

MINISTRY OF HEALTH SERVICE OF UKRAINE

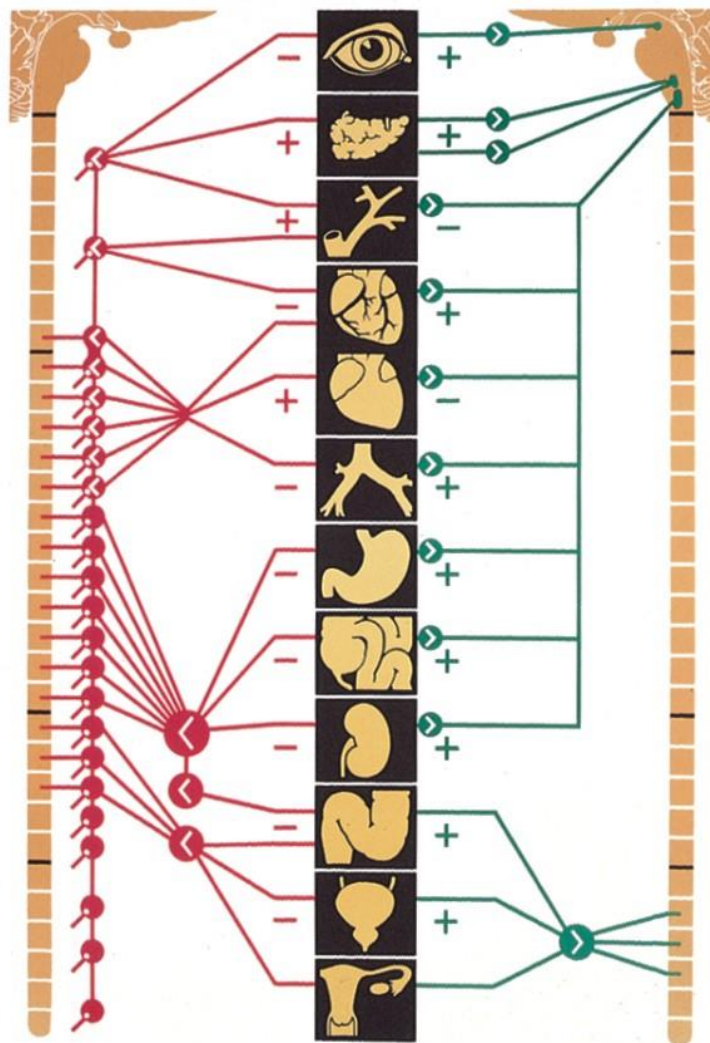
Zaporozhye State Medical University

The Department of Normal Physiology

NORMAL PHYSIOLOGY

Methodical manual for students

Module 2



Zaporozhye 2015

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Students' independent practical work is an important part of the syllabus in the course of Normal Physiology. It helps students to study this fundamental subject.

Systematic independent work enables to reach the final goal in the students' education. It is also important while preparing the students for their future clinical work with patients.

These theoretic materials, questions and tests will help students to get ready for the examination.

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CREDIT-MODULE# 2: Physiology of visceral systems: blood, respiratory organs, blood Circulation

PRACTICAL LESSON 21

Theme: Blood system. Analyze the physico-chemical qualities of the blood, erythrocytes and hemoglobin of the blood.

THE GOALS OF OCCUPATION:

To study the basic physical and chemical properties and functions of blood. To study a physiological role of Erythrocytes.

Initial level of the knowledge

1. Anatomy and histology of the Bone Marrow

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the physiological functions of the Blood .
2. Describe the morphological structure of Erythrocytes.
3. The red Cell Fragility.
4. The Sedimentation rate .
5. Explain the role of the Spleen for the Red Cells.
6. Describe the morphological structure of Hemoglobin. The Colour test of the Red cell.
7. The reactions of Hemoglobin.. The Hemoglobin in the Fetus
8. Explain the abnormalities of Hemoglobin production.
9. The synthesis and catabolism of Hemoglobin.
10. The Transfusion reactions. The Inheritance of A and B Antigens. Other Agglutinogens.
11. The RH Group. The Hemolytic Disease of the Newborn.
12. What do you know about the physiological functions of the Plasma
13. The Plasma Proteins and its function. The Origin of Plasma Proteins. The Hypoproteinemia
14. What do you know about the Anemias and the Polycythemia?

PRACTICAL WORK

TASK 1. Research of the Red Cells resistency

Put the 10 test tubes in a support, number them by marker. Add the Distilled water in each test tube according to the table. Then add the 1 % solution of Sodium Chloride (NaCl) in test tubes according to the table and add in each test tube about two drops of tinned blood.

Cautiously mix contents of test tubes and leave to stand within 15 minutes. After that note, in what test tube takes place initial and final Hemolysis of Red Cells. Concentration of a solution in these test tubes is a parameter of osmotic resistency for Red Cells.

The maximal resistance of Red Cells or the bottom value of osmotic resistency is within the limits of 0,30 - 0,25

The minimal resistance or the top value of osmotic resistency changes within the limits of 0,45-0,40.

№ test tubes	1	2	3	4	5	6	7	8	9	10
Solution's concentration	0,6	0,55	0,5	0,45	0,4	0,35	0,3	0,25	0,2	0,15
1% NaCl on ml	1,2	1,1	1,0	0,9	0,8	0,7	0,6	0,5	0,4	0,3
Distilled water on ml	0,8	0,9	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7

RESEARCH PROBLEMS

1. Describe a work. Write the results in the table. Use symbols ("-" - hemolys is absent; "+" - hemolys full; «+ - » - hemolys partial)
2. Write a conclusion. Explain in conclusions:
 - a) The mechanism of an origin hemolys
 - b) Estimate all results of research from the physiological point of view.

TASK 2. Examination of the Sedimentation rate

Collect the 5 %-s' Citrates of sodium solution to a level 50 (P) from a bottle. Release a solution on glass.

Lower a capillary in a bottle with blood. Collect the Blood in a capillary to a point 0(K). The Blood must be without air. Then release the blood in a Citrates of sodium solution on hour glass. Repeat procedure. Mix blood of a glass stick. Collect in a capillary a mix of blood with Citrates of sodium to a point 0(K). Close by a finger the top end of a capillary. .

Close a finger the top end of a capillary. The solution of blood should not follow. Put the bottom end of a capillary in the bottom rubber ring of device Panchenkova. Then insert the top end of a capillary into the top rubber ring.

Note the time. In one hour determine the height of a transparent plasma column. You should answer what distance the Red cells settled. This result is the velocity of sedimentation rate (SR).

At healthy men SR is about 3—7 mm/ hour. At healthy women SR is about 7—12 mm/ hour

RESEARCH PROBLEMS

1. Describe a a work. Draw a device Panchenkova.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on SR;
 - b) Estimate all results of research from the physiological point of view.

TASK 3. Definition of quantity the Red cells in 1 liter of the blood

The glass chamber situated under a microscope and consider Goryaev's grid on it at small and big increase. Cover the chamber by a glass and fix it to the chamber. Stop fixation of a glass when iridescent rings will appear. Ship a capillary Salli in tinned blood and collect the blood up to a level 0,02 ml. without air. Wipe the end of a capillary by filtering paper and transfer the blood to a test tube. The test tube should be filled of 4 ml by 3 % sodium chloride. Mix all a glass stick.

Take a drop dissolved (in 200 times) blood a glass stick. Put a drop of blood on an average platform of the chamber. The Capillary forces should involve a drop under integumentary glass.

Put the chamber under a microscope and start to calculation. Consider at small objective (X8), but use eyepiece X 15.

Count up the Red cells in some 5 big squares, which located on a diagonal of Goryaev's grid. Draw on a paper of 5 big squares. Divide the each big square on 16 small, write the found number of cells in each small square. Count cells inside of a small square and on top and left its borders.

Write the found quantity of the Red Cells in the formula:

$$X = \{(\Theta \times 4000 \times 200) / 80\} \times 10^6$$

Where is

x - number of Red Cells in 1 lit. of the Blood;

Θ - the sum of Red Cells in 80 small squares;

4000 - a volume of one small square;

200 - a matematic degree for the blood;

10^6 - a coefficient for recalculation in international system Si.

RESEARCH PROBLEMS

1. Describe a a work. Draw the chamber and the Goryaev's grid.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the level of Red Cells;
 - b) Estimate all results of research from the physiological point of view.

TASK 4. Definition of quantity of the Blood hemoglobin by Sali's method.

Sali's Hemometr it is a support. The back wall of the Hemometre is made of a matte glass. Three test tubes of identical diameter are inserted into a support. Two extreme test

tubes are sealed. Two extreme test tubes are sealed. They contain a solution of Muriatic Hemathine. Average test tube with divisions, it is not closed. The capillary has a label (20 mm³).

Fill an average test tube with 0,1 N solution HCl to the bottom label. Collect the blood in a capillary to a label. Place blood on a bottom of an average test tube. The top layer of a hydrochloric acid should remain uncoloured. Strike a test tube in a bottom by a finger for mixing.

Leave it to stand for 5-10 minutes. This time should be used by blood's full transformation of Hemoglobin in Muriatic Hemathine. Add to a solution the distilled water on drop. Color of a solution in a test tube should not differ from standard.

The bottom meniscus of a solution is an equivalent of hemoglobin in blood in grammes on litre after multiply a result on 10 .

At healthy men the Blood hemoglobin is about 130—160 gr/ litre. At healthy women - about 120—140 gr/ litre

RESEARCH PROBLEMS

1. Describe a work. Draw the Hemometre
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the level of the Blood hemoglobin;
 - b) Estimate all results of research from the physiological point of view.

TASK 5. Calculation the color parameter of the blood

The color parameter characterizes a degree of saturation by hemoglobin of the Red Cells. Expect a parameter under the formula:

$CP = \{ \text{the Blood hemoglobin (gr/l)} \times 30 \} / \text{on first of 4 figures of quantity the Red Cells}$

RESEARCH PROBLEMS

1. Describe a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the level of a color parameter of blood
 - b) Estimate all results of research from the physiological point of view.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 22

Theme: Protectional functions of the blood: the white blood cells and cooperative interactions between innate immunity and acquired immunity

THE GOALS :

to study the basic physiological functions of Immunity and to study a physiological role of White blood cells

Initial level of the knowledge

1. Anatomy and histology of the Bone Marrow
2. The histological structure of a White blood cell

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

15. What do you know about the physiological functions of the White blood cell?
16. Describe the morphological structure and functions of *Granulocytes*.
17. The Mast Cells and its physiological functions.
18. The Monocytes and its physiological functions.
19. Explain the role of the Granulocytes and Macrophage Colony-Stimulating factors.
20. Describe the disorders of Phagocytes function.
21. The Lymphocytes and its physiological functions.
22. What do you know about the physiological functions of Immunity?
23. The Cytokines and its physiological functions.
24. The Complement system and its physiological functions.
25. Explain the difference between Innate immunity and Acquired immunity
26. What do you know about the development of Immunity system?
27. The Memory B-cells and T-cells and its physiological functions.
28. Explain the mechanisms of Antigen recognition and Antigen presentation.
29. The T-cell Receptors, B-cells and its physiological functions.
30. The Immunoglobulins, Monoclonal Antibodies and its physiological functions
31. What do you know about the Genetic Basis of Diversity in the Immunity system?
32. The recognition of the Self. The Autoimmunity, the Tissue transplantation and other Clinical Correlates.
33. The Antigenic properties of blood. The ABO system.
34. The Transfusion reactions.
35. The inheritance of A and B Antigens, other Agglutinogens.
36. The Rh Group. What you know about the Hemolytic Disease of the Newborn

PRACTICAL WORK

TASK1. Definition of quantity the White Blood cells in 1 liter of the blood

The glass chamber put under a microscope and consider Goryaev's grid on it at small and big increase. Cover the chamber by a glass and fix it to the chamber. Stop fixation of a glass when iridescent rings will appear. Ship a capillary Salli in tinned blood and collect the blood up to a level 0,02 ml. without air. Wipe the end of a capillary by filtering paper and to transfer the blood to a test tube. The test tube should be filled of 0,5 ml by 5 % s Acetic acid and Methyleny dark blue for destruction of Red blood cells.

Mix all a glass stick. After that take a drop of blood by a glass stick and put a drop of the blood on an average platform of the chamber. The Capillary forces should involve a drop under integumentary glass.

Put the chamber under a microscope and start to calculation. Consider at small objective (X8), but use eyepiece X 15. Count up the Red cells in some 25 big squares, which located on a diagonal of Goryaev's grid. Draw on a paper of 25 big squares. Divide the each big square on 16 small, write the found number of cells in each small square .Count cells inside of a small square and on top and left its borders. Write the found quantity of the White Cells in the formula:

$$x = \{(L \times 4000 \times 20) / 400\} \times 10^6$$

Where is x — number of White Cells in 1 lit of the Blood; L — the sum of White Cells in 400 small squares; **4000** — a volume of one small square ; **20** — a mathematic degree for the blood; 10^6 — a coefficient for recalculation in international system Si.

RESEARCH PROBLEMS

1. Describe a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the level of White Blood Cells;
 - b) Estimate all results of research from the physiological point of view.

TASK2. Definition of groups of blood of the person

In red blood cells of the person there are specific antigens. They are called Agglutinogens. There are A Agglutinogens and B Agglutinogens in the human Blood. There are two types of antibodies in human plasma. They are called Agglutinin α and β . They stick together the Agglutinogens.

The necessity for work: cup of Petry, tinned blood, laboratory glasses, standard Serums of groups I, II, III. The I group of Serum contains two types of Agglutinins (α , β), the II group of Serum contains $-\beta$ Agglutinin, the III group of Serum contains - α Agglutinin.

Put the one drop of standard Serum (of I, II, III groups) on cup of Petry. Add in each Serum's drop the person's blood (in correlation 1:10). Mix by a glass stick.

Reaction of Agglutination comes in 15 minutes. Attributes of reaction - a drop of blood are transparent. Small lumps of the Red blood cells float in it.

RESEARCH PROBLEMS

Establish group of blood on presence or absence of Agglutination's reaction.

1. What group of the blood has a person?
2. Explain in conclusions:
 - a) What recipients can receive this blood?

b) What pathological transfusion Reactions can be observed?

TASK3. Definition of Rh-group

Put on the cup of Petry one drop of anti - **Rh** Serum by a pipette. It should be in 2 times more than a drop of person's blood and after that add a drop of blood and mix by a glass stick.

You can observe this result through 5 min.

Don't forget! Blood "Rh – positive" –when the Agglutination is present

Blood "Rh – negative" –when the Agglutination is absent

RESEARCH PROBLEMS

1. Describe a a work.
 2. Write a conclusion.
- a) Explain all results of research from the physiological point of view.

TASK 4. Test on compatibility of the Blood between the "donor" and the "recipient"

Put 2 ml of the «recipient's" blood (from a bottle №1) in a test tube. Put a test tube in a centrifuge (1500 number of revolutions/minutes) for 5-8 minutes. Select Serum of blood by a pipette. Put a drop of this Serum in cup of Petry.

Add a drop of "donor's" blood (from a bottle №2). It should be in 2 times less, than a drop of Serum. Mix by a glass stick. Look at the test in 15-20 minutes at room's temperature. Estimate "presence" or "absence" the reaction of Agglutination.

