strong links between the fields of CC accepting signals from various subjects, and the speech centers accepting verbal notes of subjects.

A conditioned reflex to the sound of bell arises at hearing the word «bell». Moreover, the conditioned reflex arises also if a person is shown the written word «bell». It proves the interrelation between the first and the second signaling systems.

Lab. work 11.1. Development and suppression of conditioned pupillary reflex to the bell in person

Pupillary reflex is reflex change of pupil's size depending on light amount. Physiological function of the pupillary reflex is a regulation of the amount of light getting into an eye.

Purpose of work: to learn the technique of the development and suppression of the conditioned reflex in person.

Necessary material: bell, desk lamp, screen for closing the eye. Object of research — a person.

Course of work

To perform the test, choose a person with expressed pupillary response to light. The experimenter and the person are sitting face-to-face. With good daylight the person can sit facing the window. He closes one eye with his palm (constantly during the experiment), the second eye is closed with the screen for several seconds. Once the eye is opened, the pupillary reflex is observed (pupil contracts at once as the eye opens). Turn on the bell and make sure it does not influence the pupillary reflex, then proceed to develop the conditioned reflex. For this purpose, first turn on the bell, then close the eye with the screen, i.e. two irritants work at one time: closing of the eye — un-

conditioned irritant producing dilation of the pupil, and the second irritant — the bell (conditioned irritant). Here, the conditioned irritant (bell) should surpass a little the unconditioned one.

Repeat the combined action of the two irritants 7–10 times with the intervals of 40–50 seconds. Then, without closing the eye with the screen, switch on the bell and watch dilation of the pupil, i.e. the appearance of the conditioned reflex where the bell is the conditioned irritant.

To fix the developed conditioned reflex repeat the test several more times. Then, instead of the bell, pronounce loudly the word «bell», eye opened, and watch the dilation of the pupil, i.e. the presence of the conditioned reflex.

Now fade the developed conditioned pupillary reflex: switch on the bell for several times without closing the eye.

Write down the results, explain the mechanism of the conditioned reflex development induced by the bell and the word «bell».

12. DEFINITION OF THE ELEMENTARY LEVEL MENTAL ACTIVITY OF THE PERSON

Lab. work 12.1. Definition of short-term acoustical memory volume

The short-term memory of the person is characterized by a certain volume which is determined, for example, by the number of simple symbols (digits or letters), remembered correctly upon the first presentation. The assessment can be made by the information perceived by acoustical or visual analyzers. In adult people the normal volume of the short-term memory upon the first presentation is 3–7 symbols bearing no information.

Purpose of work: to define the volume of the short-term acoustical memory.

Necessary material alphabetic and digital tables. Object of research — a person.

Course of work

To the person reads lines of numbers from table A. After reading the top lines of digits with equal intervals (2–3 seconds) the person is to repeat them. If he repeats them in correct order, he reads the next line which has one digit more in a line making 5–6 seconds pause after each digit. The volume of the short-term memory is equal to the number of digits in the longest line which has been repeated correctly.

In case the line has been repeated incorrectly, the person reads similar number of digits from another table (table B).

Table A	Table B	Table C	Table D
318	931	QWE	POI
6294	2865	URTY	OIPL
47983	74528	TYUIO	UYTRF
537416	816452	UIOPLK	QWERTY
9261483	9753861	ASDCXZV	ASRTGFE
17259463	32491576	GFEASJUI	MNBHYTEB
597183624	893652475	TYUIOLKJH	QAUTKFPFR
2673594813	6182496342	HGFDSAQWER	OIRNMDUEMS

If mistakes are made again, the test is completed and the volume of the short-term memory is equal to the number of symbols from the previous line.

Testing of the short-term memory volume with alphabet letters is performed in similar way (table C and D).

In conclusion assess the volume of short-term acoustical memory of the person.

Lab. work 12.2. Investigation of period of simple sensomotor reactions

Simple and complex responses of the person to various irritants arise not at once but in a certain latent period. Presence of the latent period is caused by the consecutive transition of the information through the various departments of analyzers, reflex arches and in many cases depends on the time of signal processing in the central nervous system. Normally, latent period of simple response to light in

adults is 180–200 milliseconds, that to the sound — 150–180 milliseconds. More complex responses are characterized by the increase of the latent period of a reflex.

