MINISTRY OF HEALTH OF UKRAINE
NATIONAL PIROGOV MEMORIAL MEDICAL UNIVERSITY, VINNYTSYA

Approved

Head of Admission Commission of VNMU,
Rector

_____ Viktoriia PETRUSHENKO

«28» березня 2025

PROGRAM FOR
BIOLOGY ENTRANCE EXAMINATION
(elective discipline)

VINNYTSYA - 2025

BIOLOGY ENTRANCE EXAMINATION PROGRAM
for persons, wishing to obtain higher education at National Pirogov Memorial Medical University, Vinnytsya on the basis of complete general secondary education

EXPLANATORY NOTE

The examination program is developed on the basis of the Programs of external independent assessment in biology on the basis of the current programs for secondary schools.

The program of examination in biology is developed on the basis of the State standard of basic and complete general secondary education, approved by the resolution of the Cabinet of Ministers of Ukraine of November 20.12.2018 № 1426, and corresponding curricula: curriculum in biology for 6-9 classes of general secondary education, approved by order Ministry of Education and Science of Ukraine from 07.06.2017 № 804, and the curriculum in biology for 10-11 grades of general secondary education (standard level), approved by the order of the Ministry of Education and Science of Ukraine from 23.10.2017 № 1407.

The task of conducting an exam in biology is:

- check the compliance of knowledge and skills of applicants to the program requirements;
- identify the level of academic achievement of applicants;
- evaluate the degree of readiness of applicants for further study at the medical university.

The biology exam program is aimed at identifying the level of knowledge and skills in the school subject "Biology" on the basis of which the entrant will be able to:

• characterize the basic biological concepts, patterns, laws and theories, biological phenomena and processes;

• operate with concepts, if necessary, to explain the processes and phenomena of living nature, confirming with examples from human life and activity, health care, the achievements of biological science;

• compare the processes of life at different levels of organization (molecular, cellular, organ, organism, population-species, ecosystem, biosphere) and identify relationships between them, establish causal, functional, structural relationships and patterns in wildlife, classify objects;

• identify the effects of bad habits on the body;

• apply biological knowledge to analyze situations that arise in various spheres of life;

• perform calculations using a mathematical apparatus;

• apply the acquired knowledge in the analysis of biological information presented in various forms (graphic, tabular, textual);

• substantiate the conclusions.

The content of the biology exam program is divided into thematic blocks according to the key elements of the content of the biology curriculum for students of general secondary education.

The program consists of 5 sections:

"Introduction. Chemical composition, structure and functioning of cells. Realization of

hereditary information","Patterns of heredity and variability", "Biodiversity","Human body as a biological system," Fundamentals of ecology and evolutionary theory".

The sections are divided into topics that define the content and scope of requirements for learning outcomes and subject skills of participants in external independent assessment in biology, specify elements of the content of certain concepts, a list of biological objects that EIT participants visually recognize and characterize.

The biology exam program focuses on the acquisition of subject skills by applicants and their achievement of certain learning outcomes in terms of methods of scientific knowledge; basic provisions of biological laws, rules, theories, patterns, hypotheses; essence of biological processes and phenomena; structure and features of biological objects; modern biological terminology and symbolism; skills: to explain, establish connections, draw diagrams and obtain information from tabular data and graphical images, recognize biological objects by their image, classify, analyze, compare and draw conclusions, use knowledge in everyday life (justify the rules of behavior in the environment environment, disease prevention measures, methods of premedical care).

Contents of the program

Section 1. General biology. Molecular biology.

1.1. *Biology as a science*. The importance of biology in the training of physicians.

1.2. *The main properties of living beings*. Chemical composition of cells: inorganic and organic substances.

1.3. *Inorganic substances*: water, mineral salts and chemical elements. Chemical composition of living systems. Inorganic substances and their role in the life of organisms. Organic compounds. Structure, properties, values of lipids, carbohydrates, proteins, nucleic acids (deoxyribonucleic acid (DNA), ribonucleic acid (RNA), adenosine triphosphate (ATP). Chemical resistance of organisms.

1.4. *Structure and functions of DNA and RNA.* Gene - the basic unit of heredity. Genetic classification. Genetic code. General concept of protein synthesis: transcription, translation.