RESEARCH PROBLEMS

1. Draw a conclusion about compatibility of the Blood between the "donor" and the "recipient" by results of research.
2. Can a doctor transfuse this "donor's" blood to this "recipient"?
3. Describe a technique of the Biological test on compatibility of the Blood between the donor and the recipient.

TASK 5. Bring the information about the Examples of Cytokines and their clinical relevance in the table

Cytokine	Cellular Sources	Major Activities	Clinical relevance
Interleukin-1			
Interleukin-2			
Interleukin-4			
Interleukin-5			
Interleukin-6			
Interleukin-8			
Interleukin-11			
Interleukin-12			
Tumor necrosis factor α			
Tumor necrosis factor β			
Granulocyte-macrophage-colony-stimulating factor			
Interferon- α			
Interferon- β			
Interferon- γ			

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 23

Theme: *Homeostasis and Blood coagulation*

THE GOALS:

To study the physiological functions of Platelets; to study the mechanism of Blood coagulation

Initial level of the knowledge

1. Histology of Platelets
2. The physiological functions of Blood's Proteins

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the Physical and Chemical characteristics so physiological functions of Platelets?
 2. What do you know about the term "Hemostasis"?
 3. Response to Injury: vascular contraction; formation of the Platelet Plug and its mechanism.
 4. Importance of the Platelet mechanism for Closing Vascular Holes.
 5. What do you know about the Blood Coagulation in the Ruptured Vessels?
 6. Mechanism of Blood Coagulation:
 - a). Conversion of Prothrombin to Thrombin;
 - b). Conversion of Fibrinogen to Fibrin- Formation of the Clot
 - c). Vicious Circle of Clot Formation;
 - d). Initiation of Coagulation: formation of Prothrombin Activator
 7. Explain the Extrinsic Pathway for Initiating Clotting.
 8. Explain the Intrinsic Pathway for Initiating Clotting.
 9. Role of Calcium Ions in the Intrinsic and Extrinsic Pathway for Initiating Clotting
 10. Prevention of Blood Clotting in the Normal Vascular system – Intravascular Anticoagulants:
 - a). Endothelial Surface factors;
 - b), Antithrombin Action of Fibrin and Antithrombin III;
 - c). Heparin and its function;
 - d). Plasmin and its function.
 11. What do you know about the Anticoagulants for Clinical use?
 12. What do you know about the Blood Coagulation Tests?
 - a). Bleeding Time;
 - b). Clotting Time;
 - c). Prothrombin Time.

PRACTICAL WORK

TASK1. Examination the Clotting Time

Take the blood from a caudal vein of a rat. Put a drop of blood on glass. Dip into a drop of blood a thin glass stick every 30 seconds. Determine the moment of occurrence of the first fibrinous string. Use a stop watch. The norm of Clotting Time is 6-10 minutes.

RESEARCH PROBLEMS

1. Describe a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the Clotting Time;
 - b) Explain all results of research from the physiological point of view.

TASK2. Examination the Bleeding Time

Make an incision scissors in a tail at a rat. Note the time of the beginning of a bleeding by a stop watch. Remove a drop of blood every 30 seconds. Put to a drop of blood each new sector of filtering paper. Repeat procedure up to a full stop of bleeding.

Observe the rules of the work: a) don't press on bleeding tail; b) don't delete the first drop of blood; c) Don't concern by filtering paper of a wound. The norm of Bleeding Time is 1-6 minutes.

RESEARCH PROBLEMS

1. Describe a a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the Bleeding Time;
 - b) Explain all results of research from the physiological point of view.

TASK3. Definition of Blood tolerance to Heparin Test

Heparin is Anticoagulant. It functions are opposite to Thrombin. Heparin prevents transformation the Fibrinogen to Fibrin .After that the Clotting Time is extended.

Place 3 drops of blood of a rat on glass with the help of a pipette. Add a drop of Heparin. Mix by a glass stick.

Dip into a drop of blood a thin glass stick every 30 seconds. Determine the moment of occurrence of the first fibrinous string. Use a stop watch

RESEARCH PROBLEMS

1. Describe a a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the Blood tolerance to Heparin Test;
 - b) Explain all results of research from the physiological point of view

TASK 4. Estimation of a degree of the capillaries resistance

Put a cuff of device Riva-Rochchi on patient's arm. Support pressure in a cuff at a level of the maximal arterial pressure. Squeeze the arm about 10 to 15 minutes.

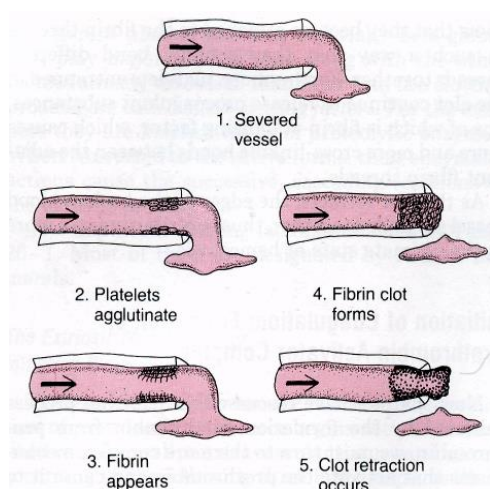
Individual hemorrhages can be in norm on a place of pressure.

If the fragility of capillaries is increased can be a lot of hemorrhages.

RESEARCH PROBLEMS

1. Describe a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence on the fragility of capillaries;
 - b) Explain all results of research from the physiological point of view

TASK 5. Explain the scheme of the Clotting process in the traumatized blood vessels.

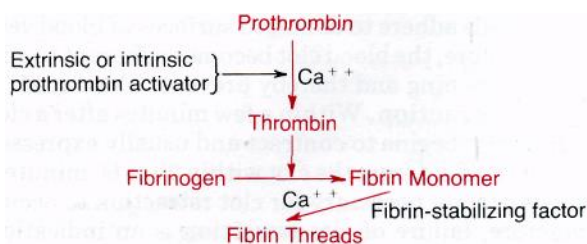


TASK 6. Explain the table of Clotting factors in the blood and their synonyms

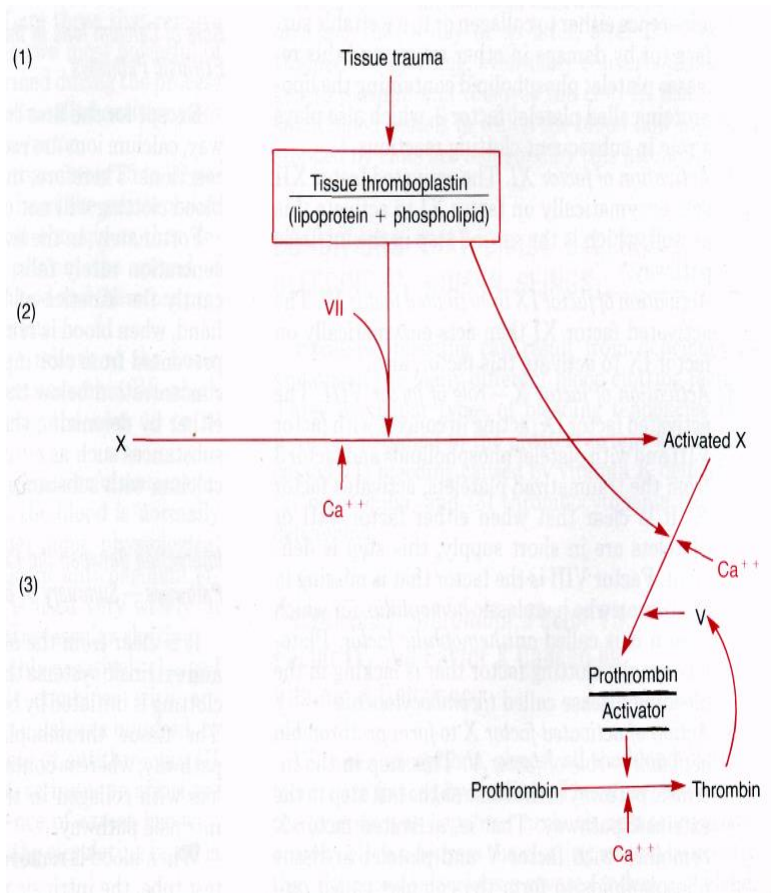
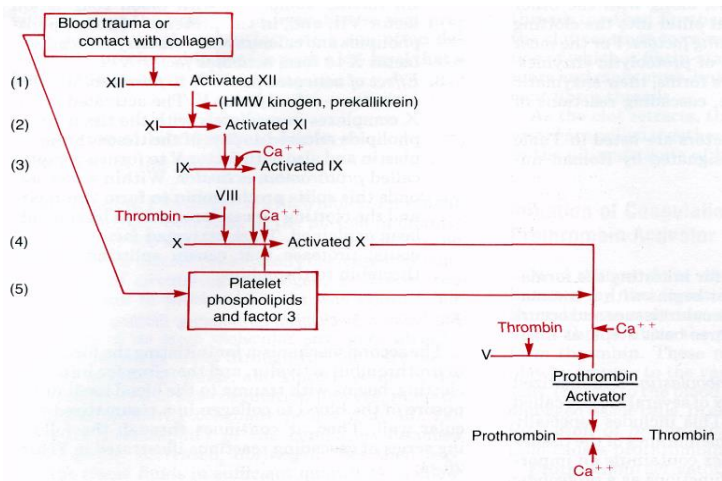
Table 26-1 CLOTTING FACTORS IN THE BLOOD AND THEIR SYNONYMS

Clotting Factor	Synonyms
Factor I	Fibrinogen
Factor II	Prothrombin
Factor III; tissue factor	Tissue thromboplastin
Factor IV	Calcium
Factor V	Proaccelerin; labile factor; Ac-globulin (Ac-G)
Factor VII	Serum prothrombin conversion accelerator (SPCA); proconvertin; stable factor
Factor VIII	Antihemophilic factor (AHF); antihemophilic globulin (AHG); antihemophilic factor A
Factor IX	Plasma thromboplastin component (PTC); Christmas factor; antihemophilic factor B
Factor X	Stuart factor; Stuart-Prower factor
Factor XI	Plasma thromboplastin antecedent (PTA); antihemophilic factor C
Factor XII	Hageman factor
Factor XIII	Fibrin-stabilizing factor
Prekallikrein	Fletcher factor
High molecular weight kininogen	Fitzgerald factor; HMWK
Platelets	

TASK 7. Explain the scheme of conversion of Prothrombin to Thrombin and polymerization of Fibrinogen to Fibrin



TASK 8. Explain the scheme of intrinsic pathway for initiating blood clotting.



9. Explain the scheme of extrinsic pathway for initiating blood clotting

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 24.

Theme: *Origin of the Heartbeat. The Electrical activity of the Heart*

THE GOALS:

Study properties of the Cardiac muscle. Study the characteristics of Heart Electrical activity.

The initial level of knowledge

1. Anatomical and histological structure of the Heart .

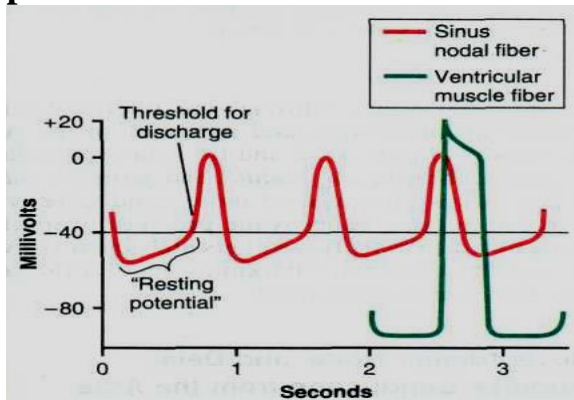
CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Explain the physiological properties of Cardiac Muscle.
2. Explain the properties of the Resting Membrane and Action Potential of Cardiac Muscle.
3. Describe the Mechanical properties of Cardiac Muscle. The Contractile Response of heart muscle.
4. What do you know about the physiological Cardiac Hypertrophy?
5. What do you know about the Metabolism of Cardiac Muscle?
6. Explain the Morphology properties of Pacemaker tissue and Pacemaker Potentials.
7. Describe the Origin of Electrocardiogram.
8. What do you know about Bipolar and Unipolar Leads?
9. Describe the Normal ECG.
10. What you know about the Heart Monitoring?

PRACTICAL WORK

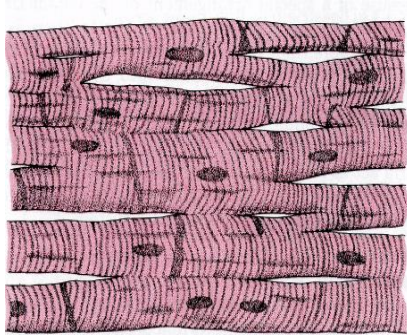
TASK 1 Write an explanation about ionic basis of Action potential and Pacemaker potential in cardiac tissues. Put the results in this table.



	ionic basis	
	Action potential	Pacemaker potential
<i>How does depolarization start?</i>		
<i>What's threshold level?</i>		
<i>Describe the depolarization phase</i>		
<i>Describe the initial rapid repolarization phase</i>		
<i>Describe the plateau phase</i>		

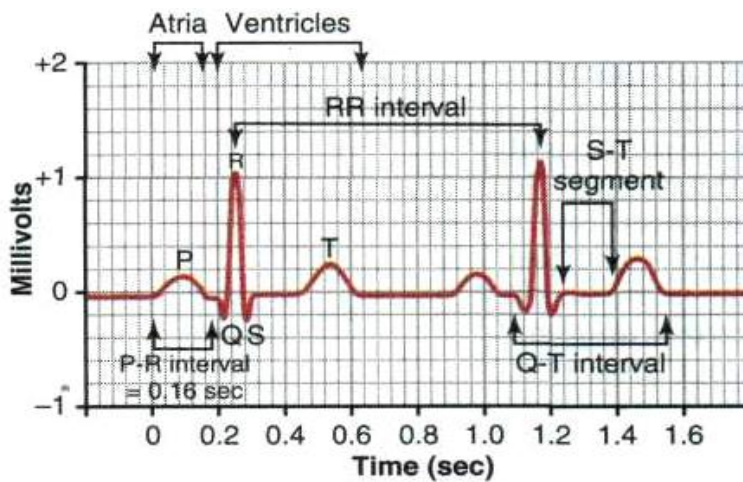
<i>Describe the repolarization phase</i>		
<i>How many Mv is Action potential?</i>		

TASK 2. Look at this figure and write an explanation about the syncytium of Heart



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TASK 3. Look at this figure. What are the various waves, segments and intervals represented in normal ECG? What are their duration and amplitude? Put the results in the table.



<i>ECG parameters</i>	<i>represent</i>	<i>duration</i>
P		
Q		
R		
S		
T		

RP		
QRS		
ST		
QT		

TASK 4. What is ECG and what is its basis? Demonstration of ECG record. How can you determine the heart rate, waves and intervals from an ECG tracing?

