MEDICAL BIOLOGY

Training text-book for the self-dependent work of students of medical and stomatological departments

Module 1. Biological peculiarities of the human vital functions

Poltava-2012
1. One of the basic properties of living organisms is ability for reproduction. What of the following level of organization of living organisms is carried out of this process on the basis of matrix synthesis?
   A. Organismic
   B. Subcellular
   C. Cellular
   D. Tissue
   E. Molecular

2. Existence of life on all levels is determined the structure of lower level. What level of organization existence of life is preceded and provides on cellular level:
   A. Molecular
   B. Tissue
   C. Organismic
   D. Population-species
   E. Biocenotic

3. To the light part of microscope belong:
   A. Mirror
   B. Revolver
   C. Base
   D. Arm
   E. Ocular

4. To the optic of microscope belong:
   A. Objective
   B. Micrometer screw
   C. Mirror
   D. Base
   E. Macrometer screw

5. To the mechanic part of microscope belong:
   A. Tube
   B. Condensor
   C. Ocular
   D. Mirror
   E. Objective

6. Immersion is used for increase:
   A. x 7
   B. x 10
   C. x 40
   D. x 20
   E. x 90.

7. Which process takes place at lowering of condenser of light microscope:
   A. Illumination of eyeshot diminishes
   B. Illumination of eyeshot is increased
   C. Focus is changed
   D. The image of object becomes more clear
   E. The contrasty of image of object diminishes

8. What function of micrometer screw:
   A. Exact focus of object's image
   B. Diminishing of eyeshot
   C. Improvement of light of eyeshot
   D. Focusing of image
   E. Increased image

9. Part of eyeshot of microscope is lighted up well and part is black-out:
   A. Dirty lenses of objective
   B. Dirty lenses of ocular
   C. Dirty glass
   D. Objective did not occupy the fixed position in the revolver disk
   E. Dirty covering glass

10. Image of object on a microslide is visible on small increasing but does not on large increasing of microscope because:
    A. Dirty covering glass
    B. Covering glass lies under the microslide
    C. Dirty lenses of ocular
    D. Objective is out of plane of image focus
    E. Insufficient light of object

11. Define property of life which provides heredity between parents and descendants:
    A. Self-regeneration
    B. Self-regulation
    C. Self-reproduction
    D. Development
    E. Growth

12. What factors conditioned appearance of independent systematic unit of Homo Sapiens in the process of evolution?
    A. Social
    B. Biological
    C. Anthropogenic
    D. Physical
    E. Chemical

13. Choose the wrong answer:
    A. Organism is the opened biological system
    B. Multicellular organism is not simply sum of cells in the «cellular state»
    C. Organism is a self-regulation system
    D. Organism is not self-regulation system
    E. Organism is opened self-regeneration and self-reproductive system.

14. Choose the correct answer:
A. Cell is an elementary unit of structure and development of organisms
B. Cell is able to develop
C. Cell is an elementary open biological system which is able to self-regeneration and development
D. Cell is an elementary open biological system which is able to self-regeneration and self-regulation
E. Cell is an elementary open biological system which is able to self-regeneration and self-regulation

15. What level of organization is fundamental and determines the typical metabolism?
   A. Organismic
   B. Subcellular
   C. Cellular
   D. Tissue
   E. Molecular-genetic

16. Chromosome of prokaryotes is circular molecular of DNA. Name the level of organization of hereditary material:
   A. Chromosomal
   B. Microfibre
   C. Molecular
   D. Nucleosome
   E. Tissue

17. One of fundamental level is organismic. On this level genotype is determined by ontogenesis of organism, its phenotype, adaptation and behavior in the environment. What ecological problems do arise up for a man on this level?
   A. Increase of amount of population
   B. Development of border states
   C. Increase of agriculture cenosis
   D. Pollution of environment
   E. Destruction of ozone layer

18. Organisms which do not have membranous organelles and their genetic material does not have nucleosome organization belong to the group:
   A. Ascomycota
   B. Viruses
   C. Eukaryotes
   D. Prokaryotes
   E. Protozoa

19. Wild-life is characterized by evolutionally conditioned structural levels of organization. Which level of genotype is determined by the typical for an organism metabolism and energy:
   A. Molecular-genetics
   B. Organs
   C. Organismic
   D. Cellular
   E. Tissue

2nd level tests
(some correct answers)

1. **Name the level of organization of the living systems on which a genotype is determined by the typical cellular metabolism:**
   1. Molecular-genetics
   2. Organismic
   3. Cellular
   4. Population-species
   5. Subcellular
   6. Biosphere

2. **Name the fundamental level of life organization:**
   1. Ontogenetics
   2. Subcellular
   3. Cellular
   4. Molecular-genetics
   5. Population-species

3. **Name the level of life organization where genotype determines ontogenesis:**
   1. Population-species
   2. Molecular-genetics
   3. Cellular
   4. Organismic
   5. Subcellular
   6. Biosphere
4. Fundamental properties of a cell as an open biosystem are:
   1. Self-correction
   2. Self-regulation
   3. Self-reproduction
   4. Self-providing

5. Cell or an organism have such properties as an open alive system:
   1. Metabolism
   2. Variation
   3. Ontogenesis
   4. Discreteunit

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**Practical class No 2 (2)**

**TOPIC:** Cell morphophysiology. Structural component of cytoplasm.

**1st level tests**

(one correct answer)

1. There is an organelle in cell. The function is: lysosome formation, polysaccharide synthesis, lipid synthesis and other. Name this organelle.
   A. Lysosome
   B. ER
   C. Complex Golgi
   D. Peroxisome
   E. Rybosome

2. Child has a dyspepsia caused by dehydration of organism. What solution is needed to renew osmotic pressure of circulatory blood?
   A. Isotonic solution NaCl
   B. Hypotonic solution
   C. Hypertensive solution
   D. Salt solution
   E. 1% solution of glucose

3. Glass-shaped cells inside the epithelium of mucous membrane of intestine and respiratory tracts excrete the glycoprotein mucin which forms mucus in solution. What organoid secretes the mucus?
   A. ER
   B. Lysosome
   C. Golgi complex
   D. Rybosome
   E. Cell centre

4. In the cells of frog experimentally destroyed the system of microtubules, located in a cytoplasm. Cells became sphere-shaped. What function of microtubules?
   A. Modify products which are coming to the cell
   B. Forming of secondary protein structure
   C. Forming of cytoskeleton
   D. Secretion of steroid hormones
   E. Detoxication of products

5. The main function of hepatocyte is detoxication. The organelle performs this function is:
   A. Mitochondria
   B. Centrosome
   C. Nucleus
   D. ER
   E. Rybosome

6. Oval-shaped structure and two membranes with cristae has:
   A. Lysosome
   B. Rybosome
   C. Mitochondria
   D. Centrosome
   E. ER

7. In the cells of muscles tissue there is an intensive aerobic process of forming and accumulation of ATP energy. In what organoid of cells take place these processes?
   A. Peroxisome
   B. ER
   C. Lysosome
   D. Mitochondria
   E. Cell centre

8. The virus of flu got into the cell. The mechanism of biosynthesis of protein reorganized abnormally and afterwards the synthesis of viral protein began to carried out:
   A. On polyribosomes
   B. In nucleus
   C. In lysosome
   D. In peroxisome
   E. In cell centre

9. One-membranous organelle contains enzymes and provides intracellular digestion. Name this organelle.
   A. ER
   B. Lysosome
   C. Golgi complex
   D. Rybosome
   E. Mitochondria

10. The 40-years man has a wound after pulling out of tooth where the active process of regeneration takes place. Define the organelle performs this process immediately:
    A. Rybosome
    B. Lysosome
    C. ER
    D. Centrosome
    E. Mitochondria
11. One-membranous circle-shaped organelle has a size 0,2-1 mkm and contains enzymes. The forming of this organelle connected with Golgi complex. Name this organelle:
   A. Centrosome
   B. Rybosome
   C. Plastids
   D. Mitochondria
   E. Lysosome

12. Circle-shaped organelle (one-membranous) with hydrolytic enzymes has a name:
   A. Centrosome
   B. Lysosome
   C. ER
   D. Complex Golgi
   E. Rybosome

13. In one of organoids there are processes of protein construction and complexing of protein with carbohydratess, fats take place. Name this organoid:
   A. Golgi complex
   B. ER
   C. Lysosome
   D. Rybosome
   E. Mitochondria

14. What organic matters are synthesized on the membranes of granular ER?
   A. Nucleic acids
   B. Protein
   C. Carbohydrate
   D. Lipids
   E. ATP

15. Which organelle completes digestion of bacteria:
   A. Lytsosome
   B. Mitochondria
   C. Granular ER
   D. Golgi complex
   E. Rybosome

16. In all kind of cells there are non-membranous organoids which consist of two different particles. They have microscopic sizes and take part in the process of protein synthesis. Name this organelle:
   A. Rybosome
   B. Lysosome
   C. Complex Golgi
   D. Cell centre
   E. Mitochondria

17. During the study of pancreas cells by an electronic microscope some organelle was found out which consists of plenty ductings, cisterns and connected with plasmalemma:
   A. Centrosome
   B. Mitochondria
   C. ER
   D. Lysosome

18. Near the nucleus some organelle was found out which consists of two cylinders and formed microtubules and located perpendicularly. There was determines that this organelle is a constituent of mitotical spindle of division in animal cells. The name of this organelle is:
   A. Mitochondria
   B. Rybosome
   C. ER
   D. Centrosome
   E. Lysosome