1.5. *The cell as the basic structural and functional unit of nature*. Characteristic features of cells - prokaryotes and eukaryotes. Structure and functions of cell organelles. The cell is like a closed system. Metabolism and energy exchange in the cell. Fundamentals of cell theory.

1.6. *Chromosomes in the interphase and metaphase of mitosis*. Hetero- and euchromatin. The structure of mitotic chromosomes. Karyotype. Human karyotype. Classification of human chromosomes.

1.7. *Cell life cycle*. Division of somatic cells by mitosis. Phases of mitosis. Meiosis. Reducing the number of chromosomes by half during gamete formation.

Section 2. Fundamentals of genetics.

2.1. *The subject and main tasks of genetics*. Basic concepts of genetics: heredity, variability, genetic material and its properties (preservation, change, implementation of genetic information). Allelic genes. Dominant and recessive genes. Homo- and heterozygous organisms. Genotype, genome, phenotype.

2.2. *Monohybrid crossbreeding,* Mendel's 1st and 2nd laws. Dihybrid crossing. Polyhybrid crossing, Mendel's third law. Interaction between genes. Multiple allelism. Determination of

blood groups according to the ABO system.

2.3. *Gender determination.* Inheritance of linked human traits.

2.4. *Types of variability*: modifications, combinations, mutations. Their significance in ontogenesis and evolution. Modification. The reaction rate. Combinatorial variability. Types of mutations. Their classification. Problems of practical genetics. Hereditary diseases caused by mutations.

Section 3. General Biology.

3.1. *Ontogenesis and its periods.* Embryonic development and its stages. Postembryonic ontogenesis. Human growth and development.

3.2. *Basic principles of Darwin's theory.* Modern concept of evolution. Micro- and macroevolution.

3.3. *Ecology.* Environment as an ecological concept. Environmental factors. Ecological human ecosystems. Adaptation of people to living conditions at the cellular, organic, population and biosphere levels. Man as an environmental factor. The main directions and results of anthropogenic impact on the environment. Environmental Protection.

3.4. *Biosphere*, basic concept. Connections of biosphere components. Biosphere as a place. The biosphere as a process. Chemical cycle model.

3.5. *Poisonous organisms*

Section 4. Human anatomy and physiology. Hygiene and human health.

4.1. *Human and animal tissues*

The human body as a whole. Association of cells into tissues. Tissue types: epithelial, connective, muscular, nervous.

The concept of bone, cartilage and free connective tissue. Hematopoietic connective tissue.

Smooth muscles and their functions. Striped muscles and their functions. Features of the heart muscle.

Neuron as a structural and functional unit of the nervous system. Reflex arc. The concept of organ, organ system. Physiological systems of human organs.

4.2. *Skeletal system. skeleton*

Review of the structure of the human skeleton. Classification and connection of bones. Composition, structure and properties of bone. The main functions of the skeleton: support, protection, its role in metabolism, hematopoietic function.

Human skeleton, structure of the spine, skull, limbs. Bones of different parts of the skeleton. Features of the structure of the human skeleton caused by bipedal movement.

4.3. *The muscular system of man*

The main groups of human muscles. Muscles of the head and neck, muscles of the torso and muscles of the extremities. The mechanism of muscle contraction.

Regulation of muscle functions. Prevention of curvature of the spine.

4.4. *The human cardiovascular system*

Blood composition. Plasma composition. Erythrocytes, their structure and function. Leukocytes, their structure and functions. The concept of immunity. Platelets. Coagulation.

Heart. Its structure and functioning. Neurohumoral regulation of the heart. Pulse. Large and small circulatory system. Blood flow through blood vessels. Vessels: arteries, capillaries and veins. Blood pressure. Bad habits and their impact on blood circulation.

4.5. *Lymphatic system*

Lymph nodes. Tissue fluid. Structure and functions of the lymphatic system. The movement of fluids in the body. Maintaining homeostasis.

4.6. *The human respiratory system*

Upper and lower respiratory tract. Nose function. Nasopharynx, structure and functions. Voice apparatus, its structure, sound formation. Trachea, bronchi, bronchioles, alveoli. Mechanism of inhalation and exhalation. Transport of oxygen and carbon dioxide.