ECG graph paper

Timed interpretation of an ECG was once incumbent to a stylus and paper speed. Computational analysis now allows considerable study of heart rate variability. A typical electrocardiograph runs at a paper speed of 25 mm/s, although faster paper speeds are occasionally used. Each small block of ECG paper is 1 mm². At a paper speed of 25 mm/s, one small block of ECG paper translates into 0.04 s (or 40 ms). Five small blocks make up 1 large block, which translates into 0.20 s (or 200 ms). Hence, there are 5 large blocks per second. A diagnostic quality 12 lead ECG is calibrated at 10 mm/mV, so 1 mm translates into 0.1 mV. A calibration signal should be included with every record. A standard signal of 1 mV must move the stylus vertically 1 cm that is two large squares on ECG paper.

Table of Frequency the Heartbeat per minute

R-R	Heart beat	R-R	Heart beat	R-R	Heart beat
1.50	40	1.02	58	0.70	86
1.48	41	1.01	60	0.69	87
1.46	41	1.00	60	0.68	88
1.44	42	0.99	60	0.67	90
1.40	43	0.98	61	0.66	91
1.38	43	0.97	62	0.65	92
1.36	44	0.96	62	0.64	94
1.34	44	0.95	63	0.63	95
1.32	45	0.94	64	0.62	97
1.30	46	0.93	64	0.61	98
1.28	47	0.92	65	0.59	102
1.26	48	0.91	66	0.58	103
1.24	48	0.90	66	0.57	105
1.22	49	0.89	67	0.56	107
1.20	50	0.88	68	0.55	109
1.19	50	0.87	69	0.54	111
1.18	51	0.86	70	0.53	113
1.17	51	0.85	70	0.52	116

1.16	52	0.84	71	0.51	118
1.15	52	0.83	72	0.50	120
1.14	53	0.82	73	0.49	122
1.13	53	0.81	74	0.48	125
1.12	54	0.80	75	0.47	128
1,11	54	0.79	76	0.46	130
1.10	54	0.78	77	0.45	133
1.09	55	0.77	78	0.44	136
1.08	55	0.76	79	0.43	139
1.07	56	0.75	80	0.42	142
1.06	56	0.74	81	0.41	146
1.05	57	0.73	82	0.40	150
1.04	57	0.72	83		
1.03	58	0.71	84		

You have to determine

a) frequency the Heartbeat per minute by table;

b) position of an electric axis of heart:

- Measure the R wave's amplitude in all 3 standard limb leads (mm)
- Horizontal position of an electric axis of the Heart – if $R_1 > R_2 > R_3$;
- Intermediate position of an electric axis of the Heart t if $R_2 > R_1 > R_3$;
- Vertical position of an electric axis of the Heart if $R_3 > R_2 > R_1$;

c) amplitude and duration of waves of the electrocardiogram

d) duration of intervals

<i>ECG parameters</i>	<i>Normal ECG</i>		<i>Patient's ECG</i>	
	<i>amplitude</i>	<i>duration</i>	<i>amplitude</i>	<i>duration</i>
P				
Q				
R				
S				
T				
RP				
QRS				
ST				
QT				

Make conclusions about your results:

TASK 5. What is the clinical importance of ECG? Write an explanation.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

The signature of the report by teacher

PRACTICAL LESSON 25

Theme: The Heart as a Pump.

THE GOALS:

Study the Heart Sounds, the mechanism of Cardiac cycle, the mechanism of Heart pumping regulation

The initial level of knowledge

1. Anatomy and Histology of Heart

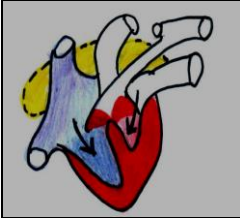
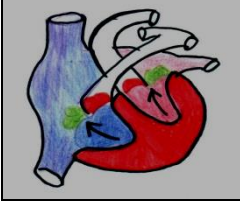

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE


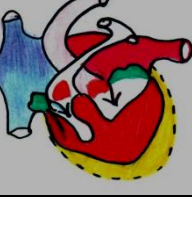
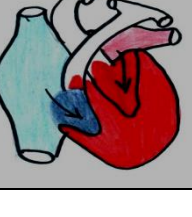
CONTROL QUESTIONS:

1. What do you know about the Mechanical Events of the Cardiac cycle? a). Events in Late Diastole; b). Atrial Systole; c). Ventricular Systole; d). Early Diastole.
2. Describe the Length of Systole and Diastole in Cardiac cycle.
3. Explain the mechanism of Arterial Pulse. Which do factors exert on Arterial Pulse?
4. What do you know about the origin of Arterial pressure?
5. Explain the physiological mechanism of Heart sounds origin. Describe the Echocardiography role in medicine.
6. What do you know about the Cardiac Output? a). Methods of Measurement; b). Cardiac Output in Various Conditions; c). Factors controlling Cardiac Output;
7. Explain the factors affecting the End- Diastolic Volume.
8. Explain the Integrated Control of Cardiac Output.
9. What do you know about the Oxygen consumption by the Heart?

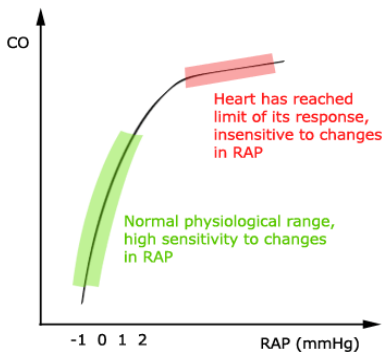
INDEPENDENT PRACTICAL WORK

TASK1. Look at these figures and write an explanation about the mechanism of Cardiac cycle. Put the results in this table.

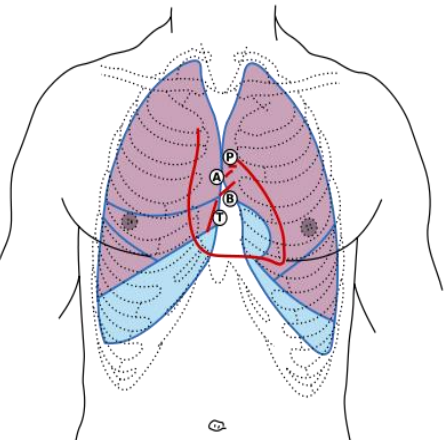
		mechanism	duration
	Atrial systole		
	Isometric contraction		
	Ejection period		

	Protodiastole		
	Isometric relaxation period		
	Rapid filling phase		

TASK2. What do you know about the Frank-Starling law? Look at this figure and write an explanation.



TASK3. Look this figure and describe the origin of Heart Sounds. Put the information in this table.

	<p>Front of <u>thorax</u>, showing surface relations of <u>heart</u> (red outline). <u>Heart valves</u> are labeled with "B", "T", "A", and "P". First heart sound: caused by atrioventricular valves - <u>Bicuspid/Mitral</u> (B) and <u>Tricuspid</u> (T). Second heart sound: caused by semilunar valves -- <u>Aortic</u> (A) and <u>Pulmonary/Pulmonic</u> (P).</p>
--	--

Heart Sounds	Mechanism	duration
<i>The First Sound</i>		
<i>The Second Sound</i>		
<i>The Third Sound</i>		
<i>The Fourth Sound</i>		

TASK 4. Auscultation the heart sounds by a stethoscope. Describe your results.

<u>Pulmonary valve</u> (to pulmonary trunk)	second <u>intercostal space</u>	left upper sternal border
<u>Aortic valve</u> (to aorta)	second <u>intercostal space</u>	right upper sternal border
<u>Mitral valve</u> (to left ventricle)	fifth <u>intercostal space</u>	lateral to left midclavicular line
<u>Tricuspid valve</u> (to right ventricle)	fourth <u>intercostal space</u>	lower left sternal border

TASK 5. Write an explanation about the effects of Autonomic Nerve System, Potassium and Calcium Ions for the Heart work. Put the information in this table.

Controlling factors	action
<i>Sympathetic nerves</i>	
<i>Parasympathetic nerves</i>	
<i>Potassium Ions</i>	
<i>Calcium Ions</i>	

TASK 6.Examine the arterial pulse in the subject provided and comment on your findings.

The radial artery is palpated with the tips of three fingers compressing the vessel against the head of radius bone. The subject's forearm should be slightly pronated and the wrist slightly flexed. The index finger varies the pressure on the artery; the middle finger feels the pulse, while the distal finger prevents reflections of pulsations from the palmar arch of arteries. The following observations are made:

rate of pulse	rhythm	character and form	types of arterial pulse	volume	tension	condition of the vessel wall	delay

Explain your results.

TASK 7.Solving the Clinical task and write an explanation

1. Does the sportsman have tachycardia before the competitions? Why?

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 26

Theme: Dynamics of Blood and Lymph Flow

THE GOALS:

Study the mechanism of Blood and Lymph Flow. Study examination of the arterial pressure, arterial pulse and results of sphygmography

Initial level of the knowledge

1. Anatomy of the Circulation system

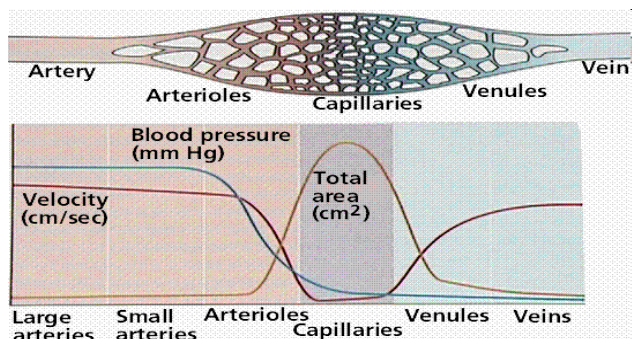
CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the Arteries, Arterioles and Capillaries functional characteristics?
2. What do you know about the Lymphatic, Arteriovenous Anastomoses, Venules and Veins functional characteristics?
3. Describe the physiological mechanism of Arterial and Arteriolar circulation:
 - a). Velocity and Blood flow;
 - b). Arterial pressure; c). Methods of Blood pressure measuring;
 - d). Normal Arterial Blood pressure
4. Describe the physiological mechanism of Capillary Circulation:
 - a). Methods of study;
 - b). Capillary pressure and flow;
 - c). Active and Inactive capillaries.
5. Lymphatic circulation and interstitial fluid volume:
 - a). Lymphatic circulation and Lymphatic System functions;
 - b). Interstitial fluid volume.
6. Describe the Venous circulation:
 - a). Venous pressure and flow;
 - b). Thoracic pump and effects of Heartbeat;
 - c). Venous pressure in the Head, Air Embolism;
 - d). Venous pressure Measuring.

INDEPENDENT PRACTICAL WORK

TASK1. Look at this figure and write an explanation about changes in blood pressure, velocity, and the area of the arteries, capillaries, and veins of the circulatory system.



TASK2. Recording of blood pressure

The term "*blood pressure*", used unqualified, refers to the lateral pressure exerted by the moving column of blood on the walls of the systemic arteries. Its measurement is an important clinical procedure as it provides valuable information about the cardiovascular system under normal and abnormal conditions

Auscultatory Method (Korotkoff)

Ordinarily, no sounds are heard when a stethoscope is applied over the brachial or any other artery. However, if the cuff **pressure** is raised above the expected systolic pressure level, and then gradually lowered, a series of sounds, called the Korotkoff sounds, are heard in the brachial artery below the cuff.

1. Locate the bifurcation of the brachial artery (it divides into radial and ulnar branches) in the cubital space, just medial to the tendon of the biceps muscle, and mark this point with a felt-tip pen. Place the diaphragm of the stethoscope on this point and keep it in position with your fingers and thumb. (The diaphragm, when in use, should not rub against the cuff or the rubber tubes or on the skin because the disturbing noises will interfere with auscultation of the sounds).

2. Inflate the cuff slowly (some sounds will be heard as the cuff pressure rises) and raise the pressure to 40-50 mm Hg above the systolic level as determined by the palpatory method.

Lower the cuff pressure slowly until the Korotkoff sounds are heard. *Phase I* sounds are clear, sharp, and tapping and last for 10-12 mm Hg fall in mercury column. *The first of these sounds, a clear tap, indicates the systolic pressure.* As the pressure falls, the character of the sounds changes (one must listen carefully to the sounds); they first become murmurish (*Phase II*), then clear and banging (*Phase III*), until they suddenly become muffled (*Phase IV*), indistinct, dull and faint, as if coming from a distance) and disappear (*Phase V*; no sounds). The muffling of sounds and their disappearance occurs nearly at the same time, there being a difference of 4-5 mm Hg between them.

The pressure at which the sounds become muffled marks the diastolic pressure. Note the reading at muffling and at disappearance of sounds, after which deflate the cuff quickly.

3. Record the blood pressure first in the supine position. Then record the pressure in the standing position immediately after the subject assumes erect position from supine posture.

6. Disconnect the metal connection on the tube connecting the cuff and the mercury reservoir, then ask the subject to do muscular exercise (eg, spot running) for 5-6 minutes. Record the pulse and blood pressure immediately after the end of exercise and then at 2-minute intervals till the pulse and BP return to resting levels.

4. Record the blood pressure with the arm raised above the head, and then with the arm hanging down below the level of the heart. Tabulate your results, showing the various readings.

Note The BP readings are seldom identical in the two arms. It has been suggested that both arms be used, preferably the right and then the left, and that the lowest reading be recorded.

Put your results in the table. Make a resume.

position	Left arm	Right arm
sitting position		
supine position		
standing position		
arm raised above the head		
arm hanging down below the level of the heart		
after the end of exercise		

TASK3. What is mean arterial pressure and what is its significance? Why does the blood exert a pressure on the arterial walls? Write an explanation.

TASK4. What are the physiological variations in blood pressure? Put your explanation in the table.

factors	action
<i>age</i>	
<i>sex</i>	
<i>Muscular exercise</i>	
<i>Diurnal variations</i>	
<i>Digestion</i>	
<i>Emotional stress</i>	
<i>Posture</i>	

TASK5. What is pulse pressure and what is its significance? Write an explanation.

TASK6. Demonstration of Carotid sinus reflex Write an explanation about mechanism of Carotid sinus reflex.

Stretch receptors in the walls of carotid sinus and aortic arch (and probably in other large arteries of thorax) continuously monitor or sense the blood pressure. Within physiological limits, a rise or fall of BP brings about appropriate reflex changes in cardiac activity and peripheral resistance to restore the BP toward the normal levels.

Procedure

1. Ask the subject to lie down supine on the examination couch. Loosen his collar and lay the neck bare. Locate the anterior edge of sternomastoid muscle and feel the pulsations of the

common carotid artery which lies deeper and medial to it. Locate the upper border of the thyroid cartilage, and feel the pulsations in the carotid sinus which is a small dilation of the internal carotid artery just above the bifurcation of the main trunk (the sinus lies just below the angle of the jaw).

2. Palpate the radial artery with your left hand and, with the thumb of your right hand press the carotid sinus against the vertebral bodies *for 2 seconds only*. The pulse can be felt at this site as well as in the radial artery.

TASK7. Draw the figure about Venous blood flow and write an explanation about the mechanism of one.

TASK8. Demonstration of Venous blood flow

The flow of blood through the veins of the forearm and the presence of valves in these veins can be demonstrated by a simple experiment. William Harvey originally described it as one of the proofs for his theory of circulation, in his 68-page book "Exercitatio Anatomica de motu cordis et sanguinis in Animalibus", published in Latin in 1828.