19. There are inconstant structures in nucleus which disappear at the beginning of cell division and afterwards again appear. They contain protein, RNA and take part in forming of subunits of ribosomes. How are such structures called?
   A. Nucleolus
   B. Nucleosome
   C. Polysome
   D. Microfilaments
   E. Microtubules

20. Sick person has a pancreatytis. This disease can be reason of autolysis of pancreas caused by function of:
   A. Lysosome
   B. Mitochondria
   C. Rybosome
   D. ER
   E. Microvilli

21. In animal cell found two-membranous organelle which has molecules of DNA and ribosome. What is the basic function of this organelle:
   A. Synthesis of protein
   B. Synthesis of ATP
   C. Transport and modification of protein
   D. Synthesis of cytoplasm protein
   E. Formation of rybosome

22. Forming of subunits of ribosomes is broken experimentally (by the action of mutagene factors). What metabolic process will be destroy?
   A. Synthesis of ATP
   B. Biosynthesis of carbohydrates
   C. Photosynthesis
   D. Cell division
   E. Synthesis of protein

23. There are membranous organelles in eukaryotes cell which appear in complex Golgi and have enzymes for destruction of H2O2. What function of this organelle?
   A. Formation of ATP
   B. Synthesis of polypeptide
   C. Breaking up of protein
   D. Synthesis of carbohydrates
   E. Oxidation of lipids
24. Mitochondria is semiautonomous organelle, matrix has 2-6 own rings of DNA, ribosomes, RNA, enzymes of replication, transcription and translation? Where the information about the primary structure of most mitochondria protein is coded the coded albumens?

A. DNA of cytoplasm  
B. DNA of sexual chromosomes  
C. RNA of matrix  
D. DNA of mitochondria  
E. RNA of chromosomes

25. Two types of cells appeared in the process of evolution: prokaryotes and eukaryotes. Which kinds of organelles are peculiar to the both types:

A. Lysosome  
B. ER  
C. Mitochondria  
D. Ribosome  
E. Golgi complex

26. ER is represented by smooth and rough systems which are functionally different. Protein and lipid synthesis are taking place:

A. In Golgi complex  
B. In smooth ER  
C. In rough ER  
D. In smooth and rough ER  
E. In ribosomes

27. Animal cells are able to the active movement. What structures provide such peculiarity:

A. Actin microfilaments  
B. Microtubules  
C. Intermediate microfilaments

28. Cell come under ionizing radiation influence at deficite of vitamin E. It favour the increased output of enzyme hydrolases to the cytoplasm and resulted is complete destruction of intracellular structures. What organoids are richer of hydrolases and can be reason of autolysis?

A. Lysosome  
B. ER  
C. Golgi complex  
D. Microtubules  
E. Mitochondria

29. Rybosomes have 4 active centre, 3 in each subunits: M-centre (connection with mRNA), A-centre (aminoacids centre), P-centre (peptide centre), PTF-centre (peptidyl transferase centre). Define centre of formation of peptide connection?

A. A-centre  
B. M-centre  
C. P-centre  
D. PTF-centre  
E. P-+A-centre

30. Detoxication of harmful matters takes place in hepatocytes which come with the blood to the liver. What organoid provides detoxication of matters in hepatocytes:

A. Rough ER  
B. Peroxisome  
C. Mitochondria  
D. Lysosome  
E. Golgi complex

Tests of second levels
(several correct answers)

1. Choose structures and matters of ribosomes:
   1. DNA+protein  
   2. rRNA+protein  
   3. small subunit + big subunit  
   4. small subunit + big subunit+mRNA  
   5. Phosphoric acid

2. DNA is located:
   1. In nucleus  
   2. In mitochondria and plastids  
   3. In vacuoles  
   4. In ribosome  
   5. In cytoplasm  
   6. In cell centre  
   7. In chromosomes

3. Name membranous organoids:
   1. Cell membrane  
   2. Centriole  
   3. Complex Golgi

4. Lysosome provides:
   1. Protein processing  
   2. Secretion  
   4. Cyclosis
5. Accumulation of waste products.

5. **Non-membranous organelles are:**
   1. Vacuoles
   2. Cell centre
   3. ER
   4. Rybosome
   5. Microtubules and microvilli
   6. Chromosomes
   7. Flagela, cilia

6. **Two-membranous organelles are:**
   1. Mitochondria
   2. Cell centre
   3. ER
   4. Rybosome
   5. Microvilli and microtubules
   6. Chloroplasts
   7. Nucleus

7. The man has a wound with pus. Which organelles provide process of healing?
   1. Lysosome
   2. Golgi complex
   3. Ribosome
   4. Nucleus
   5. ER

8. Preparation has taken on cell which caused destruction of mitochondria. What processes will be broken?
   1. Lipid synthesis
   2. Glycolysis
   3. Spindle formation
   4. Providing of energy
   5. Protein synthesis

9. Preparation has taken on cell which caused destruction of cell centre. What processes will be broken? Which organelles will be formed?
   1. Centrioles
   2. Protein synthesis
   3. Mitosis and spindle formation
   4. Chromosomes will not move apart
   5. Microfilaments and microtubules
10. What organelles of cytoplasm contain DNA?
1. Ribosomes
2. Mitochondria
3. Chromosomes
4. Chromatin
5. Peroxisome
6. Chloroplasts

Practical class № 3 (3).
TOPIC: Cell membrane. Transport through the plasmalemma.
1st level tests
(one correct answer)

1. Cytoplasmic membrane contains glycolipids and glycoproteins. On the membrane surface they are forming:
   A. Receptors
   B. Glycocalix
   C. Protective layer
   D. Ion channels
   E. Antigens

2. On the membranes of cells are located alarm molecules – protein-receptors. They connected molecules and initiates response. Receptors which perceive hormones or neuromediators:
   A. Slow the transport of substances
   B. Stir to activity the pinocytosis
   C. Enhance of active diffusion
   D. Promote formation of the open channels in membranes
   E. Enhance passive diffusion

3. To the patient wrote a prescription with the expressed lipophilic properties. What is the main mechanism of its suction:
   A. Active transport
   B. Connection with transport proteins
   C. Filtration
   D. Passive diffusion
   E. Pinocytosis

4. During microscopy of blood smear some kinds of macrophages surround by the foreign substances have found out. Name this stage of phagocytosis:
   A. Incomplete phagocytosis
   B. Approach process
   C. Intracellular digestioin
   D. Adhesion
   E. Immersion

5. Which kind of organelle provide destruction of substances which have taken up by the neutrophil?
   A. Golgi complex
   B. Peroxisome
   C. Lysosome
   D. ER
   E. Mitochondria

6. Acetylcholin stimulates contraction of skeleton muscles but decreases power of heart muscles. Why this substance caused different effects in cells:
   A. Because of different organization of cytoplasm
   B. Different effected caused by differences of cell receptors
   C. Peculiarities of cell movement
   D. Different organization of cell membrane
   E. This peculiarity defines numbers of cell receptors

7. Transport of glucose takes place without energy consumption but with the carriers of integral protein. Such mechanism has a name:
   A. Simple diffusion
   B. Active transport
   C. Osmosis
   D. Phagocytosis
   E. Endocytosis

8. Cell as opened biosystem is characterized by:
   A. Self-regulation
   B. Metabolism
   C. Presence of holes
   D. Presence of cell receptors
   E. Exocytosis

9. Substances absorb by means of channels which spread from the external membrane into the cytoplasm. This process has a name:
   A. Osmosis
   B. Endocytosis
   C. Phagocytosis
10. Organization of biological information flow goes in the direction:
A. DNA → RNA → tRNA ↔ protein
B. RNA ↔ DNA
C. RNA → protein
D. DNA → RNA ↔ tRNA → protein
E. DNA ↔ RNA → tRNA → protein

1. An action of electromagnetic radiation on epithelial cells of intestine and kidney has studied in laboratory. Which state of the cell is more sensible to destructive factor:
   A. Mitosis
   B. Phagocytosis
   C. Excretion
   D. Pinocytosis
   E. Endocytosis

2. Which substance can destroy the spindle in the process of mitosis (metaphase stage):
   A. Clochicine
   B. Iodine
   C. Methanol
   D. KCl
   E. Ethanol

3. After karyotyping of a healthy man some small acrocentric chromosome has found. What is the chromosome:
   4. Y - chromosome
   5. X – chromosome
   6. Chromosome group A
   7. Chromosome group B
   8. Chromosome group C?