Cellular respiration. Nervous and humoral regulation of respiration.

Influence of carbon monoxide. Effects of smoking and air pollutants on the respiratory system.

4.7. *Digestive system. Food.*

Mechanical processing of food and chemical decomposition of food. Structure and functions of the human digestive system. Teeth. The structure of the teeth, depending on the function performed.

Enzymes of saliva, gastric juice and pancreas. The mechanism of enzyme function. The role of bile.

Digestion in the small intestine. Absorption in the small intestine. Rectal function.

The importance of biomedical requirements for food quality and safety. Possible causes of disorders of the gastrointestinal tract.

4.8. *Urinary system*

Review of the structure of the urinary system.

Macro - and microscopic structure of the kidneys. Nephron. Formation of primary and secondary urine. Bladder and reflex urine output. Homeostatic indicators of chemical composition of urine.

4.9. *Skin*

The structure and functions of the skin. Sweat glands. Mechanism of thermoregulation. Mechanical and thermal damage to the skin. Skin hygiene. Derived leather.

4.10. *Nervous system*

Neuron as a structural and functional unit of the nervous system. Central and peripheral nervous system. Somatic nervous system. Autonomic nervous system (sympathetic and parasympathetic). Reflex arc. The structure of the spinal cord and its functions. The structure of the brain and its functions. The cerebral cortex. The concept of higher nervous activity of man. Unconditioned and conditioned reflexes. Language is the second human signal system. The effects of alcohol, drugs and toxins on the nervous system and behavior.

4.11. *The concept of sensor systems and analyzers*

4.12. *Metabolism and energy metabolism*

Metabolism of organic and inorganic substances. Assimilation and dissimilation are two sides of the same metabolic process. Regulation of metabolism. The liver and its role in metabolism. Types of metabolism. Balanced nutrition.

4.13. *Reproduction and individual human development.* Sexual reproduction. The structure of male and female reproductive systems. Embryonic period of human development. Embryos. Fetal formation. Post-embryonic period of development. Stages of life (childhood, early childhood, adolescence, early adulthood, middle adulthood, old age). Hormonal regulation of puberty.

Section 5. Zoology - scientific research of animals.

5.1. *Similarities and differences between animals and plants.*

5.2. *The system in the taxonomy of animals*. The main systematic groups of animals. The concept of species. The concept of parasitism.

5.3. *Unicellular animals*. Parasitology and medicine.

Type Flatworms. General characteristics, diversity.

Roundworms. General characteristics, diversity.

Type Ringworms. General characteristics, diversity. The role of worms in ecosystems. Significance for man.

Type Arthropoda. General characteristics of the Arthropod type.

Class Crustaceans. General characteristics of the class. A variety of crustaceans. The role of crustaceans in ecosystems, their importance for humans. Class Arachnids. General characteristics of the class. Variety of arachnids and their role in ecosystems. Significance in human life.

Class Insect. General characteristics of the class. Features of development.

Behavior of insects. Variety of insects. The role of insects in ecosystems, their importance for humans. Arthropod protection.

Clams. General characteristics, diversity of mollusks. The role of mollusks in ecosystems, their significance for humans.

Type Chordates. Skullless. Pisces. General characteristics of the Chord type. Subtypes Cranial and Cranial (Vertebrate). General characteristics of the subtype Cranial (Vertebrates). Cartilaginous fish class. General characteristics of the class, features of life processes, behavior, diversity of cartilaginous fish. Role in ecosystems and economic importance of cartilaginous fish.

Class Bone fish. General characteristics of the class, features of life processes. Behavior and seasonal phenomena in the life of fish. Variety of bony fish. Role in aquatic ecosystems. The importance of fish in human life. Fisheries. Fish protection.

Class Amphibia. General characteristics of the class Amphibians. Features of life processes and behavior. Seasonal phenomena in the life of amphibians. A variety of amphibians. The role of amphibians in ecosystems, their importance for humans. Protection of amphibians.