Procedures

1. Seat the subject on a stool with his arm resting on a table. Apply the BP cuff on his upper arm and inflate it to 30-40 mm Hg. The superficial veins of the forearm will become prominent.
2. Place the tip of your right index finger (call it "R") over one of the veins, and mark the position of the valve (call it "V") above it, with a felt pen.
3. Keeping the finger "R" in the same position, and using your left index finger, squeeze out the blood from this vein towards the elbow. Note that the segment of the vein between points "R" and "V" remains collapsed and that there is no backflow of blood. However, the vein above the valve "V" is distended and the valve becomes prominent.
4. Keeping the finger "R" in position, place the left index finger above the valve "V" and try to squeeze the blood downwards towards the finger "R". It will be noticed that the blood cannot be forced backwards across the valve "V" unless a pressure that would be enough to rupture the valve "V" is applied.

What are the functions of the valves in the veins? Write an explanation.

TASK9. What is pulse pressure and what is its significance? Use this formula. Write an explanation about your result

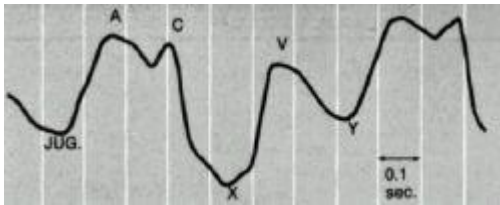
1).

$$P_p = P_s - P_d$$

Where is **P_p** - pulse pressure;

P_s - systolic pressure; **P_d** - diastolic pressure

TASK 10. What is meant by jugular venous pulse? How is record of this event obtained? Name the various waves recorded in the JVP tracing. Draw this figure and write an explanation



Normal jugular venous pulse: *A, a positive wave due to contraction of the right atrium; C, a positive deflection due to bulging of the tricuspid valve toward the atria at the onset of ventricular contraction; X, a negative deflection due to atrial relaxation; V, a positive deflection due to filling of the right atrium against the closed tricuspid valve during ventricular contraction; Y, a negative deflection due to emptying of the right atrium upon ventricular relaxation.*

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 27

Theme: The Cardiovascular Regulatory mechanism .Circulation through special Regions. THE GOALS:

Study the regulatory Central and Humoral mechanisms for Blood Circulation System

The initial level of knowledge

1. Physiological function of the Central Nervous system, Autonomic Nervous system, Endocrinology system.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the Local regulation of the Blood Circulation System?
2. Describe the Myogenic and Metabolic theories of Auto regulation:

- a) Vasodilatator metabolites;
 - b). Localized the Vasoconstriction.
3. Substances secreted by the Endothelium:
- a). Endothelial cells;
 - b). Prostacyclin and Thromboxane A2;
 - c). Nitric Oxyde, Carbon monoxyde;
 - d). Endothelins.
4. Describe the Systemic regulation by Hormones:
- a). Kinins, and Adrenomedullin;
 - b). Natriuretic hormones, Circulating Vasoconstrictors.
5. Explain the Systemic regulation by Nervous system:
- a). Neural regulatory mechanism;
 - b). Innervation of the blood vessels;
 - c). Cardiac innervation;
6. Describe the Vasomotor control:
- a). Afferents to the Vasomotor Area;
 - b).Somatosympathetic Reflex;
 - c). Baroreceptors: Carotid sinus, Aortic Arch;
 - d). Buffer Nerve Activity;
 - e). Baroreceptors resetting. Effect of Carotid clamping and Buffer Nerve section;
7. Explain function of the Atrial Stretch receptors and mechanism of Bainbridge reflex.
8. The role of Left ventricular and pulmonary receptors in blood circulations.
9. Explain the Effects of chemoreceptor stimulation on the Vasomotor Area.
10. What do you know about Sympathetic Vasodilator System and mechanism for Control of Heart Rate?
11. Physiology Circulation through Special regions: Cerebral circulation; Coronary circulation; splanchnic circulation; Cutaneus circulation; Placental Circulation.
12. Exercise and Muscle Blood Flow.

INDEPENDENT PRACTICAL WORK

TASK1. Draw a scheme and write an explanation about the mechanism of parasympathetic action for Heart work.

TASK2. Draw a scheme and write an explanation about the mechanism of sympathetic action for Heart work.

TASK3. Write an explanation about the central regulation of circulation system. Draw the scheme.

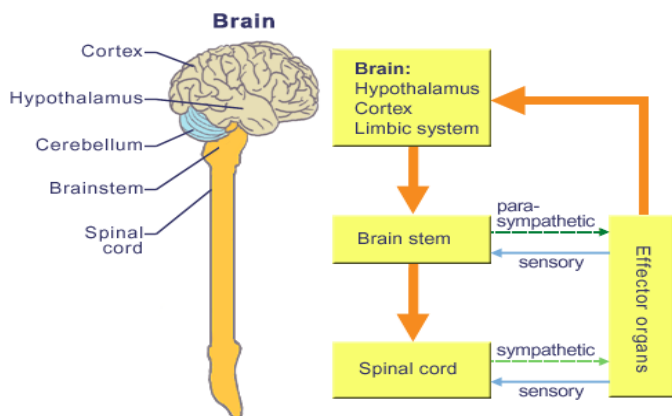
TASK4. What is physiological tachycardia and bradycardia and what are its causes? Put your explanations in this table.

N.B. An increase in heart rate above 100/min is called *tachycardia*.
A decrease in heart rate below 60/min is called *bradycardia*.

factors	Physiological bradycardias seen in	Physiological tachycardia is seen in
<i>Emotional excitement, nervousness, and apprehension</i>		
<i>Muscular exercise</i>		
<i>In the newborns</i>		
<i>Sex</i>		

<i>Diurnal variations</i>		
<i>Athletes</i>		
<i>Sleep and meditation</i>		

TASK4. Look this figure and write the explanation about mechanism of Vascular Autonomic Reflex.



TASK5. Cardiac efficiency tests (exercise tolerance tests). Put your results in the table and make a resume.

The response of the cardiovascular system to standardized exercise (*exercise tolerance test*, also called "*stress testing*") is the single and the best test for assessing the efficiency of the heart. During exercise, there is a progressive increase in the heart rate (HR) and blood pressure (BP). However, after the exercise is over, these values return to the pre-exercise levels during the next few minutes. The fact that, compared to a trained person, there is a **greater** increase in the heart rate and BP in an untrained individual during exercise, and that these values take a longer time to return to basal levels, forms the basis of exercise tolerance tests. The response to physical exercise depends on the cardiac reserve, (ie, efficiency of the heart), muscle power, training, motivation, and the state of nutrition. Therefore, the cardiac efficiency tests can also be used to test physical fitness in **an** individual.

I. Record the basal pulse rate, then ask the subject to hop 20 times on each foot, raising the shoulders 6 inches at each step.

If the heart is healthy, there should be little disturbance of breathing and the pulse rate should not increase by more than 10-20 beats per minute, and should return to pre-exercise level in about a minute.

Record these timings in your work book.

II. Harvard Step Test

Caution This is a test for physical fitness and should not be used in patients.

Protocol Record the basal pulse rate. Then ask the subject to alternately step up and down, lifting each foot about 20 inches (16 inches in females) off the ground, at a rate of 30 double steps per minute, for a period of 5 minutes. (Alternately, the subject may step up and down a 50 cm bench (40 cm in females), at a frequency of 30 times/min for 5 minutes). Stop the test if the subject feels breathless and exhausted and is unable to continue the **test**.

Count the pulse rate 1 minute after the end of the exercise. The pulse rate is inversely proportional to the degree of cardiac efficiency. To obtain an approximate idea of the cardiac efficiency index, count the pulse rate at the following intervals:

- i. Between 1 and 1,5minutes= /min (a)
- ii. Between 2 and 2,5minutes= /min (b)
- iii. Between 3 and 3,5minutes= /min (c)
- iv. Time after which the pulse rate returns to basal levels = minutes

$$\text{Cardiac efficiency Index} = \frac{\text{Duration of exercise in seconds (300)}}{a+b+c} \times 100$$

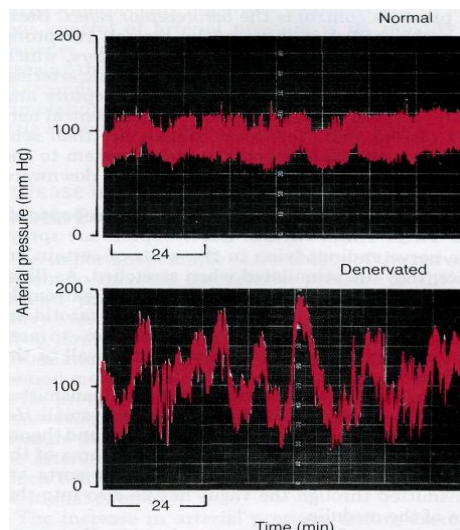
	pulse rate	time
a	Between 1 and 1,5minutes	per/min
b	Between 2 and 2,5minutes	per/min
c	Between 3 and 3,5minutes	per/min
	Time after which the pulse rate returns to basal levels	min
	Cardiac efficiency index	

In normal individuals, the cardiac efficiency index is nearly 100 per cent, but is more in sportspersons.

Efficiency index Over 50%- Efficiency is excellent; 81-90% - Efficiency is good' 55-80% - Efficiency is average; Below 55%-Efficiency is poor

Resume:

TASK6. What do you think about this figure? Write an explanation and make a resume.



Figures 1. Two-hour records of arterial pressure in a normal dog (above) and in the same dog (below) several weeks after the Baroreceptors had been denervated.

TASK7. Which hormones are hypertonic or hypotonic for blood pressure? Put your results in the table and write an explanation.

<i>hormones</i>	Mechanism for hypertonic effect	Mechanism for hypotonic effect
Adrenaline		
Bradykinin		
Prostaglandin		
Thyroxin		
Aldosterone		
Histamine		
Vasopressin		
Natriuretic peptide		
Angiotensin		
Serotonin		
Vasoactive intestinal polypeptide		

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 28

Theme: The Respiratory System. Research of external breath

THE GOALS OF OCCUPATION:

Study the biomechanics of breath, parameters of external breath, and observation methods of the external breath.

The initial level of knowledge

1. Anatomic and histological structure of Respiration System.

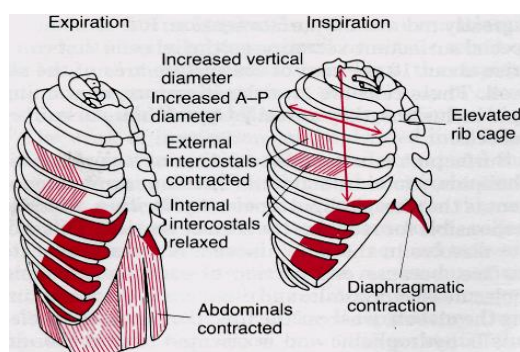
CONTROL THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the Properties of Gases and Partial pressure?
2. Explain the Anatomy of the Lungs:
 - a). air passages;
 - b). the physiology features of bronchi and their innervation;
 - c). Pulmonary circulation.
3. Describe the Mechanics of Respirations:
 - a). inspiration and expiration; What is the mechanism of deglutition apnea?
 - b). Lung volumes;
 - c). respiratory Muscles;
 - d). Bronchial tone, Compliance of the Lung and Chest Wall.
5. The Alveolar Surface Tension. Surfactant and it function.
6. Work of Breathing.
7. Differences in Ventilation. Blood flow in different parts of the lung.
8. The Dead space. Uneven Ventilation

INDEPENDENT PRACTICAL WORK

TASK1. Look this figure and write an explanation about differences between expansion and contraction of the thoracic cage during expiration and inspiration.



TASK2. Determination of breath holding time (BHT)

Relevance Breathing can be held for a variable period of time by different individuals depending upon the functional status of lungs, development of respiratory muscles, practice, age and sex. Breath holding time (BHT) is a simple test which can provide useful information in health and disease of the lungs.

PROCEDURES

As the students work in batches of two, one becomes the subject and the other acts as the observer.

1. The subject should sit quietly for a few minutes, breathing normally, before the BHT exercises are started. The observer uses a stop watch and records the time for each determination.

2. Ask the subject to pinch his nostrils with the thumb and forefinger, and hold his breath after a normal inspiration. Note the time for which the breath can be held. Make 3 observations at intervals of 5 minutes.

Using the same procedure, record the BHT after (i) a normal expiration; (ii) a deep inspiration; (iii) a deep expiration; (iv) hyperventilation (deep and fast breathing) for 20 times; (v) rebreathing from a large polythene bag for 15-20 seconds, with a nose clip on. (Discontinue if there is discomfort);

Tabulate your results and record these in your work book.

BHT Time					
	after a normal expiration	after a deep inspiration	after a deep expiration	after hyperventilation (deep and fast breathing)	after rebreathing from a large polythene bag for 15-20 seconds
BHT					

N.B.The normal BHT after a deep inspiration may vary from 40 seconds to over a minute.

TASK2.What are the factors which increase or decrease the breath holding time? Put information in this table.

factors which increase BHT	factors which decrease BHT
N	n

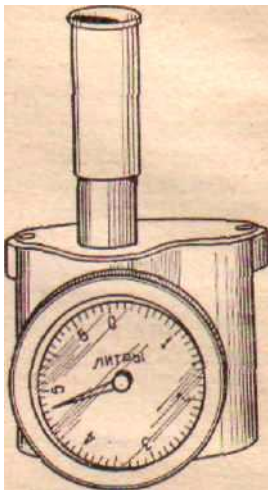
TASK3. Vital capacity and peak expiratory flow rate

Relevance Estimation of vital capacity is an important determination for assessing the ventilatory functions of the lungs in health and disease. Vital capacity is also employed as a criterion of physical fitness.

Definition

Vital capacity (VC), also called *forced vital capacity (FVC)*, or *forced expiratory volume (FEV)*, is the largest amount of air a person can expel from the lungs with maximum effort after first filling the lungs by a deepest possible inspiration. The subject inspires to total lung capacity (TLC) and then forcibly exhales to residual volume (RV).

A **simple spirometer** is generally available for student work



1. Ask the subject to breathe normally for a few times. Then ask him to inspire as deeply and fully as possible and, while keeping the nostrils closed with his thumb and finger, to expire with a maximum effort into the mouthpiece which is held tightly between the lips. The pointer on the spirometer indicates the volume of expired air. The forced expiration should be deep and quick but without undue haste.

2. Record the vital capacity in the standing, sitting, and lying down positions in order to study the effect of posture. Take 3 readings, at intervals of 5 minutes, for each determination. The purpose of taking three readings is not to get their average, but to familiarize the subject with the procedure, the third reading being usually the maximum in most cases. The subject can also be motivated to improve his performance.
For report: Maximum value = . Liters

3. Tabulate your results showing the three readings in each of the standing, sitting, and supine postures, and indicate the maximum value in each case.