5. How many homologous chromosomes pairs are there in normal 2n somatic cell:
   A. 22 pairs
   B. 23 pairs
   C. 24 pairs
   D. 46 pairs
   E. 44 pairs

6. 14-years girl has a Turner syndrome (absence of one sexual chromosome). Her karyotype is:
   A. 45, XO
   B. 46, XX
   C. 47, XXY
   D. 46, XY
   E. 47, trisomy of 13 pair

7. Name the chromosome which has centromere with almost two equal arms:
   A. Telocentric
   B. Subcentric

8. Man sexual chromosome are taking:
   A. From group A
   B. From group C
   C. From group D
   D. From group F
   E. From group G

9. Number of chromosome in human karyotype is 46. This amount was detected due to work of:
   A. Barr
   B. Navashyn
   C. Levitsky
   D. Patau
   E. Tiyo and Levan

10. X-chromosome is placed:
    A. In group C
    B. In group A
    C. In group D
    D. In group G
    E. In group F

11. Which mechanism provides human karyotype saving in generation of somatic cells:
    A. Endomitosis
    B. Meiosis
    C. Mitosis
    D. Fertilization
    E. Meiosis+fertilization

12. Which mechanism provides human karyotype saving in generation of sexual reproduction:
    A. Endomitosis
    B. Meiosis
    C. Mitosis
    D. Fertilization
    E. Meiosis+fertilization

12. Number of chromosomes in human somatic cells is:
   A. 48
13. Y-chromosome belongs to:
A. Metacentric  B. Submetacentric  C. Acrocentric  D. Telocentric  E. Satellite

14. How many groups are taking from the human karyotype:
A. 4  B. 6  C. 7  D. 5  E. 10

15. Karyotyping in practical medicine is using for the:
A. Definition of human sex  B. Diagnostics of chromosomal diseases  C. Definition of blood groups  D. Diagnostics of molecular diseases  E. Definition of type of inheritance

16. There are two bodies of sexual chromatin in epithelium of buccal smear of some women. What is set of her sexual chromosomes:
A. Two  B. Three  C. One  D. Four  E. Five

17. Karyotype of healthy man contains 46 chromosomes. How many autosomes do somatic cells have:
A. 23  B. 22  C. 44  D. 46  E. 92

18. On the basis of some classification by a convention of experts held at Denver, Colorado in 1960. What the principle of Denver system:
A. Classification base on presence of satellite in chromosomes  B. Classification base on size and form of chromosomes  C. Classification base on painting of chromosomes  D. Classification base on telomere localization  E. Classification base on number of chromosomes

19. Metaphase plate has a chromosome with centromere index 0,21-0,23 (21-23%). This chromosome belongs:
A. To the group A, submetacentric  B. To the group G, acrocentric  C. To the group В, acrocentric  D. To the group C, metacentric  E. To the group G, telocentric

20. After staining of amniotic liquid with fluorescent dyes some small colon-shaped body was found. Possible karyotype of fetus is:
A. 46. XY  B. 47. XXX  C. 46. YY  D. 47. XXX  E. 46. XX

2nd level tests
(some correct answers)

1. Interphase nucleus has:

2. Which processes and structures will break after distraction of protein tubulin:
   4. Chromosome and division process  5. Ribosome and protein synthesis

3. Some physical agents can disturb the cell centre. What processes and structure are involved in this process:
   1. Centrioles  2. Protein synthesis  3. Mitosis and spindle formation
   4. Diversion of chromosomes  5. Flagella and microfilaments

4. Homologous chromosomes are characterized by:
   1. The same form and size  2. Moving to the one pole  3. Conjugate during meiosis
   4. Contain the same groups of linked genes
   5. Moving to the different poles  6. Can have different poles and different linked group

5. Chromosome of bacteria has organized as:
   1. Nucleosome  2. Double strands of DNA
   3. Double strands of DNA+RNA  4. DNA+histone
5. One myofibril

6. On this stage are studying of human karyotype:
   1. Prophase
   2. Anaphase
   3. Metaphase
   4. Telophase
   5. Prometaphase

7. Call the levels of organization of eukaryotic cell:
   1. Polynucleotide DNA chain
   2. Double DNA chain
   3. Nucleosome thread
   4. Chromatin fibre
   5. Prophase chromatin
   6. Interphase chromonema

8. Interphase chromosome contains:
   1. Sugar, phosphate group, nitrogenous base
   2. Histone proteins
   3. DNA
   4. Nucleosome

9. Sexual chromosomes belong to the group:
   1. A
   2. C
   3. D
   4. G
   5. F
   6. E

10. Chromosome of eukaryotic cells has such levels of organization:
    1. Polynucleotide DNA chain
    2. Double DNA chain
    3. Nucleosome
    4. Chromatin fibre
    5. Prophase chromatin
    6. Interphase chromonema

11. Human karyotype contains:
    1. Telocentric chromosome
    2. Acrocentric chromosome
    3. Metacentric chromosome
    4. Satellite
    5. Submetacentric chromosome

12. Human karyotype is characterized by:
    1. Diploid number of chromosomes
    2. $44A + 2G$
    3. Forms of chromosomes only submetacentric
    4. 46 chromosomes + 2 sexual chromosomes
    5. Chromosomes meta- and submetacentric
    6. Specific by the forms and size

13. Ideogram of human karyotype is proposed by:
    1. Denver
    2. Navashyn
    3. Levitsky
    4. Patau
    5. Casperson
    6. Tio and Levan

14. Eukaryotic cell chromosome during interphase has special levels of organization of tightly coiled DNA (packing):
    1. Polynucleotide DNA chain
    2. Double DNA
    3. Nucleosome thread
    4. Chromatin fibre
    5. Interphase chromatid

15. At what mitosis stage is karyotype usually defined:
    1. Prophase
    2. Anaphase
    3. Metaphase
    4. Telophase
    5. Interphase

16. Metacentric chromosomes are present in group:
    1. A
    2. C
    3. D
    4. G
    5. F
    6. E

17. Normally human sexual chromosomes are:
    1. Telocentric
    2. Acrocentric
    3. Metacentric
    4. Satellite
    5. Submetacentric

18. Euchromatin has such levels of packing as:
    1. DNA chain
    2. Double DNA chain
    3. Nucleosome thread
    4. Chromatin fibre
    5. Interphase chromatid
20. Secondary and tertiary structures of chromosomes define:
1. Polynucleotide DNA chain
2. Double DNA chain
3. Nucleosome thread
4. Chromatin fibre
5. Interphase chromatide

Practical class № 5 (5)

**TOPIC:** Molecular basis of heredity. Characteristics of nucleic acids.

1st level tests
(one correct answer)

1. Among the organic matters of cells some polymer found out which consists of 10 thousand monomers. This molecule is able to be a carrier of genetic information. By X-ray analysis is discovered that molecule consists of two spiral threads. Name this organic compound:
   A. rRNA
   B. DNA
   C. Hemoglobin
   D. Insulin
   E. Cellulose

2. The DNA daughter's spirals are formed as a result of replication and consist of one maternal chain and one daughter. Such method of replication is named:
   A. Conservative
   B. Analogous
   C. Identical
   D. Disperse
   E. Semiconservative

3. During DNA replication there can be substituting of one basis by other that can result in appearance of one nonsense triplets. As a result of such replacement will be:
   A. Doubling of basis in synthesized DNA chain
   B. Stop of polypeptide chain synthesis
   C. Loosing of nitrogenous base
   D. Enhance of polypeptide synthesis
   E. Inversion of nucleotide

4. Damage of structural gene – area of DNA molecule took place. But replacement of amino acid did not happen because afterwards damage was liquidated. What process liquidated mutation:
   A. Translation
   B. Transcription
   C. Reparation
   D. Opposite transcription
   E. Replication

5. In the cell of man the damage of DNA molecule took place caused by the action of ultraviolet. What system will provide proceeding in the damaged area by specific enzyme on unharmed chain:
   A. Termination

6. It is known that the sequence of placing of nucleotides in DNA and i-RNA determines the proper sequence of including of amino acid in a polypeptide chain. This accordance of sequence of nucleotides with the sequence of amino acid has the name:
   A. Gene
   B. Triplet nature
   C. Universality
   D. Replication
   E. Genetic code

7. In the cells of man constantly there are processes of maintainance, self-reproduction and genetic information transfer. Leading role belongs in these processes:
   A. Nucleic acids
   B. Polypeptide
   C. Lipids
   D. Carbohydrates
   E. Proteins

8. In an experiment artificially stopped conjugation of E.coli through certain spans of time. Knowing what genes for this time passed to the recipient cell it is possible to define:
   A. Order of genes in bacterial chromosome
   B. Speed of replication
   C. Nucleotides of DNA
   D. Frequency of mutant genes
   E. Presence of gene-regulator

9. What organic compounds carry out the role of mediators between the molecules of DNA as the carriers of genetic information and polypeptide chains as elementary features:
   A. RNA
   B. Carbohydrates
   C. Lipids
   D. Protein
   E. ATP

10. Through the human organism the flow of matters, energy and information passes constantly. “Reading” and realization of genetic information at development of the dental
system on molecular level is connected with properties of:
A. Nucleic acids
B. Carbohydrates
C. Lipids
D. Aminoacids
E. Mineral matters

11. During replication with certain frequency there are spontaneous errors can happen. For example, changed cytosin joins to adenin. As a result there is replacement of nucleotides pair. The mechanism of self-correction is working in such cases. What enzyme provides the self-correction of DNA:
A. DNA-polymerase
B. Ligase
C. Reparation enzymes
D. DNA-polymerase
E. DNA-glycolasi

12. Under the action of ultraviolet in the DNA molecule appears double thymine (T=T). All the same changes of DNA will bring to the deletion in next replication or to replacement of nucleotides pair in DNA molecule. What reparation provides proceeding of DNA molecule:
A. Before-replication reparation
B. Dark reparation
C. Postreplication reparation
D. Light reparation
E. SOS-reparation

13. Prokaryotes and eukaryotes cells characterized by reproduction. Molecular mechanism of reproduction base on:
A. Reparation
B. Transcription
C. Replication
D. Karyokinesis
E. Genes amplification

14. Molecular of mRNA is connected with protein and forms informosomes. This structure has a function:
A. Provides connection with ribosomes
B. Makes stability of mRNA linear structure
C. Provides forming of mRNA tertiary structure
D. Destroy of mRNA
E. mRNA stored

15. DNA molecular has different space forms depended on environment. Bacteria takes on special form during the spore formation in dehydrate cell surrounding:
A. Z-form
B. D-form
C. A-form
D. B-form
E. C-from

16. Stress arises as a result of DNA replication in a spiral. Name enzymes which remove DNA stress:
A. DNA-topoisomerase
B. DNA-polymerase
C. RNA-primase
D. DNA-helicase
E. DNA-ligase