Purpose of work: to define the time of simple sensomotor reactions to light and sound irritants, to investigate the time of responses in conditions of the abstract attention.

Necessary material: multipurpose diagnostic device. Object of research — a person.

Course of work

To investigate simple sensomotor reactions, the person should sit in a chair in relaxed state. The person holds the control unit with a lamp and the control knob. The person is provided with 20 automatic consecutive flashes with irregular intervals between them. The person should press the button instantly each time the lamp flashes. The device automatically processes the intervals between flashing of the lamp and pressing the button. After the button has been pressed the last time, the devise will display the average response time in milliseconds. Then the latent period of response to sound is estimated.

After that, responses to light and sound in conditions of the abstract attention are estimated. The person is asked questions (maths problems), along with it he has to respond to light irritant.

Compare the obtained periods of the simple reaction at rest and at abstract attention.

Lab. work 12.3. Definition of the type of human working capacity («owl–lark» test)

The type of the human work capacity (morning, evening, arrhythmic) is substantially determined by his constitutional features.

Purpose of work: to define type of human work capacity with the «owl — lark» test.

Necessary material: questionnaires.

Course of work

Answer the following questions:

Question	Answer	Code
1. It is hard for you to get up early in the morning?	Yes, almost always Sometimes Seldom Extremely seldom	3 2 1 0
2. If you had an opportunity to choose, what time would you go to bed in the evening?	After 1 o'clock at night Before 1 o'clock Before 23 o'clock Before 22 o'clock	3 2 1 0
3. What breakfast do prefer to have during the first hour after having got up?	Full course Less full Boiled egg Cup of tea or coffee	0 1 2 3

Question	Answer	Code
4. If to recollect your last quarrels at work or at home, when did they mainly occur?	First half of a day Second half of a day	0 1
5. What can you refuse easily?	Morning tea, coffee Evening tea	2 0
6. Take the watch and note the time time. Simultaneously, without looking at the watch, try to measure 1 minute as precise as you can, then look up at the watch again. How precisely can you measure the time within one minute?	Less than a minute More than a minute	0 2
7. How easily can you change your meal habits during holidays, travel?	Very easily Easily Difficult Remains unchanged	0 1 2 3
8. If you have an important job to do in the morning, how earlier do you to bed?	More than two hours One-two hours Less than an hour As usual	3 2 1 0

Calculation of results. Summarize using codes and define type of work capacity:

0–7 points — morning type («lark»);

8–13 points — arrhythmic type («pigeon»);

14–20 points — evening type («owl»).

In conclusion note the type of work capacity of the person.

Lab. work 12.4. Definition of dominating type of memory

Memory is a very complex process including perception, fixation, storing and reproduction of information. There is a genetic memory, immunological (linked with the genetic) memory and neurological memory which is divided into short-term and long-term memory.

Different people may have different memory — acoustical, visual, motor or combined.

Purpose of work: definition of dominating type of memory.

Necessary material: separate cards with four lines of words (10 words in each line). The number of cards should correspond to the number of people. Object of research — a person.

Course of work

1. The experimenter reads out loud the first line of words with the 5 seconds intervals. After 10 seconds rest people write down the remembered words. Then they have a pause for 5 min.

2. The experimenter distributes cards, text faces down. Upon the command students turn the cards over and read the text for 1 mines, then turn the cards over again and in 10 seconds write down the remembered words. Then they have a pause for 5 min.

3. The experimenter reads out loud the words of the 3rd line, students repeat them in whisper and «write down» them in imagination. After 10 sec an interval write down the remembered words. Then they have a pause for 5 min.

4. The students are distributed cards with the words of the 4th line and read them, then the experimenter reads them aloud.

Students repeat them in whisper and «write down» them in imagination. In 10 seconds they write remembered words down in writing-books.

The data of the experiment are written down into the table.

Type of memory	No. of words in a line (a)	No. of words kept in memory (b)	Coefficient of memory
Acoustical			
Visual			
Motor-acoustical			
Combined			

Make a conclusion on the dominating type of memory.

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CONTENTS

Учебное издание

Киеня Александр Иванович
Заика Эдуард Михайлович
Мельник Виктор Александрович
Штаненко Наталья Ивановна

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Часть II

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для иностранных студентов, обучающихся на английском языке

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