4. Write the resume.

	in the standing	in the sitting	in the supine postures
Vital capacity (VC)	L	L	L

4. Define the:

- a). ...**TV (tidal volume)**. There is the volume of air inspired or expired with each normal breath; it amounts to about 500 milliliters in the average young adult.
- b). ...**ExRV (expiratory reserve volume)**. There is the extra amount of air that can be expired by forceful expiration after the end of a normal tidal expiration; this normally amounts to about 1100 milliliters.
- c). ...**InsRV (inspiratory reserve volume)**. There is the extra volume of air that can be inspired over and beyond the normal tidal volume; it is usually equal to approximately 3000 milliliters
- d). ...**RV (residual volume)**. There is the volume of air still remaining in the lungs after the most forceful expiration. This volume averages about 1200 milliliters
- e). ...**standard parameter by the formula:**

For the man: $VC = [27,63 - (0,112 \times \text{age in years}) \times \text{height in sm}]$

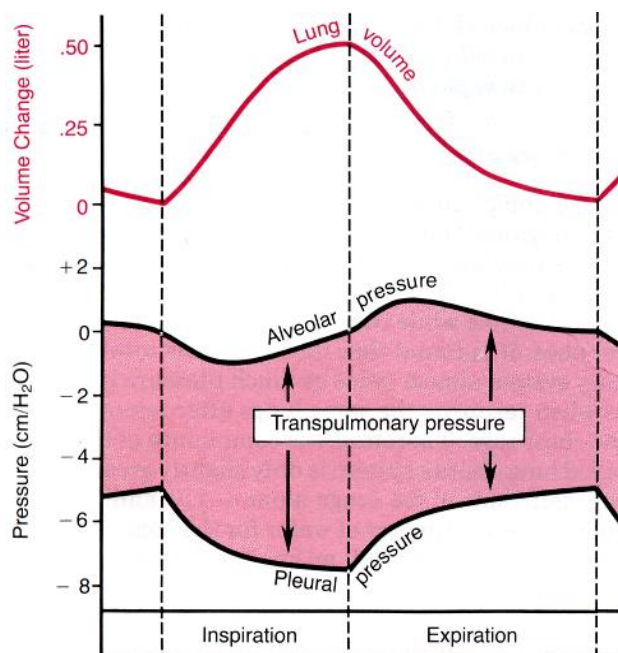
For the women: $VC = [21,73 - (0,101 \times \text{age in years}) \times \text{height in sm}]$

N.B. The normal VC ranges from 3.5 to 4.5 liters, the values being about 20% lower in the females. Since the VC depends on (the age, sex, body build, occupation, etc various formulae have been devised to predict VC in a given person.

5. Write the resume

TASK4. Look at this figure and write the explanation.

Changes in lung volume, alveolar pressure, pleural pressure, and transpulmonary pressure at the beginning of inspiration is approximately — 5 centimeters of water, which is the amount of suction that is required to hold the lungs open to their resting level. Then, during normal inspiration, the expansion of the chest cage pulls the surface of the lungs with still greater force and creates a still more negative pressure down to an average of about — 7.5 centimeters of water.



These relationships between pleural pressure and changing lung volume are illustrated in this Figure.

TASK5. What does surfactant function have? Put information in this table.

	function
Surfactant	

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 29

Theme: The gas exchange in the Lungs. Pulmonary circulation. The gas transport between the Lungs and tissues

THE GOALS:

Study the physiological mechanisms of the gas transport between the Lungs and tissues.

Initial level of the knowledge

1. Anatomy of Pulmonary Blood vessels.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

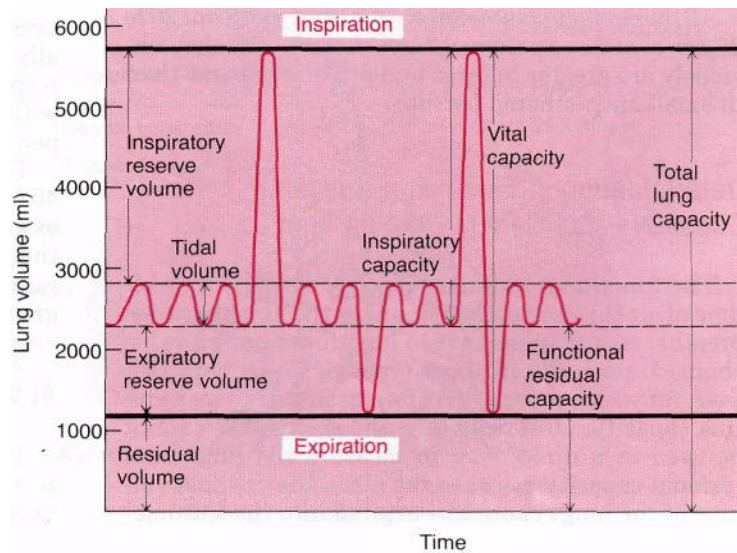
CONTROL QUESTIONS:

1. What do you know about the gas exchange in the Lungs:
 - a). Sampling Alveolar air and composition of Alveolar air ;
 - b). Diffusion across the Alveolocapillary membrane;
2. Describe the Pulmonary circulation:
 - a). Pulmonary Blood vessels;
 - b). Pressure, volume and flow;
 - c). Capillary pressure, effect of Gravity;
 - d). Ventilation and Perfusion ratios;
 - e). Pulmonary reservoir.
3. Regulation of Pulmonary flow.
4. Lung defense mechanism.
5. The metabolic and endocrine functions of the Lungs.
6. Oxygen transport:
 - a). Oxygen delivery to the tissues;
 - b). Reaction of Hemoglobin;
 - c). Factors affecting the affinity of Hemoglobin for Oxygen;
 - d). Myoglobin
7. Describe the Carbon Dioxide transport:
 - a). Fate of Carbon Dioxide in Blood;
 - b). Chloride shift;
 - c). Summary of Carbon Dioxide transport.

INDEPENDENT PRACTICAL WORK

TASK1. Demonstration of computer Spirography method. Look at this curve.

Which volumes and capacities are not recorded on a spirometer? Write an explanation.



TASK2 .Find out the physiological dead space, expiratory reserve volume, residual volume, inspiratory reserve volume, and functional residual capacity from the given data. Make resume.

Data

- a). Tidal volume = 450ml
- b). Alveolar air PCO₂ = 40 mm Hg
- c). Expired air PCO₂ = 26 mm Hg
- d). Total lung capacity = 5200 ml
- e). Inspiratory capacity = 3000 ml
- f). Vital capacity = 4000 ml

Physiological dead space = $\frac{\text{Alveolar air PCO}_2 - \text{Expired air PCO}_2}{\text{Alveolar air PCO}_2} \times \text{Tidal volume}$;

Expiratory reserve volume = Vital capacity - Inspiratory capacity;

Residual volume = Total lung capacity - Vital capacity;

Inspiratory reserve volume = Inspiratory capacity - Tidal volume;

Functional residual capacity = Residual volume + Expiratory reserve volume

TASK3. Look at this figure and write an explanation for one.

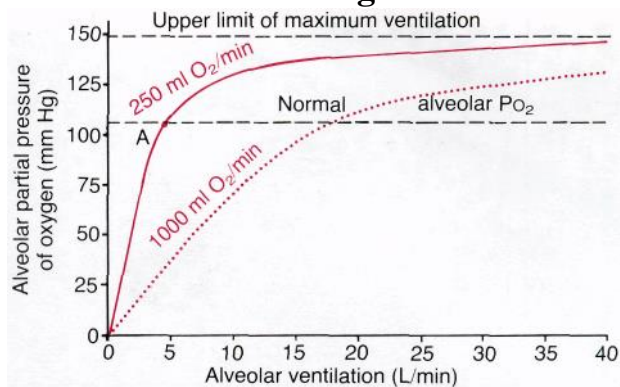


Figure 1. Effect of alveolar ventilation and of two rates of oxygen absorption, 250 ml/min and 1000 ml/min, from the alveoli on the alveolar PO₂

TASK4. Look at this figure and write an explanation for one.

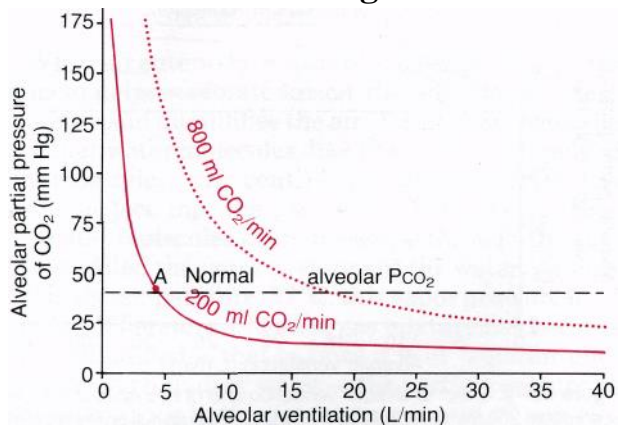
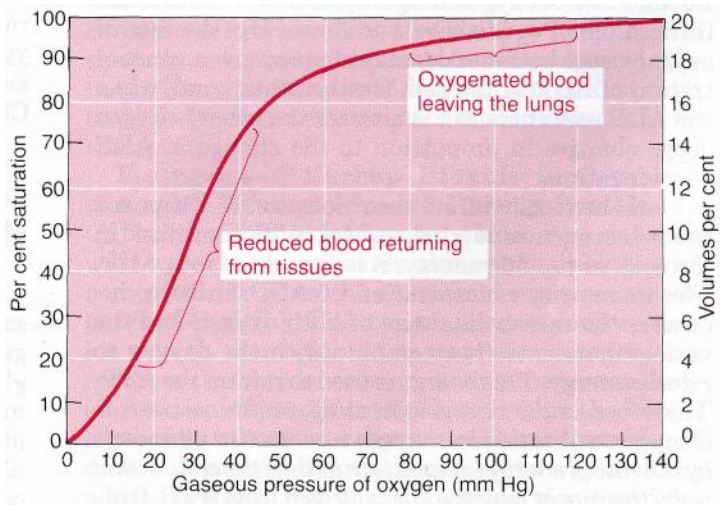


Figure 2. Effect on alveolar Pco₂ of alveolar ventilation and rate of carbon dioxide excretion from the blood

TASK 5. Look at these figures. Write an explanation for oxygen- hemoglobin dissociation curve.



THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 30

Theme: Regulation of Respiration. Respiratory Adjustments in health.

THE GOALS:

Study the regulation mechanisms of respiration.

Initial level of the knowledge

1. Anatomy of Autonomic and Central nervous systems, physiology of Endocrine system.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the neural control of Breathing?
 - a). Medullary systems;
 - b). Pontine and Vagal influences.
2. Regulation of Respiratory activity.
3. Chemical control of regulation:
 - a). Carotid and Aortic bodies;
 - b). Chemoreceptors in the Brainstem.
4. Ventilatory responses to changes in Acid – Base balance;
5. Ventilatory responses to CO₂;
6. Ventilatory responses to Oxygen Lack.
7. Effects of Hypoxia on the CO₂ response curve.
8. Effect of H on the CO₂ response.
9. Breath Holding. Hormonal effects on respiration
10. Non chemical influences on respiration:
 - a). Responses mediated by receptors in the air ways and Lungs;
 - b). Coughing and Sneezing;
 - c). Responses in patients with Heart-Lung Transplants;
 - d). Afferents from “Higher centers”, from Proprioceptors;
 - e). Respiratory components of Visceral reflexes;
 - f). Respiratory effects of Baroreceptor stimulation and effects of Sleep
11. Respiratory Adjustments in health. Effects of Exercise:
 - a). Changes in Ventilation;
 - b). Changes in the tissues;
 - c). Exercise tolerance and Fatigue.

INDEPENDENT PRACTICAL WORK

TASK1. Determine the oxygen carrying capacity and oxygen content of arterial and venous blood samples from the data provided below:

Data

- a). Percentage saturation of arterial blood with oxygen=97%
 - b). Percentage saturation of venous blood with oxygen=75%
 - c). Hemoglobin concentration=14.5g /dl
-

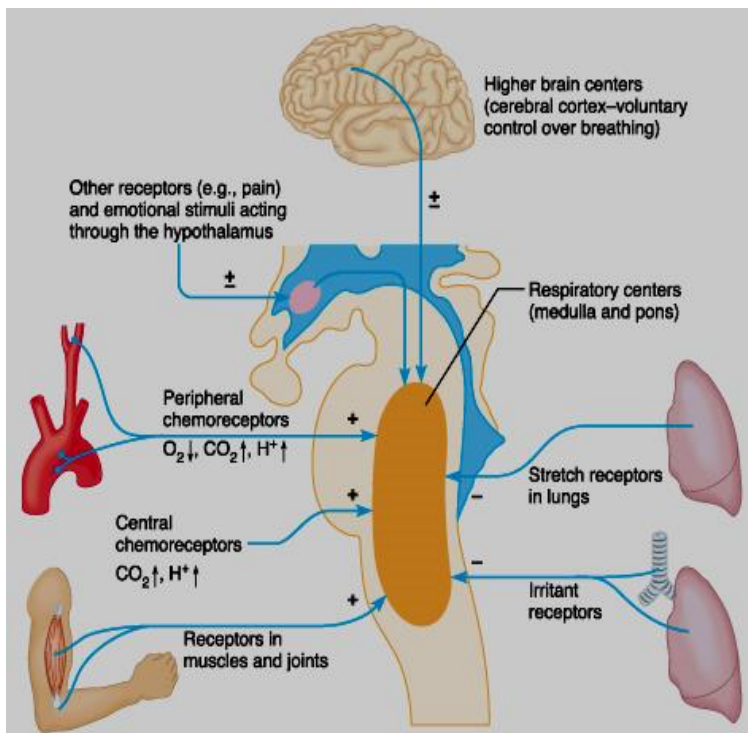
Oxygen carrying capacity of blood (ml/100ml)

= Hg% x 1.34=.....(ml/dl)

Formula for oxygen content of blood= (Percentage saturation x capacity)/ 100

TASK2. What is the normal alveolar ventilation? How is it regulated? Write an explanation.

TASK3. Look this figure and write an explanation about the Central and Humoral mechanisms of breath regulation.



TASK4. Look at this figure and write the explanation about it.

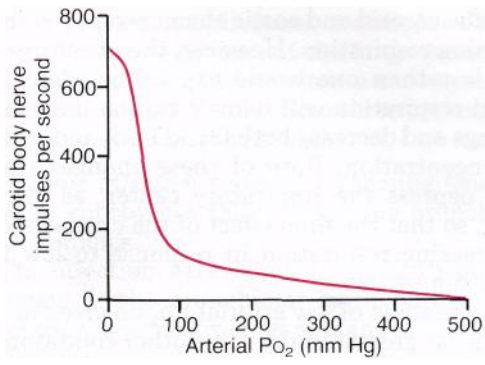


Figure 1.Effect of arterial PO₂ on impulse rate from the carotid body of a cat

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PRACTICAL LESSON 31

Theme: Gastrointestinal function .Digestion and absorption of substances.Digestion into the Mouth.

THE GOALS OF OCCUPATION:

To study the digestion and absorptium of Carbogydrates, Proteins, Lipids, absorptium of Water and Electrolites, Vitamins and Minerals.