17. For the treatment of bacteriosis are using medicines which break replication of bacteria cells. Replication enzyme represses medicine is:
A. DNA-gyrase
B. DNA-ligase
C. RNA-primase
D. DNA-polymerase
E. DNA-helicase

18. mRNA contains information and non-information parts. 5'-end has a CAP, 3'-polyadenil fragment (poly-A). The function of this parts in mRNA is:
A. Attach to the ribosome
B. Transport through the nuclear pores
C. Connection with rRNA ribosomes
D. Protect mRNA against fission
E. Define mRNA space structure

19. DNA has different forms. In replication process DNA takes on:
A. B form
B. A form
C. C form
D. D form
E. Z form

20. Bacteria in conjugation process forms cytoplasm bridge where from the cell-donor to recipient cell is moving DNA fragment (plasmids). The meaning of this process is:
A. Deletes mutation
B. Provides metabolism
C. Activation of mutation process
D. Provides exchange and recombination of genetic materials
E. Increase heterozygous genes

21. Ultraviolet rays break integrity of molecules DNA that cause formation of pyrimidine dymers (reason of mutations). Why radiation-exposed cells survive in light more better than in darkness:
A. Photoreparation takes place
B. Activation of mitosis
C. Recombinative reparation takes place
D. Activation of DNA-polymerase
E. Another kinds of reparations take place

22. DNA molecular has different space forms depended on environment. On replication process DNA takes on this form:
A. A
B. B
C. C
D. D
E. Z

23. Genome of eukaryotes cell has a large amount of replication points therefore replication goes in both directions. The meaning of this process is:
A. S-period shortening  
B. Less waste of energy  
C. More strict replication  
D. Reparation improves  
E. Less mutation arising

24. Which group of organisms have circle-shaped form but have not histones:

A. Viruses  
B. Bacteria  
C. Protozoa  
D. Fungi  
E. Bacteriophage

2nd levels tests (several correct answers)

1. One nucleotide consists of:
   1. Pentose, phosphate group, nitrogenous base
   2. Hexose, phosphate group, nitrogenous base
   3. Amino acids, phosphate group, thymine
   4. Nitrogenous base and uracil
   5. Tetrose, phosphate group, adenine

2. DNA consists of:
   1. Nucleoside+phosphate group
   2. Purine bases
   3. Pyrimidine bases
   4. Adenine, thymine, guanine, uracil

3. Which enzymes take part in replication process:
   1. RNA-primase
   2. DNA-polymerase
   3. RNA_polymerase
   4. DNA-ligase

4. RNA molecule has:
   1. Nucleoside+phosphate acid
   2. Purine base
   3. Pyrimidine base
   4. Adenine, thymine, guanine, uracil

5. Primary and secondary structures of DNA are:

6. Self-correction of DNA provide:

7. Name the processes had discovered genetic role of nucleic acids:

8. Replication is characterized by:

9. Reparation process includes enzymes:

10. Which cytoplasm organelles of eukaryotes cell contains DNA:
7. Ribosome
8. Mitochondria
9. Chromosomes
10. Chromatin
11. Peroxisome
12. Chloroplasts

11. RNA functions are:
1. Ability of replication
2. Transfer of genetics information
3. Provides hereditary information realization

12. Biopolymers are:
1. Myoglobin
2. DNA
3. tRNA
4. ATP
5. Insulin

13. Some physical factors provoke destruction in the DNA-topoisomerase structure. Which processes will disturb:
1. Structure and movement of cytoplasm
2. DNA synthesis
3. Cell centre and spindle formation
4. Mitosis
5. Ribosome and protein synthesis
6. Replication

14. iRNA functions are:
1. Ability for replication
2. Self-correction
3. Provides realization of hereditary information
4. Provides translation
5. Ability for gene mutations forming
6. Regulation intracellular processes

15. Nucleotide of rRNA consists of:
1. Ribose, phosphate group, nitrogenous bases
2. Ribose, phosphate group
3. Ribose, phosphate group, pseudouracil
4. Adenine, guanine, cytosine, pseudouracil
5. Adenine, guanine, cytosine, thymine

16. tRNA consists of:
1. Nucleoside+phosphate group
2. Purine bases
3. Pyrimidine bases
4. Adenine, guanine, cytosine, thymine
5. Adenine, guanine, cytosine, uracil
6. Guanine, cytosine, thymine,
7. Nitrogenous bases + ribose + phosphate group.

**TASKS**

1. One DNA chain has such nucleotide sequence: ATG-ACC-GAC-ACG-CAC-GTA-CCT-GCA-TAC-GG-TCA-GTT-TGC ...... Determine second DNA chain.
2. DNA fragment contains 1120 adenyl nucleotide that consists of 28% of common quantity. How many guanil, cytidyl and thymidyl nucleotides are there in this fragment ? What length of this fragment ?
3. The chemical analysis shows that 26% of the common iRNA is the adenine, 6% - guanine, 40% - uracil. What nucleotide content does the corresponding region of double chain DNA has?
4. RNA has such nucleotide sequence: AAU-UUC-CCA-GGC-CCU-AGC. Determine the sequence of “right” non-coding DNA chain.
5. Part of right DNA chain has such structure: GGG-CAT-AAC-GCT-CCA-GTC-CCC. Determine:
   1) sequence of left chain
   2) length of this DNA region
   3) content of each nucleotide in this DNA fragment
5. In DNA molecular there is 30% deoxyadenosinmonophosphate. How many deoxyguaninmonophosphate are there in this fragment?
1. It is known that information about the sequence of amino acids in protein molecule it is written as a sequence of four types of nucleotides in the molecule of DNA, thus different amino acids are encoded by the different amount of triplets - from one to six. Such feature of genetic triplets is named:
   A. Degeneracy
   B. Non-overlapping
   C. Triplet nature
   D. Universality
   E. No punctuation

2. Eukaryotes have the sequences of nucleotides in the DNA molecule of DNA which increase speed of transcription. These activators of transcription are named:
   A. Exons
   B. Transposons
   C. Enhancer
   D. Introns
   E. Codons

3. At the study of features of genetic code students found out, that some amino acids correspond by 6 codons, 4 codons, 3 codons, 2 codons. What property of genetic code it is related to:
   A. Degeneracy
   B. Non-overlapping
   C. Triplet nature
   D. Universality
   E. No punctuation

4. It is known that information about the sequence of amino acids in protein molecule is written as a sequence of nucleotides in the molecule of DNA. There are many amino acids that are encoded by a few different triplets. Such property of genetic code is named:
   A. Degeneracy
   B. Non-overlapping
   C. Triplet nature
   D. Universality
   E. No punctuation

5. It is known that genetic code has triplet nature and degenerate characteristics. Replacement of what nucleotide in an encoding triplet can not disturb it content:
   A. Second
   B. First

6. Polypeptide synthesized on a ribosome consists of 54 amino acids. What amount of codon had mRNA which was a matrix during synthesis:
   A. 44
   B. 27
   C. 108
   D. 162
   E. 54.

7. Sequence of triplets of mRNA exactly answers to the sequence of amino acid in polypeptide chain. Such property of genetic code is named:
   A. Degeneracy
   B. Non-overlapping
   C. Triplet nature
   D. Universality
   E. No punctuation

8. During questioning of students from a theme "Molecular biology" the teachers asked: "Why genetic code is universal"? Correct must be an answer: "Because genetic code is..."
   A. Universal for all organisms
   B. Has information about protein structure
   C. Triplet nature
   D. Codes aminoacids
   E. Colinearity

9. It is discovered that not all point mutations like replacements of pair of nitrogenous bases cause replacement of amino acid in polypeptide. What property of genetic code is this:
   A. Degeneracy
   B. Non-overlapping
   C. Triplet nature
   D. Universality
   E. No punctuation

10. The various forms of life appeared in the process of evolution. What characteristic does explain unity of all living organisms:
   A. Genetic material of all living forms is DNA
   B. Identical enzyme complex
   C. Universal genetic code
   D. Identical organization of the inherited material
   E. Cellular organization of living organisms
11. In molecular biology use the method of determination of order of nucleotides location inside gene by means amino acid content. What property of genetic code is based on:
   A. Degeneracy  
   B. Non-overlapping  
   C. Triplet nature  
   D. Universality  
   E. No punctuation

12. One of main conditions of life there are permanent chemical transformations of substances - metabolism that is regulated by quantitative composition and activity of enzymes. What molecular structures control the synthesis of these proteins-enzymes:
   A. Structural gene  
   B. Gene-regulator  
   C. Gene clusters  
   D. Tandem genes  
   E. Satellite DNA genes

13. In the nucleolar organizers of human chromosomes 13-15, 21,22 there are about 200 cluster genes that synthesize RNA. What RNA synthesize these areas of chromosomes:
   A. tRNA  
   B. rRNA  
   C. mRNA  
   D. mnrNA  
   E. tRNA+rRNA

14. It is observed that the amino acid selenocystein goes in the proteins content, that associates with tRNA. Which codons of genetic code is used for insert of selenocystein in polypeptide:
   A. Any codon  
   B. Codon which codes cystein  
   C. Four-nucleotides codon  
   D. Stop-codon  
   E. Two codons together

14. Information from unit of transcription is read one-way from 5'-end to 3'-end. What is this determined:
   A. Promoter organization  
   B. Terminator  
   C. Enhancer  
   D. Silensor

15. Genes form clusters (5 genes of different histons which is divided by spacer areas, introns are absent) repeated many times, for example, in the genome of man - 35 times. Why such organization of histone genes is needed:
   A. For forming of nucleoli  
   B. For rapid formation of nucleosome  
   C. For the formation of nucleus membranes  
   D. For formation of subunits of ribosomes  
   E. For formation of apparatus of division