Class Reptiles. General characteristics of the Creeper class. Features of life and behavior processes. Seasonal phenomena in the life of reptiles. A variety of reptiles. The role of reptiles in ecosystems, their significance for humans. Protection of reptiles.

Class Birds. General characteristics of the class Birds. Features of bird life. Features of adaptation to flight and different living environments. A variety of birds. Reproduction and development of birds.

Seasonal phenomena in the life of birds. Behavior of birds: nesting, mating behavior, care for offspring. Birds fly. The role of birds in ecosystems. Their significance for, man. Protection of birds. Poultry breeding.

Class Mammals. General characteristics of the class Mammals. Features of mammalian life. Diversity of mammals. Seasonal phenomena in the life of mammals, their behavior. The role of mammals in ecosystems, their importance to humans. Mammal protection. Livestock.

List of recommended practical tasks:

1. Polydactyly is determined by the dominant gene (A). The parents have polydactyly and they are heterozygous. How many and what types of gametes can these parents form? What is the probability of giving birth to a healthy baby?
2. Human hemophilia - a sex-linked recessive disorder (Xh-allele of hemophilia, HN-allele of normal blood clotting). A healthy woman marries a healthy man. What is the probability that their child will have hemophilia?
3. Parents have brown eyes (B-brown eyes, b - blue eyes). They are heterozygous for this trait. How many and what types of gametes are possible for these parents? What is the probability of giving birth to a child with blue eyes?
4. Human recessive trait (a), the dominant trait of curly hair (A), is a recessive disorder (b-allele of albinism, B-allele of normal skin color). Parents have curly hair, and they are healthy heterozygotes on this basis. What is the probability of giving birth to a child with albinism and straight hair?
5. Write the sequence of the mRNA chain of the following DNA sequences: ACC - ATT - CGG - CCT - ATA - GCT - CAA - GGA.

EVALUATION CRITERIA
for entrance exam in Biology

Each exam task consists of 20 questions of different difficulty level:
10 questions of the first level and 10 questions of the second level. Applicants' knowledge is assessed on a 100-point scale.

Evaluation criteria for test tasks 1 – 10 (first level of difficulty)
4 points - the correct answer to the question
0 points - the answer is incorrect or absent
Evaluation criteria for test tasks 11 - 20 (second level of difficulty)
6 points – the correct answer to the question
0 points - the answer is incorrect or absent

Table of conversion of test points, received by applicants in biology entrance exam into a rating grade (on 100-200 points scale)

Test point	*Rating grade 100-200*	Test point	*Rating grade 100-200*
0	*didn't pass*	51	138,75
2	*didn't pass*	52	140,00
3	*didn't pass*	53	141,25
4	*didn't pass*	54	142,50
5	*didn't pass*	55	143,75
6	*didn't pass*	56	145,00
7	*didn't pass*	57	146,25
8	*didn't pass*	58	147,50
9	*didn't pass*	59	148,75
10	*didn't pass*	60	150,00

11	*didn't pass*	61	151,25
12	*didn't pass*	62	152,50
13	*didn't pass*	63	153,75
14	*didn't pass*	64	155,00
15	*didn't pass*	65	156,25
16	*didn't pass*	66	157,50
17	*didn't pass*	67	158,75
18	*didn't pass*	68	160,00
19	*didn't pass*	69	161,25
20	100,00	70	162,50
21	101,25	71	163,75
22	102,50	72	165,00
23	103,75	73	166,25
24	105,00	74	167,50
25	106,25	75	168,75
26	107,50	76	170,00
27	108,75	77	171,25
28	110,00	78	172,50
29	111,25	79	173,75
30	112,50	80	175,00
31	113,75	81	176,25
32	115,00	82	177,50
33	116,25	83	178,75
34	117,50	84	180,00
35	118,75	85	181,25
36	120,00	86	182,50
37	121,25	87	18375
38	122,50	88	185,00
39	123,75	89	186,25
40	125,00	90	187,50
41	126,25	91	188,75
42	127,50	92	190,00
43	128,75	93	191,25
44	130,00	94	192,50
45	131,25	95	193,75
46	132,50	96	195,00
47	133,75	97	196,25
48	135,00	98	197,50
49	136,25	99	198,75
50	137,50	100	200