Initial level of the knoveledge

1. Anatomy of Alimentary tract.

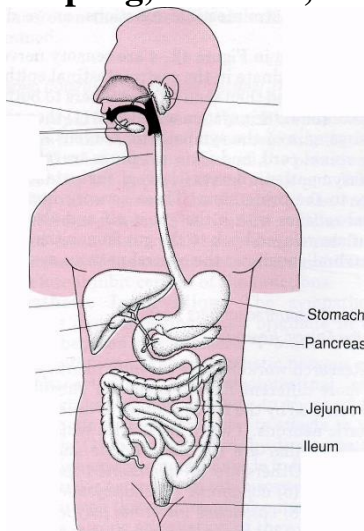
THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

- 1.What you know about the general function of Alimentarytrac.
2. Carbohydrates : digestion and absorption.
3. Proteins and Nucleis acids: digestion and absorption.
4. Lipids: digestion and absorption.
5. Absorption of Water and Electrolits.
6. Absorption of the Vitamins and Minerals.
7. Characteristics of the Gastrointestinal wall;
 - a). the gastrointestinal smooth muscle;
 - b). Gastrointestinal circulation;
 - c). the Enteric nervous system, Extrinsic innervation;
 - d). peristalsis, basic electrical activity and regulation of Motility;
 - e) migrating motor complex.
8. Gastrointestinal hormones:
 - a). enteroendocrine cells;
 - b). Gastrin and its function;
 - c). Cholecystokinin – Pancreozymin and their function;
 - d). Secretin, Gip, Vip peptide VV, Ghrelin, Motilin, Somatostatin and other Gastrointestinal Hormones and their function.
- 9.Digestion into the mouth: mastication; ionic composition of Saliva; control of salivary secretion.

INDEPENDENT PRACTICAL WORK

TASK1 Look and note at this figure the Mouth, the Salivary and Parotid glands, the Esophag, the liver, all pats of the Colon,the Anus. Describe their function.

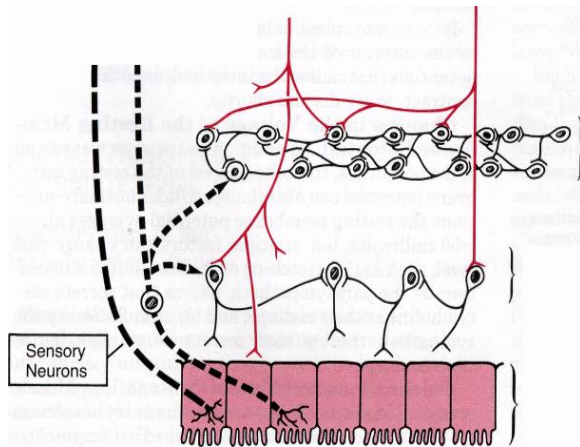


TASK2. Look and note at this figure the Myenteric plexus, the Submucosal plexus, Epithelium. Explain and describe their function.

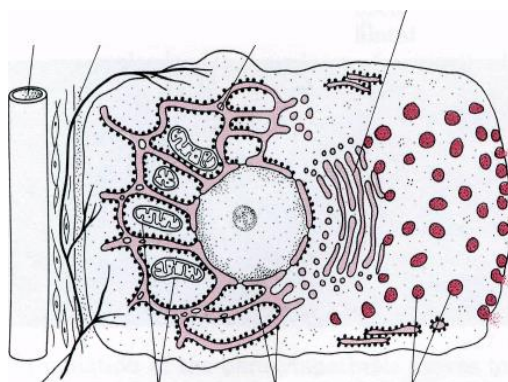
To prevertebral ganglia,

Spinal cord and brain stem Sympathetic
(mainly postganglionic)

Parasympathetic
(preganglionic)



The TASK3. Look and note at figure the Capillary, the Basement membrane, the Endoplasmic reticulum, the Golgi apparatus, the Nerve fiber, the Mitochondria, the Ribosomes and the Zymogen granules. Explain their function



Typical glandular cell.

TASK4.Studying of reaction on Mucin.

During 1-2 minutes rinse a mouth of distilled water of 20 ml. Repeat manipulation 3 times. Filter the collected saliva through a filtering paper. Add to 2 ml of a saliva some drops of an acetic acid. After that Mucindrops out as a white sediment. And the saliva loses viscosity.

RESEARCH PROBLEMS

1.Describe this research and write a conclusion on value of saliva's Mucin.

TASK5.Studying of saliva's pH

Eat one sweet before performance of work. Then, collect 2 ml of a saliva in a test tube. Place a strip of a display paper in a test tube with the help of a tweezers. Take out a strip and immediately compare the received colouring to a scale.

RESEARCH PROBLEMS

1.Describe this research and write a conclusion by the received results

TASK6.Write the information in the table

source	enzyme	activator	substrate	Catalytic function or products
	Salivary α-amylase			
	Lingual lipase			
	Pepsins			
	Gastric lipase			
	Trypsin			
	Chymotrypsins			
	Elastase			

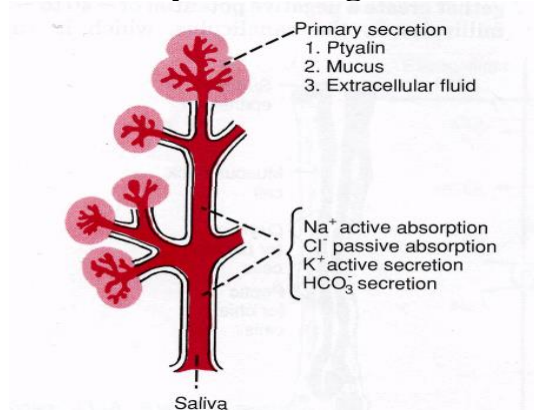
	Carboxypeptidase			
	Colipase			
	Pancreatic lipase			
	Bile salt –acid lipase			
	Cholesteryl ester hydrolase			
	Pancreatic α-amylase			
	Ribonuclease			
	Deoxyribonuclease			
	Phospholipase A2			
	Enteropeptidase			
	aminopeptidases			
	Carboxypeptidases			
	Endopeptidases			
	Dipeptidases			
	Maltase			
	Lactase			
	Sucrase			
	A-Dextrinase			
	Trehalase			
	Nuclease and related enzymes			
	Various peptidases			

TASK7. Write the information about normal transport of substances by the intestine and location of maximum absorption or secretion in this table

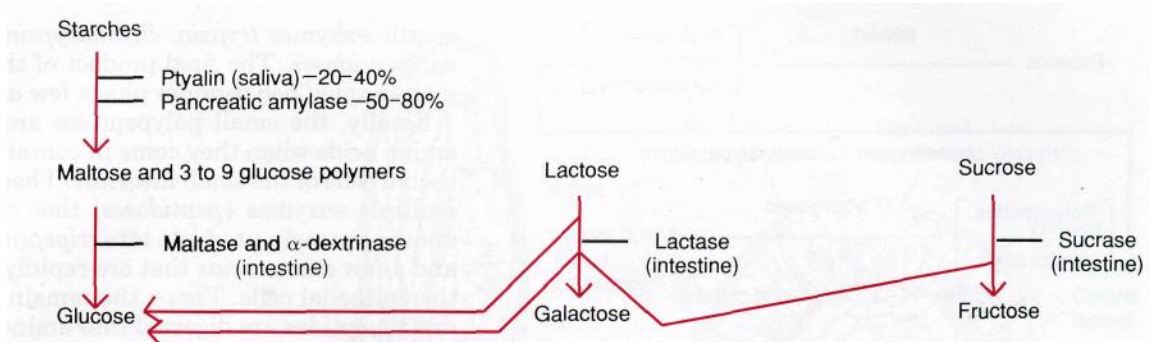
	Small intestine			
Absorption of	Upper	Mid	Lower	Colon
Sugars				
Amino acids				
Water-soluble and fast-soluble vitamins				
Betaine, sarcosine				
Antibodies in newborns				

Pyrimidines				
Long-chain fatty acid absorption and conversion to triglyceride				
Bile salts				
Vitamin B12				
Na⁺				
K⁺				
Ca⁺				
Fe⁺				
Cl⁺				
SO₄²⁻				

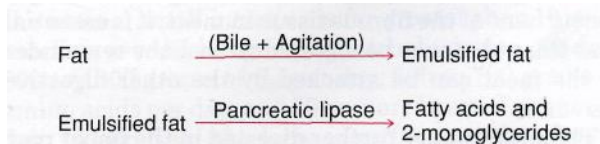
TASK8. Look at this figure and write an explanation about the formation and secretion of saliva by a salivary gland.



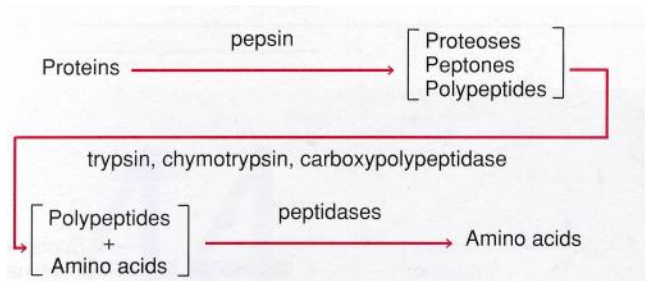
The TASK9. Look at these schemes and write an explanation about digestion substans.



A. Digestion of carbohydrates.



B. Digestion of fats.



C. Digestion of proteins.

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PRACTICAL LESSON32

Theme: Digestion functions of Stomach and Pancreas

THE GOALS:

Study the digestion function of Stomach and Pancreas

Initial level of the knowledge

1. Anatomy of Esophagus, Stomach and Pancreas

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Functional anatomy of Stomach.
2. The glands of Stomach and their functions.

3. Functions of Stomach.
4. Properties and composition of Gastric juice.
5. Functions of Gastric juice: digestive, hemopoetic and protective functions.
6. Pepsinogen and Hydrochloric acid secretion.
7. Gastric motility and emptying. Hunger contractions
8. Regulation of the Gastric Secretion. Cephalic, Gastric and Intestinal influences.
9. Regulation of Gastric motility and Emptying.
10. Anatomic considerations of the Pancreas and Pancreatic juice composition.
11. What do you know about the pancreas role in digestion function?
12. Regulation of the Pancreatic juice secretion.

INDEPENDENT PRACTICAL WORK

TASK1. Put information about the Stomach functions in this table.

#	<i>Stomach functions</i>	<i>your explanation</i>
1.	Storage function	
2.	Mechanical function	
3.	Digestive function	
4.	Protective function	
5.	Hemopoetic function	
6.	Excretory function	

TASK2. Two years ago Bob developed cancer and a doctor removed his Pylorus. What happened with Stomach secretory function after that? Write an explanation.

TASK3. Put information about the Gastric enzymes role for digestive in this table.

	<i>Food types</i>	<i>Final products of digestion</i>
Gastric amylase		
Gastric gelatinase		
Pepsin		
Gastric lipase		
Rennin		

TASK4. Analysis Basal Acid Output (BAO) AND Maximal Acid Output (MAO) in Gastric juice.

The specimen is collected over a 2½ hour period. The first 60 minutes, collected in 15-minute intervals is called the Basal Acid Output (BAO). The amount of gastric juice collected from a normal patient will range from 30 mLs to 80 mLs. After chemical stimulation with pentagastrin, histalog, or histamine, the following continuous 60 minutes of 15-minute interval collections is called the Maximal Acid Output (MAO). These four consecutive 15-minute samples are used for the MAO value. Normal values for basal and maximal acid output are as follows:

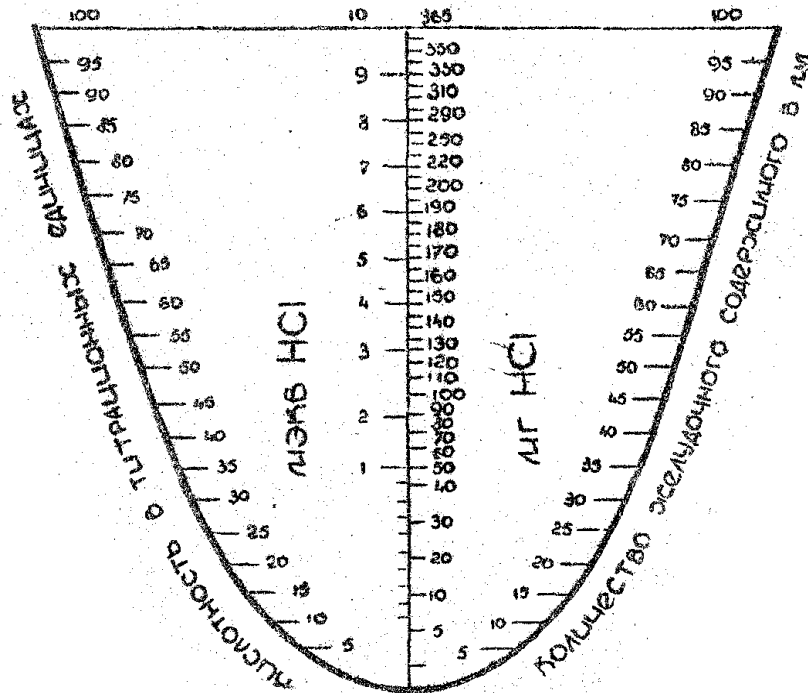
	BAO mMol/hr	MAO mMol/hr	Typical ratio of BAO to MAO
man	0-10	7-48	~20%
women	0-6	5-30	~20%
Gastric ulcer	>2	1-20	20%-40%
Gastric cancer	>2	0-20	~20%
Pernicious anemia	0	0	0

There were about three parenteral introductions of substances and Vagal stimulation for an animal. How can BAO and MAO change after experiment? Put information in this table.

substances	BAO	MAO	Typical ratio of BAO to
-------------------	------------	------------	--------------------------------

	mMol/hr	mMol/hr	MAO
Gastrin			
Histamine			
Enterogastrone			
Vagal stimulation			

TASK5 . Definition the debit of hydrochloric acid in gastric juice by a nomogram.



Nomogram

Mark volume of gastric juice (ml) in the right branch of this curve. Then mark acidity of this one (T/unit) in the left branch. Connect these two points by a ruler. The point of intersection between the ruler and vertical line of Nomogram is quantity of hydrochloric acid (mg).

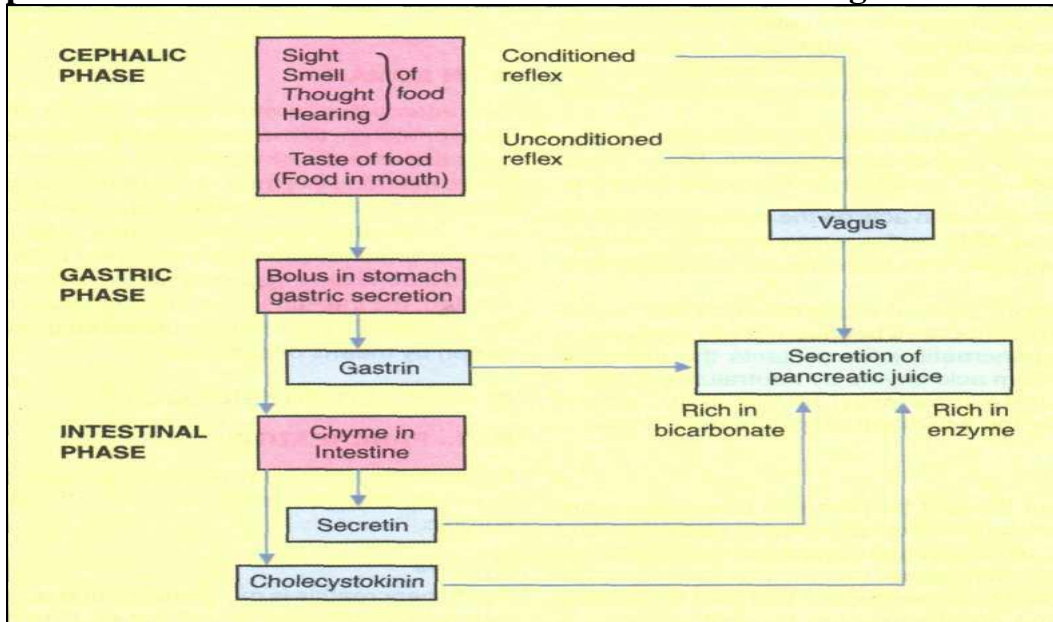
The amount of hydrochloric acid in gastric juice collected from a normal patient will range from 40 to 150 mg (during the first 60 minutes of gastric secretion) and from 40 to 220 mg (during the second 60 minutes of one).