16. In a nucleolar organizer the genes of rRNA presented in great numbers. They form clusters and have many copies (for a man are approximately 100 copies). Why such organization of rRNA genes is needed for genome:
   A. For providing of replication  
   B. For rapid formation of subunits of ribosomes  
   C. For activating of genes in DNA  
   D. For the rapid synthesis of tubulin-proteins  
   E. For the rapid synthesis of proteins-histons

17. One of main conditions of life there are permanent chemical transformations of substances - metabolism that is regulated by quantitative composition and activity of enzymes. What molecular structures control the synthesis of these proteins-enzymes:
   A. Structural gene  
   B. Gene-regulator  
   C. Gene clusters  
   D. Tandem genes  
   E. Satellite DNA genes

18. During the regeneration of epithelium of mucous membrane of oral cavity the replication (autoreproduction) of DNA took place according to semiconservative mechanism. Nucleotides of new DNA strand are complementary to:
   A. Informational codons  
   B. Maternal strand  
   C. Introns  
   D. DNA-polymerase enzyme  
   E. RNA-polymerase enzyme

2nd level tests
(several correct answers)

1. Genetic code has characteristics:
   1. Universality  
   2. Colinearity  
   3. Specify  
   4. Self-regulation  
   5. Degeneracy  
   6. One aminoacids codes by one anticodon  
   7. Can be non-triplet  
   8. “Reading” from two DNA chain
1. Fragment of DNA
2. Material unit of life organization
3. DNA fragment which determine phenotype
4. DNA fragment provides polypeptide synthesis

3. Gene of prokaryotes – operon has:
   1. Nucleoside+phosphoric acids
   2. Promoter
   3. Acceptor locus
   4. Structural part

4. Determine the characteristics of genetic code which provide saving of genetic information:
   1. Universality
   2. Co-linearity
   3. Specify
   4. Complementary
   5. Degeneracy
   6. One aminoacids codes by one anticodon
   7. Triplet nature
   8. “Reading” from two DNA chain

5. Gen of eukaryote has:
   1. Exons+introns
   2. Promoter
   3. Acceptor locus
   4. Structural part
   5. Operator
   6. Regulator
   7. Terminator

6. What is the basic structural-functional differences of organization of eukaryotes genes from prokaryotes one:
   1. Exon-intron organization
   2. Polycistrons
   3. Monocistrons
   4. Regulation provide only protein-
   5. Operator
   6. Regulation is combinative
   7. Termination
   8. Can change activity during their life
   9. Alternative splicing is possible

Tasks
1. There are 800 aminoacids in protein content. What the length of gene that codes the protein synthesis?
2. Structural gene includes 990 nucleotides (one DNA chain) but 30% of this amount are intron. Determine number of aminoacids which code this gene.
3. Eukatyote gene (two DNA chains) contains 30000 nucleotides. Functional part -25%. Structural part – 40% (exons). How many aminoacids includes such protein coded by this gene?
4. Vasopressin (protein) consists of 9 aminoacids coded by: TGT-TAT-TTT-GAA-GAT-TGT-CCT-CGT-GGT. Determine:
   a) how many DNA nucleotides and triplets
   b) length of gene
   c) aminoacids content of vasopressin
5. Fragment of corticotrophin hormone has such structure: ser-tir-ser-meth-pro-ala-ileu. Determine tRNA anticodons.
6. What DNA molecule replacement has more influences: one nucleotide deficiency or whole nucleotide falling?
7. What the length of genes determining the normal hemoglobin molecule that consists of 287 aminoacids?
8. Protein chain has such nucleotide content: valine-leucine-histidine-serine-isoleucine-alanine-arginine-proline-tyrosine. Determine sequence of gene.
9. DNA codons which are coding valin: CAA, CAG, CAT, CAC. Determine mRNA codons.

Practical class № 7 (7)

TOPIC: Mechanism of regulation activity of genes in prokaryotes and eukaryotes.
Non-chromosomal (cytoplasmic) heredity. Gene engineering.
1st level tests
(one correct answer)

1. What functions of gene-regulator?
A. Control of protein-repressor
B. Coding of mRNA
C. Coding of tRNA
D. Termination of transcription
E. Termination of translation
2. Processing is “maturation” of mRNA. This process includes splicing. What process will be disturbed as a result of splicing disorders?
A. Formation of mutant mRNA
B. Degradation of mRNA
C. Genetic code does not change
D. Codon replacement
E. Nucleotides replacement
3. During biosynthesis of enzymes the main flow of information in cell will be:
A. tRNA-mRNA-DNA-polypeptide
B. mRNA-polypeptide-DNA
C. DNA-mRNA-polypeptide
D. DNA-polypeptide-mRNA
E. Polypeptide-mRNA-DNA
4. At the end of mRNA chain there is a “stop” fragment called:
A. Terminator
B. Promoter
C. Repressor
D. Operator
E. Regulator
5. According to the hypothesis of lactose operon (Jacob, Mono, 1961), in Escherichia coli inductor is lactose. This substance joins to the:
A. Protein-repressor
B. Gene-operator
C. Gene-regulator
D. Promotor
E. Structural gene
6. Gene which codes of aminoasids chain of protein-repressor is called:
A. Promoter
B. Terminator
C. Regulator
D. Modifier
E. Operator
7. Gene-operator releases from protein-repressor. After this is beginning:
A. Aminoacids activation
B. Translation
C. Replication
D. Processing
E. Transcription
8. Promoter marks the site at which transcription of mRNA starts but here deletion of two nucleotides pairs takes place. It leads to the:
A. Absence of protein synthesis
B. Anomaly of protein formation
C. Unlimited protein synthesis
D. Normal protein formation
E. Termination of protein synthesis
9. Different human cells can simultaneously synthesize different proteins because:
A. At the same time in cells transcribe different DNA fragments
B. One organism has different DNA
C. In the same organism different cells have different processes of protein biosynthesis
D. Mutations take place
E. Proteins have different structure
10. Sick person has disorder of magnesium ions decreasing which are necessary for attachment of ribosome to ER. Disturbance of protein synthesis takes place on stage of:
A. Translation
B. Transcription
C. Replication
D. Polysome formation
E. Transduction
11. During studying of protein synthesis the mouse is used. It got injection of marked alanine and thryptophan. These aminoacids are localized near by:
A. Ribosome
B. Smooth ER
C. Cell centre
D. Lysosome
E. Golgi complex
12. Lymphocyte is affected by AIDS virus. In this situation information flow goes from:
A. RNA-DNA-mRNA-polypeptide
B. DNA-mRNA-polypeptide-DNA
C. DNA-polypeptide-mRNA
D. mRNA-polypeptide-DNA
E. Polypeptide-RNA-DNA-mRNA
13. Eukaryotes genetic apparatus has a structure: exon-intron-exon. Determine the structure of pro mRNA in accordance of this scheme?
A. Exon-intron-exon
B. Exon – exon - intron
C. Exon - exon
D. Intron - exon
E. Exon - intron
14. Fragment of DNA molecule has exon parts. What is it?
A. Intervening sequence
B. Expressed sequence
C. Enhancers
D. Tandem genes
E. Regulation part
15. Some of chemical elements are able to provoke mutations (deletion type). Determine disturbance in structural part of gene.
A. Genetic code does not change
B. Exchange of several nucleotides
C. Inversion in DNA fragment
D. Disorder in DNA reading frame
E. Exchange in DNA fragment
16. Processing includes splicing (cutting off introns and sewing together exons by means of enzymes). Disorder of splicing leads to:
A. mRNA degradation
B. Mutant mRNA forming
C. Genetic code does not change
D. Exchange of codons
E. Exchange of mRNA codons
17. Most of the mutations (inversion type) caused by insertion of mobile elements into structural genes. There are 90 nucleotides pairs inserted into genes. It can be reason of:
A. Inclusion of 30 aminoacids in polypeptide chain
B. Mutant gene does not provide transcription
C. Inclusion of extra aminoacids will not happen
D. Mutation without displacement of DNA reading frame
E. Inclusion of 90 aminoacids in polypeptide chain.
18. Some triplets mRNA (UAA, UAG, UGA) do not code any aminoacids but there are terminators in translation process. How does it call ?
A. Stop-codon
B. Operators
C. Anticodon
D. Exons
E. Introns
19. Under the action of mutagene factors the content of several triplet changed. But cell continues synthesis of the same protein. It happens because of such characteristics of genetic code:
A. Triplet nature
B. Universality
C. Degeneracy
D. No punctuation
E. Colinearity
20. Ribosome subunits formation was blocked in the cell with the help of chemical drugs. It will lead to disturbances the synthesis of:
A. Carbohydrates
B. Proteins
C. Lipids
D. DNA
E. RNA
22. mRNA has information about aminoacids sequence in polypeptide chain. Determine the quantity of tRNA which transport aminoacids to the place of protein synthesis.
A. Number of proteins
B. Number of nucleotides
C. Number of aminacids
D. Number of triplets
E. Number of different types of tRNA
23. Which molecules of nucleic acids determine synthesis of polypeptides on ribosomes.
A. Pro-mRNA
B. tRNA
C. mRNA
D. rRNA
E. mRNA
24. Which enzyme provides transcription process:
A. Topoisomerase

B. RNA-polymerase
C. DNA-polymerase
D. Endonuclease
E. Helicase
25. Aminoacids activation provides by specific enzymes. Such enzymes are called:
A. Nuclease
B. Aminoacid-tRNA-synthetase
C. DNA-polymerase
D. Polynucleotideligase
E. Ligase
26. Translation process takes place with the help of several dozens of ribosomes on the one mRNA chain. Complex of ribosomes has a name:
A. Golgi complex
B. Big subunit
C. Small subunit
D. Rough ER
E. Polysome
27. Which process provides realization of hereditary information in polypeptide chain:
A. Translation
B. rRNA formation
C. tRNA formation
D. mRNA formation
E. Replication
28. Translation takes place in bacteria cell. Matrix for synthesis one mRNA molecule is:
A. Fragment of one DNA chain
B. DNA molecule
C. One DNA chain
D. DNA chain without introns
E. DNA chain without exons
29. In some human cell there is mRNA with exons and introns fragments. It happens because of absence of:
A. Processing
B. Replication
C. Transcription
D. Translation
E. Prolongation
30. Linear protein molecule corresponds to its primary structure. Which chemical bond appears between aminoacids molecules:
A. Peptide
B. Hydrogen
C. Disulphide
D. Hydrophobic
E. Ion
31. Some gene codes polypeptide chain and contains 4 exons and 3 introns. After processing matured mRNA contains nucleotides which are complementary to:
A. All introns
B. Two exons and one intron
C. One exon and one intron
D. Four exons
E. Four exons and three introns
32. Most of structural genes are not functionally the same. They have exons and
intron. Name “unmatured” molecule being synthesized on the DNA fragment:
A. Pro-mRNA
B. mRNA
C. tRNA
D. rRNA
E. iRNA

33. Process of synthesis “unmatured” mRNA is called:
A. Termination
B. Replication
C. Elongation
D. Translation
E. Transcription

34. mRNA is shorter than pro-mRNA. Totality of transformation stages from pro-mRNA to mRNA is called:
A. Replication
B. Processing
C. Recognition
D. Translation
E. Termination

35. Some chemical factors provoke disturbance of subunits formation. As a result of this process will be disturbed synthesis of:
A. Carbohydrates
B. Proteins
C. Lipids
D. DNA
E. RNA

36. Sick child recovers from flu. Formation of large amount of immunoglobulin was found as a result of increasing synthesis of proper mRNA. What do we call process of protective proteins synthesis:
A. Translation
B. DNA mutation
C. DNA reparation
D. DNA replication
E. Transcription

37. Sick person needs increased quantity of protein. Which medicine is necessary to take:
A. Medicine increase translation
B. Medicine decrease translation
C. Medicine decrease transcription
D. Medicine increase replication
E. Medicine decrease replication

38. Name the noncoding parts of genes:
A. Intron
B. Exon
C. Muton
D. Recon
E. Site

48. Speed of translation in bacteria cells is 12-17 amino acids per second. But for eukaryotes only 2. This speed is bound up with:
A. Spatial disconnection between transcription and translation
B. Peculiarity of prokaryotes ribosomes
C. Size of eukaryotes ribosomes is bigger than prokaryotes
D. Absence of processing at prokaryotes
E. Transcriptions mistakes

49. After translation process there are processes of protein “maturation” take place (formation of secondary and tertiary structures, making complex with lipids and carbohydrates molecules, ect.) Name the process of formation of active proteins which have metabolic functions:
A. Polypeptide elongation
B. Posttranslation modification
C. Inductive translation
D. Peptide termination
E. Dipeptide translocation

50. According to researches there are 35% of human genes is “reading” from different frames but 40% undergo alternative splicing. What is the meaning of this process:
A. 1 gene codes 1 protein
B. 1 gene codes several mRNA kinds
C. 1 gene codes 1 mRNA
D. 1 gene codes 1 polypeptide
E. Does not any meaning

51. Prion protein (PrP) is coding by gene PRNP, which localized on 20 chromosome and has two forms – normal cellular and infective. Which conditions provide arising of prion disease:
A. Deletion gene PRNP
B. Mutation gene PRNP
C. Increasing expression of gene PRNP
D. Decreasing expression of gene PRNP
E. Degradation PrP

52. One of forms of phenylketonuria arises up as a result of mutation which takes place in 12th intron. As a result of mutation last exon does not join. What process will be disturbed:
A. Termination of transcription
B. Attachment poly-A
C. Transcription
D. Translation
E. Splicing

53. Speed of biosynthesis of prokaryotes protein is higher, than in eukaryotes. It is determined by:
A. High level of metabolism
B. Transcription and translation are not divided by space and time
C. Presence of enhancers
D. Structure of prokaryotes RNA-polymerase
E. High activity of enzymes of transcription and translation

54. Information from unit of transcription is read one-way from 5’-end to 3’-end. What is it determined:
A. Silensor
B. Enhancer
C. Terminator
D. Promotor organization
E. Structural genes

2nd level tests
(several correct answers)

1. What enzymes and processes characterize translation:
   1. Recognition
   2. RNA-polymerase
   3. Peptide bond formation
   4. Initiation
   5. Elongation
   6. Aminoacyl-tRNA-synthetase
   7. Topoisomerase
   8. Terminal proteins

2. What from the following substances are biopolimers:
   6. Myoglobin
   7. DNA
   8. tRNA
   9. ATP
   10. Insuline

3. What enzymes and organoids of cell take part in the process of translation:
   1. Ribosome subunits
   2. mRNA
   3. RNA-polymerase
   4. A-center of ribosome
   5. P-center of ribosome
   6. Aminoacyl-tRNA-synthetase
   7. Granular ER
   8. Aminoacyl-tRNA

4. Gene activity of prokaryotes provide:
   1. Protein-regulator
   2. Gene-regulator
   3. Repressor
   4. Effectors
   5. Enhancer

5. Organization of biological information flow in a cell goes in directions:
   1. DNA → RNA → tRNA → protein
   2. RNA ↔ DNA
   3. RNA → protein
   4. DNA → RNA → polypeptide
   5. DNA → DNA

6. Name stages of transcription:
   1. Elongation
   2. Determination
   3. Recognition
   4. Initiation
   5. Termination

7. Name the enzymes which take part in transcription:
   1. RNA-primase
   2. DNA-polymerase
   3. RNA-polymerase
   4. RNA-ligase
   5. Helicase
   6. Restrictase
   7. Nuclease
   8. Reparation enzymes

8. Name stages of translation:
   1. Elongation
   2. Determination
   3. Recognition
   4. Initiation
   5. Termination

9. What enzymes take part in mRNA maturation, where this process is taking place:
   1. Nucleus
   2. Granular ER
   3. RNA-polymerase
   4. RNA-ligase
   5. Helicase
   6. Aminoacyl-tRNA-synthetase
   7. Nuclease
   8. Mitochondria

10. Where the synthesis(translation) of proteins which are not secreted, but remain in the cytoplasm takes place:
    1. Granular ER
    2. Cytoplasm ribosomes
    3. Mitochondria
    4. Nucleus
    5. Golgi complex
    6. RNA-polymerase

11. What enzymes are used in the genic engineering:
    1. DNA-depended RNA-polymerase
    2. RNA-depended RNA-polymerase
    3. DNA-ligase
    4. Reverse transcriptase
    5. Helicase
    6. RNA-polymerase
12. What are the basic structural-functional differences between eukaryote gene organization and prokaryote one:

8. They have exon-intron organization
9. Polycistrons structure
10. Monocistrons structure
11. Regulation provide only protein-repressors

TASKS

1. What change in the molecule of DNA has more stronger influence on a protein structure: fall of one nucleotide from to the triplet or whole triplet? Why?

2. Protein consists of 150 amino acids. How many nucleotides include gene that encodes this protein, if introns fragment is 50%.

3. What changes will take place in the structure of protein molecule, if in the encoding area of DNA: ТАА,GААА between 7 and 8 nucleotides to insert cytosine and between the thirteenth and fourteenth is thymine, at the end of chain to add 3 G and 2 C?

4. The polypeptide area of virus of tobacco mosaic consists of next amino acids: ser-gly-ser-ileu-tre-pro-ser. As a result of mutagene factor influence on mRNA the cytosine transforms on guanine. Define changes in polypeptide structure after influence of mutagene. But mean that place of serine can be determine by six triplets in genetic code table.

Practical class 8(8)
1st level tests
(one correct answer)

1. How many DNA molecules does somatic cell have in postsynthetic period (mitotic cycle)?
   A. 92
   B. 46
   C. 23
   D. 48
   E. 24

2. Name the period of cell cycle where synthesis of DNA takes place.
   A. Presynthesis (interphase)
   B. Synthesis (interphase)
   C. Mitosis
   D. Premitotic period of interphase
   E. Postsynthesis period of interphase

3. How many DNA molecules does human somatic cell have in presynthesis period?
   A. 23
   B. 92
   C. 46
   D. 69
   E. 48

4. During mitosis studying in onion cell spiral-shaped chromosomes found out. There are located in the cell equator midway. Name this phase of mitosis.
   A. Interphase
   B. Prophase
   C. Anaphase
   D. Telophase
   E. Metaphase

5. Synthesis of protein-tubulines was blocked in the cell. Such proteins take place in spindle forming. It will lead to disturbance in the process of:
   A. Separation of chromosomes
   B. Spiralization of chromosomes
   C. Cytokinesis
   D. Despiralization of chromosomes
   E. Mitosis

6. Maximum condensed chromosomes are present in the cell during:
   A. Metaphase
   B. Prophase
   C. Interphase
   D. Anaphase
   E. Telophase

7. Daughter chromatids are moving to the opposite poles at:
   A. Anaphase
   B. Metaphase
   C. Telophase
   D. Prophase
   E. Interphase

8. Cell cycle includes many processes such as growth, organelle formation, protein synthesis, RNAs, lipids and carbohydrates synthesis. On this stage DNA does not synthesize:
   A. Presynthesis
   B. Synthesis
C. Premitotic
D. Telophase
E. Anaphase