The patient's second portion of gastric juice (90ml) contains about 60 T/unit of acidity. How many mg of hydrochloric acid are there in his specimen? Explain your result and write an explanation.

TASK 6. Write your explanations for these clinical situations.

- The patient has got gastric juice hyper secretion. Why can't he eat a fried meat?
- The acidity of patient's gastric juice was increase. Can he eat meat-broth?

TASK7. Look at this figure and write your explanation for this clinical situation. The person's Secretin level was increase. How can it change the Pancreatic juice Ph?



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PRACTICAL LESSON 33

Theme: Digestion functions of Liver, Small Intestine and Colon.

THE GOALS:

Study the digestion function of Liver, Small Intestine and Colon

Initial level of the knowledge

1. Anatomy of Liver, Small Intestine and Colon

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. What do you know about the functional anatomy of the Liver and Biliary system?
2. Synthesis of Plasma proteins by Liver.
3. Bile and its digestion function: a). Bilirubin metabolism and excretion; b). Jaundice and other substances conjugated by Glucoronyltransferase; c). other substances Excreted in the Bile.
4. What do you know about the role of gallbladder in digestion? The Gallstones and effects of Cholecystectomy
4. Regulation of the biliary secretion.
5. The anatomic considerations of Small intestine and Colon.
6. What can you tell about intestinal mucus and intestinal motility? Regulation of intestinal secretion
7. Transit time in the Small intestine to Colon. Describe the mechanism of motility and secretion in the colon. Regulation of Colon secretion
8. Absorption in the colon. Intestinal bacteria.Feces.Defecation.

INDEPENDENT PRACTICAL WORK

TASK1. Put information about the functions of Liver in this table.

#	<i>Liver functions</i>	<i>your explanation</i>
1.	Metabolic function.	
2.	Storage function	
3.	Synthetic function	
4.	Secretion of Bile	
5.	Excretory function	
6.	Heat production	

7.	Hemopoetic function	
8.	Hemolytic function	
9.	Inactivation of Hormones and Drugs	
10.	Defensive and detoxification functions	

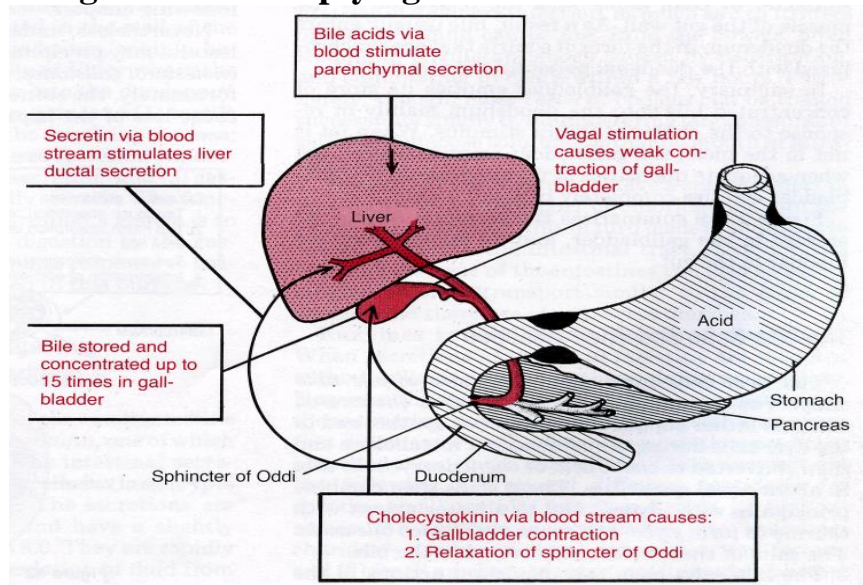
TASK2. Put information about the Bile functions in this table.

#	<i>Bile functions</i>	<i>your explanation</i>
1.	Digestive function.	
2.	Absorptive function	
3.	Excretory function	
4.	Laxative action	
5.	Antiseptic action	

6.	Choleretic action	
7.	Maintenance of pH in gastrointestinal tract	
8.	Prevention of Gallstone formation	
9.	Lubrication function	
10.	Cholagogue action	

TASK3. Study the bile action to fat filtration. Take two test tubes with funnels. Put filters paper into the funnels. Moisten the first filter with bile but the second one with water. Fill about a ml of oil into the each o two. Oil is faster to filter off through the bile layer then through moist paper. Why? **Describe this experiment. Writeen explanation**

TASK 4. Look at this figure. Write an explanation about the regulation of Liver secretion and gallbladder emptying.



TASK5. Two years ago Den developed Gallstone and a doctor removed his gallbladder. What happened with digestion function after that? Write an explanation.

TASK6. Put information about the Intestine enzymes role for digestive in this table.

<i>Enzymes type</i>	<i>Food types</i>	<i>Final products of digestion</i>
<i>Proteolytic enzymes</i> : such as aminopeptidase,		

dipeptidase and tripeptidase		
Amylolyticenzymes: such as lactase, sucrase, maltase, dextrinase and trehalase		
Lipolyticenzymes: such as intestinal lipase		

TASK7. Put information about the regulation of succusericus secretion in this table.

	type of regulation	mechanism	effect
1.	Nervous regulation :		
a).	Stimulation of parasympathetic nerves		
b).	Stimulation of sympathetic nerves		
c).	The local nervous reflexes		
2.	Hormonal regulation:		
a).	cholecysto-kinin		
b).	secretin		
c).	enterocrinin		

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TASK 8. Study the parietal digestion in rat's Intestine.

Put about a ml of physiological solution and 0, 5 ml of starch slurry in two test tubes. Add a piece of rat's crushed intestine into the first of the two. Put these test tubes in a thermostat (at 37 ° C) for 20 minutes. Then add about a drop of iodine solution in both ones. Estimate the Amylase activity by color change. **Describe this experiment. Write an explanation.**

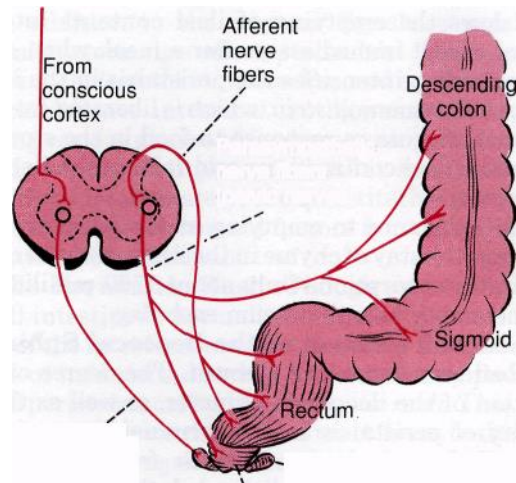
TASK9. The person's Secretin level was decrease. How can it change the succusertericus secretion?

TASK10. Put information about the Colon functions in this table.

<i>Large intestine functions</i>	<i>your explanation</i>
Digestive function.	
Absorptive function	
Formation of feces	
Excretory function	
Secretory	

function	
Synthetic functions	

TASK 11. Look at this figure. Write an explanation about the afferent and efferent pathways of the parasympathetic mechanism for the defecation reflex.



External anal sphincter

Internal anal sphincter

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 34

Theme: Regulation of the Energy metabolism

THE GOALS:

Study the mechanisms of energy exchange, methods of computation of basic exchange.

Initial level of the knowledge

1. Aerobic and anaerobic oxidation of matters.
2. Final products of oxidation: proteins, oils and carbohydrates.

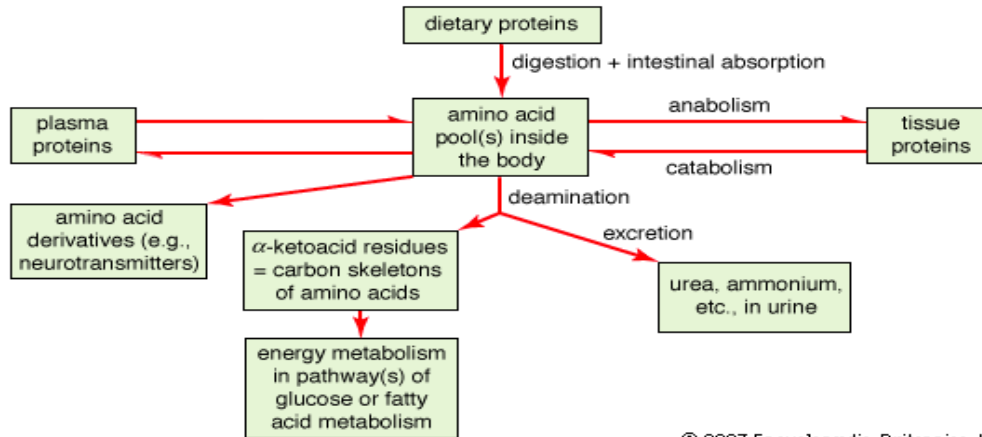
CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Release of Energy from foods and the concept of “free energy”.
2. Metabolism of Carbohydrates and formation of Adenosine triphosphate (ATP).
3. Lipid metabolism.
4. Protein metabolism.
5. Regulation of feeding. Obesity and starvation.
6. Vitamins and mineral requirements
7. Energetics and metabolic rate
8. Dietary balances.

INDEPENDENT PRACTICAL WORK

TASK1. Look at this scheme. What kind of factors can increase or decrease the proteins metabolism in a man? Put information in this table.



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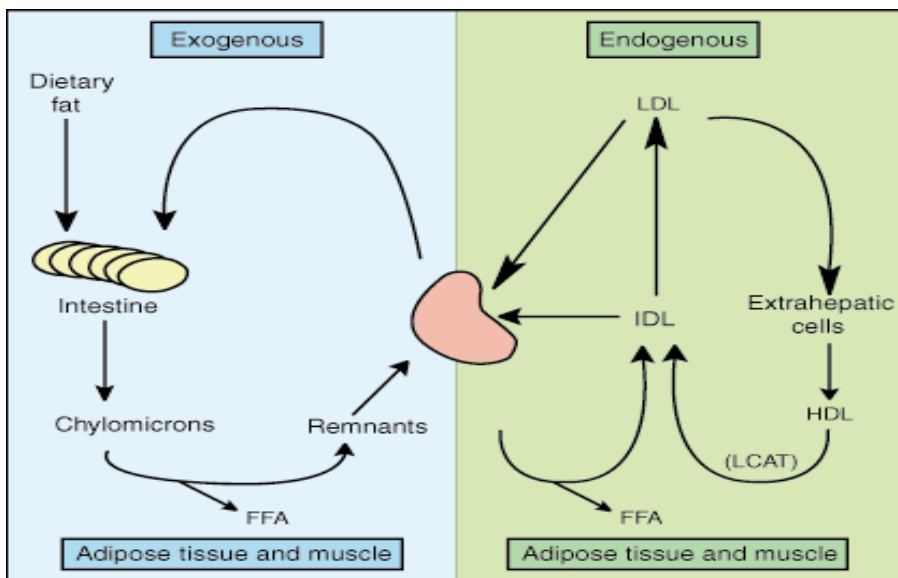
The factors	High proteins metabolism	Low proteins metabolism	Physiology mechanism
hungry			
n.....			

--	--	--	--

TASK2. What central and humoral mechanisms do the Carbohydratesmetabolisms change? Put information in this table

the factors	High carbohydrates metabolism	Low carbohydrates metabolism	Physiology mechanism
hungry			
n.....			

TASK3. Look at this scheme. What kind of factors can increase or decrease the lipid metabolism in a man? Put information in this table



The	High lipid	Low lipid	Physiology mechanism
-----	------------	-----------	----------------------

factors	metabolism	metabolism	
hungry			
n.....			

TASK4. Calculate of daily caloric requirements from data provided.

Data: Subject awake for 17 hours; Light type of work for 6 hours; Body weight=58 kg; Body surface area=1.6 m²; BMR=38 Calories/h/m²; Ambient temperature=15° C. Total caloric requirements of the subject per day=e+f+g ?

Preparation a diet sheet.

The aim of nutrition is to determine the type and amount of foods that would not only supply the energy and materials for growth, repair, and enzymatic activities, but also promote health and well being. This includes the problem of undernutrition in economically poor countries and overnutrition in rich people.

An optimal diet includes adequate calories, proteins, fats, carbohydrates, enough water, minerals, and vitamins.

Planning a diet In planning an adequate diet, the following criteria are taken into account:

1. It must be palatable and satisfying.
2. It must have sufficient energy value (calories) to maintain body weight, physical and mental efficiency, and body temperature.
3. It must contain proper proportions of proteins, carbohydrates, and fats.
4. It must maintain nitrogenous equilibrium.
5. It must contain proper proportions of minerals, vitamins, and enough water.

Total Caloric Requirements

The caloric values of foods, ie, the energy released when 1 gram of a particular food is metabolized, is given below:

Type of food Caloric value (kcal/g)

Proteins 4.1 For practical purposes, the caloric value

Carbohydrates 4.1 of proteins, carbohydrates, and fats are

Fats 9.3 taken as 4,4, and 9 respectively. Knowing

=the quantities of these foods in the diet,

the total caloric intake can be calculated.

Calculation of Total Caloric Requirements

1. Body surface area (BSA) is determined from the height and weight of the person from a chart (nomogram) provided for the purpose, (see appendix)
2. Basal metabolic rate (BMR) is determined from the age, sex, and the BSA of the individual from a chart provided for this purpose.
3. Since $BMR = \text{Calories expended per hour per m}^2 \text{ BSA}$,
- $\text{Calories expended per hour} = BMR \times BSA$
4. A person is awake for 16 hours in a day,
- $\text{Calories expended during waking hours} = BMR \times BSA \times 16$ (a)
5. A person sleeps for 8 hours during which the caloric requirement is 90% of BMR
- $\text{Calories consumed during sleep} = BMR \times BSA \times 8 \times 90/100$ (b)
6. Work allowance: the calories consumed during the working period are dependent upon the type of work, as shown below:
Type of work Calories/hr/kg body weight

Light	1.7
Moderate	2.5
Heavy	5.0

A person normally works for 8 hours a day; therefore, work allowance is calculated as under for a person doing moderate type of work-
 $\text{Work allowance} = 8 \times 2.5 \times \text{Body weight in kg}$ (c)
7. Non-working allowance for the energy requirements of daily activities such as taking a bath, donning clothes, talking or other movements which a person performs while awake.
 $\text{This allowance is taken as 400 kcal per day.}$ (d)
8. Total calories required per day:
 $\text{This is calculated as follows: } a + b + c + d \text{ (as mentioned above)}$ (e)
9. Specific dynamic, or calorogenic, action of food (SDA):
 $\text{Depending on the types of foodstuffs burnt in the body, 10-15\% of the total caloric needs is added.}$ (f)
10. Climate: A correction for ambient temperature during the day is required after calculating the figure (f) above. If the environmental temperature is about 25° C, no correction is required. If it is higher by 5-10° C, the caloric requirement is reduced by 5%. If the temperature is lower by 5-10° C, the caloric requirement is increased by 3%. (g)
11. Extra calories are required during pregnancy (250-350 Calories/day) and during lactation (550-600 Calories/day).

TASK5. Find out the basal metabolic rate (BMR) of the subject from the data given below. Write a conclusion.

Date

- a). Oxygen consumption in 6 minutes = 1470 ml
b). Body surface area (BSA) of the subject = 1.6 m²
c). Standard BMR for the age and sex of the subject = 40 Cal/m²BSA/hour
-

Oxygen consumption in 1 hour = 14.70 liters

When 1 liter of oxygen is consumed, 4.8 Calories are released.

Calories released from consumption of 14.7 liter of oxygen = ?

BMR = Calories consumed per hr / BSA ; BMR = ?

Standard BMR for the subject = 40 cal/m²BSA/hour; Calculated BMR is in excess or decrease by n calories/m²BSA/hour

Percentage excess or decrease = $n / 40 * 100\% = \dots\%$

Normal range = ±15%

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 35

Theme: Physiology of thermoregulation

THE GOALS:

Study the mechanism of thermoregulation

Initial level of knowledge

1. Biochemistry of thermoregulation
2. Principles of temperature regulation in poikilothermic and homothermic animals

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Normal body temperature.
2. Heat production.
3. Heat loss: a). heat conduction; b). convection; c.) radiation.
4. Temperature regulation and Fever. Hypothermia.
5. Role of the CNS in regulation of body temperature.

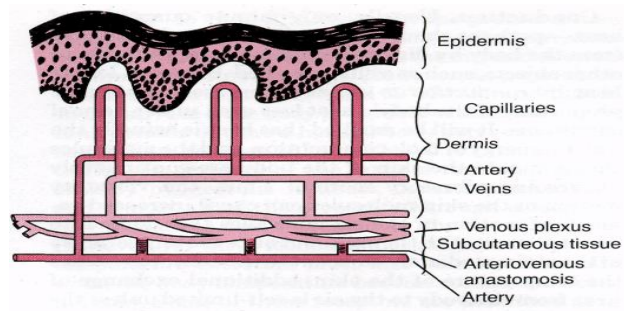
6. Behavioral control of Body temperature.

INDEPENDENT PRACTICAL WORK

TASK1. Put information about factors for Heat production and Heat loss.

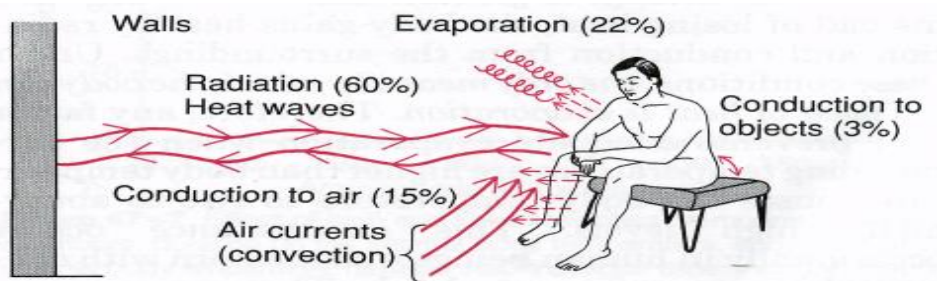
Heat production		Heat loss	
<i>factors</i>	<i>mechanism</i>	<i>factors</i>	<i>mechanism</i>

TASK2. Look at this figure. Write explanation about the role of blood vessels in regulation of body temperature.



TASK3. What do you know about the control of Heat conduction to the skin by the Sympathetic nervous system? Write explanation.

TASK4. Look at this figure and describe the mechanisms of heat loss from the body. Use this table.



factors	mechanism
radiation	

conduction	
convection	
evaporation	

TASK5. What do you know about the role of Aldosterone for acclimatization of the sweating mechanism to Heat? Write an explanation.

TASK6. What do you know about the role of the Hypothalamus in regulation of body temperature? Write an explanation .Use this table.

Structure of the brain	function
<i>Anterior Hypothalamic-Preoptic area</i>	

<i>Posterior Hypothalamus</i>	
<i>receptors</i>	

TASK7. Write an explanation about behavioral control o body temperature.

TASK8. Clinical testing of temperature sensation.

I. Prepare three jars of water in the order—hot, warm, and cold. The hot water should be as hot as can be easily tolerated by a finger without evoking pain. Ask the subject to dip his right index finger in the cold water, and the left in the hot water. After about 30 seconds, ask him to dip both index fingers in the warm water. Ask him to describe the sensations resulting from the experiment.

II. "Cold" and "Warm" spots: Satisfactory thermal probes can be made by taping the two inches of the blunt ends of pithing needles with electrician's insulation tape (the plastic serves as an insulated handle). Pack 3-4 such probes each in a 500 ml beaker filled with hot water and another beaker filled with crushed ice and water.

Make a 3 cm square with a sketch pen on the dorsum of the subject's hand, and divide this into 4 squares. Ask him to close his eyes. Very gently touch the skin within the squares with a probe. The subject is to report "cold" or "hot" as the case may be. Select hot and cold probes at random and test for hot and cold spots until the entire square has been mapped. Mark the locations where the subject reports hot sensations with red dots and those of cold sensations with blue dots. (Dry each probe before use, and return it to the beaker after use). Several other areas may be tested in a similar manner. Use the same colored dots to show hot and cold spots within the grid drawn in your work book.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 36

Theme:*The role of kidneys in urine formation. Glomerular filtration and its regulation*

THE GOALS:

Study the mechanism of urine formation and its regulation.

Initial level of knowledge

1. Anatomy of kidneys; innervation of kidneys.
2. Renal blood vessels.
3. Osmotic and oncotic pressure.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Physiology of excretory system, its composition and function.
2. Describe the kidney functions.
3. What do you know about the functional anatomy of
 - a). Nephron;
 - b). Juxtaglomerular apparatus;
 - c). Renal circulation?
3. Describe the mechanism of Urine formation (Glomerular filtration, tubular reabsorption, tubular secretion)
4. What do you know about the Glomerular filtration?
 - a). Glomerular filtration rate;
 - b). Filtration fraction;
 - c). pressures determining filtration;
 - d). filtration coefficient.
5. Plasma clearance.

INDEPENDENT PRACTICAL WORK

TASK 1.Put information about functions of kidneys in this table.

#	Functions	...about this function
1.	Role in homeostasis:	

a).	Excretion of Waste products	
b).	Maintenance of water balance	
c).	Maintenance of electrolyte balance	
d).	Maintenance of acid base balance	
2.	Hemopoetic function	
3.	Endocrine function	
4.	Regulation of blood pressure	
5.	Regulation of blood calcium level	

TASK 2. Look a picture and write an explanation about structure and functions of nephron.

TASK3. What do you know about the factors regulating Glomerular filtration rate? Put information about ones in this table.

#	Factors	...about this factor
1.	Tubuloglomerular feedback mechanism	
2.	Glomerular capillary pressure	
3.	Colloidal osmotic pressure	
4.	Hydrostatic pressure in Bowman's capsule	
5.	Renal blood flow	
6.	Constriction of afferent arteriole	
7.	Constriction of efferent arteriole	
8.	Systemic arterial pressure	
9.	Sympathetic stimulation	
10.	Surface area of capillary membrane	
11.	Permeability of capillary membrane	

TASK 4. What is it effective filtration pressure? Write an explanation. Calculate the effective filtration pressure from the data given below.

Data

a). Glomerular capillary hydrostatic pressure = 55mmHg

- b). Glomerular capillary blood osmotic pressure = 30mmHg
 - c). Bowman's capsular fluid pressure = 15mmHg
 - d). Bowman's capsular fluid osmotic pressure = 0mmHg
- effective filtration pressure = a – (b+c)**

**TASK 5. What is it Glomerular filtration (GFR) rate? Write an explanation.
Calculate the Glomerular filtration rate from the data provided below.**

Data

- a). Concentration of inulin in plasma (P) = 0,24 mg/ml
- b). Concentration of inulin in urine (U) = 34 mg/ml
- c). Rate of urine formation (V) = 0,9ml/min

GFR (...ml/min) = U*V/ P

TASK 6. Write an explanation for these clinical tasks

1. The osmotic blood pressure increases. How will the urine formation change?

2. Substance V normally can not be found in the urine. Does it mean that it can not be filtered and can not be secreted?

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 37

Theme:*The role of kidneys in urine formation. Physiology of reabsorption and secretion*

THE GOALS:

Study the main mechanism of urine formation and its regulation.

Initial level of the knowledge

1. Classification and mechanisms of transport through cell membrane.
2. Features of kidneys blood circulation.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Tubular reabsorption:
 - a). Selective reabsorption;
 - b). the mechanisms of reabsorption;
 - c). the mechanisms of reabsorption Na^+ , glucose, amino acids, proteins, water.
2. Tubular reabsorption and secretion:
 - a). reabsorption and secretion urea;
 - b). reabsorption and secretion K^+ ;
 - c). Secretion H^+ ;
 - d). ammonia secretion.
3. Concentration of urine.
4. Determination the tubular reabsorption.
5. Regulation of reabsorption processes.
6. Incretory function of kidneys
7. Process of urine excretion and its regulation
8. Kidneys and hemopoiesis
9. Physiology of micturition

INDEPENDENT PRACTICAL WORK

TASK 1. Calculate the urea clearance from the given data. Write an explanation for your results.

Data

Concentration of urea in urine (U) = 20 mg/ml

Concentration of urea in blood (B) = 38 mg/100ml

Rate of urine flow (V) = 1,5ml/min

Since the urine flow is less than 2.0ml/min, the formula of “standard” urea clearance is

$$= \frac{U \times V}{B} \times 100$$

Since the urine flow is more than 2.0ml/min, the formula of “maximum” urea clearance is

$$= \frac{U \times V}{P}, \text{ where P is concentration of inulin in plasma}$$

Data

Concentration of urea in urine (U) = 40 mg/ml

Concentration of inulin in plasma (P) = 0,24 mg/ml

Rate of urine flow (V) = 3ml/min

NB: The value for maximum clearance is 65-100ml/min; while the normal value for standard clearance is 40-65ml/min

TASK 2. Write an explanation for clinical tasks

1. The oncotic blood pressure increases. How will the urine formation change?

2. The patient suffers from primary aldosteronism. It means that secretion of aldosteron is increased. It usually caused by the tumor of adrenal cortex. How will the concentration of renin in plasma change?

TASK3. The analysis of kidney I function by test of Zemnckii:

The urine of the patient was taken during the day

Daytime diuresis

test	time	Amount of the	Specific gravity
------	------	---------------	------------------

		urine	
1.	6-9 a.m	270 ml	1012
2.	9-12 a.m	220 ml	1014
3.	12-15 p.m	210 ml	1016
4.	15-18 p.m	200 ml	1013
General amount of urine:			

Nighttime diuresis

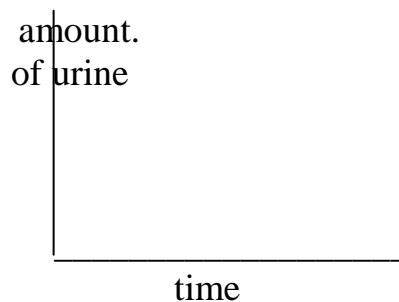
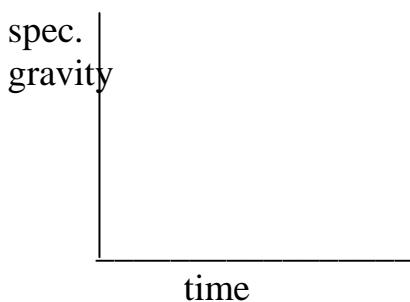
test	time	Amount of the urine	Specific gravity
5.	18-21 p.m	180 ml	1017
6.	21-24 p.m	120 ml	1027
7.	24-3 a.m	180 ml	1014
8.	3-6 a.m	120 ml	1024
General amount of urine:			

NB: The daily diuresis is bigger than nightly in healthy person.

Draw graphs (diagrams) of change in specific gravity, amount of the urine during day. Write an explanation for these diagrams.

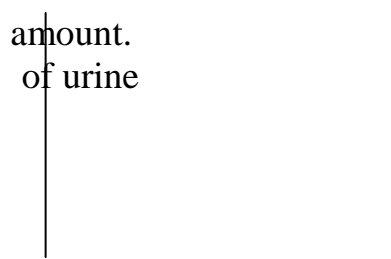
Daily diuresis

Nightly diuresis



Nightly diuresis

Daily diuresis



time

time

TASK 4. Put information about mechanism of kidney reabsorption in this table.

#	Substances	Site of reabsorption ... and ...about mechanism
1.	Sodium	
2.	Water	
3.	Glucose	
4.	Amino acids	
5.	Bicarbonates	

TASK 5. Put information about functions of nerves supplying urinary bladder and sphincters in this table.

nerve	On detrusor muscle	On internal sphincter	On external sphincter
Sympathetic nerve			
Parasympathetic nerve			
Somatic nerve			

TASK 6. Draw the scheme of Micturition reflex.

HE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 38

Theme: Physiology of human's ontogenesis

THE GOALS OF OCCUPATION:

Learn ages peculiarities of ontogenetic periods of people's progress. Learn the progress of reproductive organs and reproductive functions of masculine and female organism. Analyse the indexes of hormonal changes in reproductive period of progress. Learn the mechanisms of biological aging

Initial level of the knowledge

1. The notion of ontogenesis.
2. Sexual glands and its structure.
3. Hormonal regulation of functional activity of sexual glands.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. The ontogenetic periods of people's life.
2. Functions of sexual system, genetic determination of sex.
3. Sexual differentiation of masculine and female organism.
4. Hormonal regulation of masculine sexual functions.
5. Hormonal regulation of female sexual functions.
6. Sexual masculine pubescence.
7. Sexual female pubescence.
8. Extinction of reproductive masculine functions.
9. Extinction of reproductive female functions.
10. Pregnancy, childbirth.
11. Physiological mechanisms of aging.

INDEPENDENT PRACTICAL WORK

TASK1. Make a table: «Changing the weight and growth in children».

Age	Weight (kg)	Growth (sm)
New-borns		
1 month		
2 months		
3 months		
4 months		
5 months		
6 months		
1 years		
7 years		
12 years		
16 years		
20 years		
40 years		
60 years		
80 years		
100 years		
Grown - ups		

TASK2. Make the table: «The age changes of vision's sharpness at children and grow-ups».

The age	The vision's sharpness
1 week	
1 month	
3 months	
6 months	
1 year	
3year	
5 years	
8-15 years	
25 years	
45 years	
65 years and older	

TASK 3 .Write recommendations for preservation of active longevity of the person.

THE CONTROL OF THE LAST LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 39

Theme : Module control 1. Control of Practical Tasks

PRACTICAL LESSON 40

Theme : Module control 1. Tests Control.