9. Mitotic cycle is a mechanism that provides organism development, regeneration and reproduction. It is possible because of:
A. Equal chromosomes separation
B. Chromosomes duplication
C. Diploid cells formation
D. Non-equal chromosomes formation
E. Changes in genetics information

10. Changeable structures in nucleus (contain protein and RNA) which disappear at the beginning and appear at the end of division called:
A. Nucleolus
B. Nucleosomes
C. Histone
D. Microfibrils
E. Heterochromatine

11. What mitotic phase of human cell has 92 single-chromatid chromosomes:
A. Anaphase
B. Telophase
C. Metaphase
D. Prophase
E. Interphase

12. Human somatic cells are diploid (2n). But polyploid cells of marrow can have 64n chromosomes number. What is mechanism of their forming:
A. Endomitosis
B. Polytetania
C. Mitosis
D. Amitosis
E. Meiosis

13. Some human cells along the whole life do not undergo mitosis and their content is invariable. There are:
A. Neurons
B. Endothelium
C. Muscle cells
D. Epidermis
E. Blood cells

14. After radiation influence disturbance of DNA takes place during S-period of interphase. What will happen in such cells:
A. Blocking of replication and mitosis
B. Prereplication reparation
C. Postreplication reparation
D. Replication continues and mitosis takes place
E. SOS – reparation takes place

15. In the culture of peripheral blood of liquidators of Chernobyl disaster leucocytes with chromosomes from 44 to 48 were found that can testify disorder of mitotic cycle. Where do such abnormal process takes place:
A. Anaphase
B. S-period (interphase)
C. Prophase
D. Presynthesis period

16. During experiment on the cell culture which are divided by mitosis some substance destroying the spindle is used. What do we call this substance:
A. Penicillin
B. Colchicine
C. Histamine
D. Methionine
E. Iodine

17. Define the mitosis phase where nuclear membrane restores their structure:
A. Interphase
B. Prometaphase
C. Telophase
D. Cytokinesis
E. Replication

18. Period between two division is called:
A. Interphase
B. Prometaphase
C. Telophase
D. Cytokinesis
E. Replication

19. Replication takes place in:
A. Telophase
B. S-period
C. Presynthesis period
D. Prometaphase
E. Telophase

20. Nucleolus disappears during cell division and after division appears again. Phase of disappearance is:
A. Interphase
B. Postsynthesis period
C. Prophase
D. Telophase
E. Metaphase

21. Call the processes of presynthesis period:
A. DNA replication
B. Protein synthesis and division of centrioles
C. DNA, RNA, protein synthesis, cell growths, accumulation of energy
D. DNA replication, accumulation of energy
E. Transcription

22. Call the processes of synthesis period:
A. DNA replication
B. Protein synthesis and division of centrioles
C. DNA, RNA, protein synthesis, cell growths, accumulation of energy
D. DNA replication, accumulation of energy
E. Transcription
23. Call the processes of postsynthesis period:
   A. DNA replication
   B. DNA repARATION
   C. Processing
   D. Centrioles doubling
   E. Synthesis of spindle protein
24. Determine genetic information after synthetic period:
   A. 1n 1c
   B. 2n 2c
   C. 2n 4c
   D. 4n 4c
   E. 4n 2c.
25. Determine genetic information after presynthetic period:
   A. 1n 1c
   B. 2n 2c
   C. 2n 4c
   D. 4n 4c
   E. 4n 2c.
26. The chromosomes become aligned at the equator midway between the spindle poles in the stage of:
   A. Interphase
   B. Prophase
   C. Metaphase
   D. Anaphase
   E. Telophase
27. Chromosomes have single-chromatids structure in the stage of:
   A. Prophase

B. Prometaphase
C. Metaphase
D. Anaphase
E. Telophase
28. Each cell divides into two daughter cells and an equal distribution of chromosomes results:
   A. Replication and chromosomes moving
   B. Independent separation of chromosomes (anaphase)
   C. Crossing-over and separation of chromatids
   D. Amplification of genes and independent separation of chromosomes
   E. Replication and chromatids separation
29. Duration of human cell cycle is different: skin epithelium – 10-20 days, leukocytes – 4-5 days, marrow – 8-12 hours.
On the cellular level duration is regulated by:
   A. Protein synthesis (S-phase activators)
   B. Synthesis of histone protein
   C. Intensification of S-period
   D. Intensification of protein tubuline
   E. Does not regulate
30. The base of cell division of eukaryotes and prokaryotes is molecular process called:
   A. Reparation
   B. Transcription
   C. Replication
   D. Karyokinesis
   E. Amplification of genes

2nd level tests
(several correct answers)

1. On this stage of mitotic cycle chromosomes become visible:
   1. Prophase
   2. Anaphase
   3. Metaphase
   4. Telophase
   5. Interphase
2. Cell cycle is:
   a) complex of events involves cell preparation and division
   b) existence starts from the cell formation to division or death
   c) period where cell performs complex of specific functions
   d) natural changes of structural-functional characteristics of cell
   e) cell life cycle results to reproduction and transmission of hereditary information
3. Mitotic cycle is:
   a) complex of events involves cell preparation and division
   b) existence starts from the cell formation to division or death
   c) several processes start from first division to the next and provide formation of new generation
   d) natural changes of structural-functional characteristics of cell
   e) cell life cycle results to reproduction and transmission of hereditary information
4. Biological significance of mitosis:
   a) provides transmission of hereditary material from generation to generation
   b) provides formation of new generations which are equal by hereditary information
   c) universal mechanisms of eukaryotes reproduction during their ontogenesis
   d) mechanisms determines saving, transmission and “reading” of hereditary information
5. Phases of mitotic cycled are:
6. Name the periods where such processes take place:
   1) protein synthesis
   2) DNA replication
      a) mitosis  b) postsynthesis period
   c) synthesis
   d) presynthesis

7. Some physical agents can disturb synthetic processes (G1 period). What stages of cell cycle in somatic cell will be disturbed as a result of this event:
   a) G2 period  b) mitosis  c) S period

8. Different chemical factors can provoke disturbance of enzymes which take place of DNA uncoiling. It will lead to block DNA despiralization in this cell on the phase of:
   a) mitosis
   b) S period
   c) replication
   d) telophase

9. Spindle formation was blocked in the cell with the help of colchicine. Which mitosis stage will be disturb ?
   a) interphase  b) mitosis
   c) metaphase  d) anaphase

10. DNA replication takes place on:
    a) interphase
    b) G1
    c) G2
    d) S

11. Which type of mitosis do not lead to the chromosomes decreasing:
    a) amitosis  b) mitosis  c) meiosis

12. What type of cell division is typical for somatic cells:
    a) amitosis  b) mitosis  c) meiosis

13. Mitosis has important biological significance because:
    a) it is base of gametes formation  c) provides genetical homogenous of daughter cells
    b) provides saving of chromosomes number  d) provides reduction of chromosomal set

14. Constancy of chromosomes number maintains from generation to generation with the help of:
    a) mitosis  b) meiosis
    c) endomitosis  d) fertilization

15. How many chromosomes does metaphase plate have:
    a) 46;  b) 23+23;
    c) 23;  d) 92.

16. Indicate correlation of chromosomes and DNA number at:
    a) telophase (mitosis)
    b) metaphase (mitosis)
    c) S-period (interphase)
    d) telophase (meiosis)
    e) meiosis (anaphase)

17. Chromatids are moving to the opposite poles during anaphase. In this period genetic information contains the following amount of DNA and chromosomes:
    a) 92 chromosomes 92 DNA
    b) 46 chromosomes 46 DNA
    c) 23 chromosomes 23 DNA

18. During the following period chromosomes become aligned at the cell equator midway between the poles at the stage of:
    a) prophase  b) metaphase  c) anaphase  d) telophase

19. In order to study a karyotype it is necessary to stop work of enzymes which take place of DNA replication. What process will be disturbed as a result of this event in the first place:
a) DNA replication  
b) DNA reparation  
c) G2 period  
d) synthesis of spindle protein  
e) S period  
f) mitosis

20. Somatic 2n cell at mitosis division was broken by a colchicine. How many chromosomes does the nucleus have:  
a) anaphase -4n; b) metaphase – 2n; c) metaphase – 4n; d) anaphase – 2n.

21. Which difference between mitosis and amitosis:  
a) chromosomes doubling on the base of DNA reduplication  
b) chromosomes spiralization on the period of nucleus division  
c) formation of two nuclei from the one mother’s nucleus  
d) DNA duplication before cell division

22. Place the following processes one after another:  
a) chromosomes doubling  
b) spindle formation  
c) chromosomes condensation, nucleus membrane disappears  
d) chromosomes are moving to the opposite poles  
e) chromosomes arrange on equator  
f) cytokinesis  
g) division of chromosomes

23. Mitosis was broken by a chemical substance. As a result of this process one single-nucleus cell has formed. In which phase was this process disturbed first? Determine the chromosomes number.  
1) a) prophase b) metaphase  2) a) haploid  
c) anaphase d) telophase  b) diploid c) polyploid

24. On anaphase and metaphase plate there are:  
a) n; b) 4n; v) 2n;  
r) n + n; d) 2n + 2n

25. Mechanisms caused by polyploid cell called:  
a) amitosis  
b) mitosis  
c) meiosis  
d) endomitosis  
e) polyteny

Tasks

1. In different groups of cells all initial cells have 2n chromosomes number and 2c DNA number. After division in next interphase different cells have following number of chromosomes: first group of cells is 2c, in other group - 1c, third group - 4c and the last group vary from diploid to increasing or decreasing but number of DNA were not divisible by haploid number of DNA. Name types of cell division for each group of cell.

2. Some chemical factors provoke disturbances in synthetic period of mitotic cycle. Is it possible for this cell to enter mitosis?

3. Nerve cells of embryo after several mitotic cycles lose ability for reproduction and differentiation. Name the period of mitotic cycle where matured specialized cells perform their function?

4. DNA content analyze in embryonic fibroblast nuclei culture multiplying by mitosis showed the cells with DNA content 2c - 46%, 4c – 12%, the rest of the cells were with intermediate DNA content. How can we explain such phenomenon?

5. Different chemical factors can provoke disturbance in work of protein. They take place in process of DNA despiralization. What can happen to the cell cycle as a result?

1st level tests
(one correct answer)

1. According to the rule of constant chromosomes number each kind of animals has a definite amount of chromosomes. Which of the following mechanisms controls of chromosomes constancy:
   A. Meiosis
   B. Schizogony
   C. Amitosis
   D. Regeneration
   E. Budding

2. The elementary unite of heredity (asexual and sexual reproduction) is:
   A. One pair of nucleotide
   B. One DNA strand
   C. Two DNA strands
   D. One nucleotide
   E. One gene

3. Using the non-damaged epithelium cells smear of oral cavity the oval nuclei with different size there were detected. What do we call this type of cell division?
   A. Amitosis
   B. Schizogony
   C. Binary fission
   D. Mitosis
   E. Meiosis

4. After meiosis in some women the non-divergence of one pair of chromosomes was found. How many chromosomes will be present in mature ovum?
   A. 22 or 24
   B. 23
   C. 45 or 47
   D. 23 or 25
   E. 46

5. Acrosome is forming from:
   A. Nucleus
   B. ER
   C. Golgi complex
   D. Centrioles
   E. Cytoplasm

6. During gametogenesis first and second meiotic division are taking place:
   A. Growth
   B. Forming
   C. Maturation
   D. Multiplication
   E. Synthetic period

7. How many chromosomes do sexual chromosomes have after first meiotic division?
   A. 23
   B. 46
   C. 44
   D. 92
   E. 22

8. How many chromosomes do sexual chromosomes have at the end of second meiotic division?
   A. 23
9. First division of meiosis are taking place in:
   A. Ovogonia
   B. Spermatogonium
   C. Spermatid
   D. Primary spermatocytes
   E. Polocyte

10. Which kind of cells have diploid number of chromosomes:
    A. Secondary oocytes
    B. Oocytes
    C. Ovum
    D. Polocyte
    E. Spermatozoa

11. During ovogenesis haploid cells are forming (1n 1c):
    A. Ovogonia
    B. Primary ovocytes
    C. Primary polocytes
    D. Zygotes
    E. Ovum

12. During spermatogenesis haploid cells are forming (1n 1c):
    A. Spermatogonium
    B. Primary spermatocytes
    C. Secondary spermatocytes
    D. Zygotes
    E. Spermatozoa

13. At what meiosis phase does conjugation of chromosomes take place:
    A. Anaphase 1st meiotic division
    B. Anaphase 2nd meiotic division
    C. Metaphase 1st meiotic division
    D. Prophase 1st meiotic division
    E. Prophase 2nd meiotic division

14. Define phase of 1st meiotic division where crossing-over takes place:
    A. Leptotene
    B. Zygotene
    C. Pachytene
    D. Diplotene
    E. Diakinesis

15. Name unmatured man’s sexual cell where crossing-over take place:
    A. Spermatogonium
    B. Primary spermatocytes
    C. Secondary spermatocytes
    D. Zygotes
    E. Spermatozoa

16. Name unmatured female sexual cell where crossing-over take place:
    A. Ovogonia
    B. Primary oocytes
    C. Secondary oocytes
    D. Zygotes
    E. Ovum

17. Name stage of gametogenesis where all cells are identical:
    A. Growth
18. The genetic information in sexual cells are stored in:
   A. Ribosomes
   B. ER
   C. Golgi complex
   D. Nucleus
   E. Centriole

19. During two meiotic divisions are forming:
   A. Somatic cells
   B. Diploid cells
   C. Haploid cells
   D. Genetic identical cells
   E. Mutational cells

20. Name the process of genetic material reshuffling on gene level which provides variety of organic world?
   A. Crossing-over
   B. Conjugation
   C. Binary fission
   D. Diakinesis
   E. Cytokinesis

21. Mammal’s ovum contains thousand molecules of mRNA, tRNA, rRNA. Such molecules are forming during prophase I meiosis. Which process provides synthesis large amount of RNA in ovum:
   A. DNA replication
   B. Transcription
   C. Translation
   D. Amplification of genes
   E. Reparation

22. Fertilization is the union of an ovum and one sperm but there are many sperms are going towards the ovum. Name the process of polyspermy blocking:
   A. Increasing of ovum’s metabolism
   B. Destroying of membranous receptors
   C. Forming of membranous receptors of eggs
   D. Destroying of membranous receptors of eggs
   E. Decreasing of membrane’s penetration.

23. Human ovum contains thousand molecules of mRNA, tRNA, rRNA. Such molecules are forming during stage of diplotene. Which process provides synthesis large amount of RNA in ovum?
   A. Amplification of genes
   B. DNA replication
   C. Transcription
   D. Reparation
   E. Translation

2nd level tests
(some correct answers)

1. At what gametogenesis stage does meiosis take place:
   a) multiplication; b) growth;
   c) maturation; d) formation.

2. At what meiosis stage do meiosis and crossing-over take place:
   a) prophase 1; b) prophase 2;
   c) metaphase 1; d) pachytene.
3. During gametes forming (meiosis) homologous chromosomes are:
   a) going to the one pole to one gamete;
   b) undergo conjugation and moving towards the different poles to different gametes;
   c) exchange of homologous parts and by means of chiasmata are forming different figures.
4. Results of 1st meiotic division:
   a) formation of new cells with the same chromosomes number;
   b) formation of new cells with haploid chromosomes number and DNA;
   c) formation of new cells with haploid chromosomes number and diploid number of DNA;
   d) formation of cells with reshuffling genetic information by means of crossing-over.
5. Transmission of inherited characters of species in each generation conditioned by:
   a) behavior of chromosomes in mitosis;
   b) behavior of chromosomes in meiosis;
   c) features of cytoplasm division between daughters cells in mitosis;
   d) features of cytoplasm division between daughters cells in meiosis
6. How many chromosomes and which number of DNA have:
   a) spermatogonium; b) primary spermatocytes;
   c) secondary spermatocytes; d) spermatozoon;
   g) primary sexual cells (gonocytes).
7. Which mechanisms provides saving of constant karyotype in each generation:
   a) meiosis; b) mitosis; c) fertilization.
8. At what gametogenesis zone stage does meiosis take place?
   a) multiplication; b) growth;
   c) maturation; d) forming.
9. Cells of organism have 22 pairs of chromosomes. How many chromosomes will be::
   a) spermatozoa; b) ovum;
   c) zygote; d) somatic cells.
10. What are the mechanisms provide genetic variety of gametes in the process of meiosis?
    a) non-equal arrangement during meiosis (ovogenesis);
    b) independent separation of homologous chromosomes during meiosis I;
    c) crossing-over; d) conjugation;
    e) random combination of non-homologous chromosomes during separation.
11. What are the mechanisms provide saving of constant karyotype in each generation in the process of sexual reproduction:
    a) mitosis; b) endomitosis; c) meiosis; g) meiosis + fertilization.
12. What number of chromosomes have:
    a) ovogonia; b) primary ovocytes;
    c) secondary ovocytes; d) ootid; e) polocytes.
13. Describe the behavior of non-homologous chromosomes during meiosis:
    a) all non-homologous chromosomes derived from each parent (including joined chromosomes) transmits to the gametes;
    b) non-homologous chromosomes at metaphase I meiosis are arranged their chromatides between poles;
    c) non-homologous chromosomes are forming different bivalent which are separating independently from each other;
    d) non-homologous chromosomes derived from each parent are separating randomly during 1st division and define forming of different reshuffling gametes.
14. Name the forms of asexual reproduction:
    a) polyembryony, b) schizogony,
    c) conjugation, d) parthenogenesis,
15. The latest type of reproduction arose from the evolution process is:
    a) vegetative; b) asexual;
c) sexual; d) parthenogenesis?

16. Characteristics of asexual:
   a) paternal organisms are forming specialized cells – gametes;
   b) offsprings are forming from one or several parental lines;
   c) parent – one or two individuals;
   d) reproduction provides one individual;
   e) the main mechanism of reproduction is mitosis;
   f) the main mechanism of reproduction is meiosis;
   g) offsprings – genetical copy of parent;
   h) offsprings are genetically different from the parent as a result of combinative variation.

Tasks
1. There are two spermatozoa into the ovum. What the ways of them?
2. During spermatogenesis are forming 4 sperms from one spermatogonia but during ovogenesis only one ovum and 3 polar bodies (shortly eliminated). What is biological importance of non-equal separation of cytoplasm during ovogenesis? How many chromosomes do the ovum and polar bodies have?
3. The man’s testis in growth period has 22000 primary spermatocytes. How many secondary spermatocytes and sperms can be formed?
4. The women’s ovary in growth period has about 400 primary ovocytes. How many secondary ovocytes and polocytes can be formed?
5. Some ovogonia has one mutant gene which has formed in presynthetical period. How many secondary ovocytes can get such gene?
6. Primary ovocyte has mutant gene (before DNA duplication). How many zygotes will get such gene?