


Ministry of Science and Higher Education of Russian Federation  
Federal State Autonomous Educational Institution of Higher Learning  
KAZAN (VOLGA REGION) FEDERAL UNIVERSITY

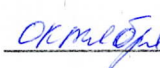
Approved

vice-rector for scientific activities

Dep. of the Admissions Committee



 D.A. Tayursky

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BIOLOGY ENTRANCE TEST PROGRAM

## INTRODUCTORY PART

The form of the entrance exam in person and (or) using remote technologies. Exam in the form of a test in accordance with the form of the Unified State Examination (USE).

The content of the examination task is established in accordance with the entrance test program developed on the basis of the Federal State Educational Standard of Secondary (Complete) General Education, approved by the Order of the Ministry of Education

No. 413 of 05/17/2012, as well as the Federal State Educational Standard of Basic General Education, approved by Order of the Ministry of Education and Science No. 1897 of 12/17/2010. The structure of the examination task and the assessment criterion corresponds to the Specification of Control Measuring Materials of the Unified State Examination in Biology.

On the biology exam, the applicant must show:

- knowledge of basic concepts, theoretical provisions and laws operating in living nature;
- understanding of the principles of the structure and functioning of living systems of various levels, knowledge of the basics of classification of organisms;
- ability to solve biological problems, including problems in genetics;
- possession of a high level of biological thinking, understanding of the integrity, interconnectedness and community of the organic world, the development of living nature;
- the ability to generalize the material, the ability to analyze it, formulate and substantiate conclusions.

The maximum score is 100.

The exam lasts 3 hours (180 minutes).

## CONTENTS OF THE PROGRAM

### **Biology as a Science.**

Biology is the science of living nature. Contribution of biology to the formation of the modern scientific picture of the world and the general culture of the individual. The importance of biological science for agriculture, industry, medicine, nature conservation. Biology methods.

Organizational levels of living things: molecular, cellular, organismic, population-specific, ecosystem, biosphere. Properties of living systems: features of chemical composition, metabolism and energy, openness, growth, self-reproduction, heredity and variability, irritability, self-regulation; their manifestation in animals, plants, fungi and bacteria.

### **Cell: structure and functioning.**

The main provisions of the cell theory, its significance in modern science. A cell is a structural and functional unit of living things. The cellular structure of organisms as a reflection of the unity of living nature.

Chemical composition of cells. The content of chemical elements in the cell. Water, mineral salts and other inorganic substances, their role in life. Features of the structure and function of organic substances: proteins, carbohydrates, lipids, nucleic acids in connection with their functions. The structure and function of cell organelles; the interconnection of these components as the basis of its integrity.

Variety of cells. Prokaryotic and eukaryotic cells. Features of the structure of cells of plants, animals and fungi. Viruses are non-cellular forms. The role of viruses as causative agents of diseases, their prevention.

Cell metabolism and its components - assimilation (anabolism) and dissimilation (catabolism). Plastic and energy metabolism. Enzymes, their properties and role in metabolism. The main stages of plastic exchange. DNA replication. Genes. Genetic code and its properties. Transcription. Broadcast. The role of matrix processes in the implementation of hereditary information. Autotrophic and heterotrophic organisms. The stages of photosynthesis and the role of chlorophyll in this process. Biospheric significance of photosynthesis. Chemosynthesis. The main stages of energy metabolism. Fermentation and



cellular respiration, the metabolic role of oxygen. The role of ATP in energy and plastic metabolism. The relationship of energy and plastic metabolism.

### **Reproduction and individual development of organisms.**

Cell division is the basis for the growth, development and reproduction of organisms. Mitosis and meiosis are the main ways of dividing a eukaryotic cell. Interphase. Stages of mitosis and meiosis. The importance of mitosis and meiosis.

Sexual and asexual reproduction, their role in nature. Methods of asexual reproduction in animals, plants and fungi. Development of germ cells. Fertilization in animals and plants. Double fertilization is a feature of flowering plants. Alternation of sexual and asexual generations (gametophyte and sporophyte) in plants.

Ontogenesis is the individual development of an organism, the main stages of ontogenesis. Embryonic and postembryonic development. The main stages of development of the embryo (for example, animals). Direct development and development with metamorphosis (indirect). Life cycle concept.

### **Fundamentals of Genetics and Breeding.**

Genetics is the science of heredity and variability of organisms. Basic methods of genetics. Hybridological analysis, mono-, di- and polyhybrid crossing. Basic concepts of genetics: gene, allele, trait, homozygote and heterozygote, dominance and recessiveness, genotype, phenotype and reaction rate.

The laws of heredity, established by G. Mendel, and the conditions for their implementation. Cytological foundations of the implementation of the laws of G. Mendel. Complete and incomplete dominance.

Chromosomal theory of heredity. Linked inheritance and its cytological basis, linkage disorder. Crossing over (crossing of chromosomes) and its meaning. Genetic sex determination, sex chromosomes and autosomes, inheritance of sex-linked traits.

Genotype as an integral historically developed system. The concept of the interaction and multiple action of genes. The role of the genotype and environmental factors in the formation of the phenotype. Forms of variability of organisms: modification and hereditary variability, mutational and combinative variability, their role in nature. Causes of mutations. The influence of the environment on the mutation process, mutagens. The main sources of



combinative variability: independent behavior of homologous chromosomes in meiosis, crossing over, fertilization.

The importance of genetics for public health. Hereditary human diseases and measures for their prevention. Influence of radioactive radiation and chemical mutagens (including nicotine, alcohol and drugs) on human heredity.

Genetics is the theoretical basis of breeding. Breed of animals and variety of plants. The main methods of plant and animal breeding: mutagenesis, polyploidy, hybridization, artificial selection.

Modern biotechnologies: genetic and cellular engineering, microbiological synthesis, their role in the development of health care, industry, agriculture and nature conservation.

### **The diversity of wildlife.**

The system of the organic world. Classification of organisms and the role of K. Linney as the founder of scientific systematics. The main systematic categories are: species, genus, family, order (order), class, type (department), kingdom. Features of the structure and functioning of representatives of the main kingdoms of living nature: bacteria, plants, animals and fungi.

*The kingdom of bacteria.* The main features of the structure and life of bacteria, their reproduction. Disputes. The role of bacteria in the biosphere. The importance of bacteria for agriculture, industry and medicine. Disease-causing bacteria and the fight against them.

*The kingdom of fungi.* Forms of the vegetative body of fungi. Hat mushrooms, their structure, nutrition, reproduction. Molds. Yeast. Ecological groups of mushrooms. Parasitic fungi that cause diseases of plants, animals and humans. Mycorrhiza. The role of fungi in the biosphere and their significance for humans.

Lichens are organisms of symbiotic origin, formed by mycobiont (fungus) and phycobiont (cyanobacterium or green unicellular alga). Lichen structure. Environmental and morphological groups. Food. Reproduction. The role of lichens in the biosphere and significance for humans.

*The kingdom of plants.* General characteristics of plants. The role of plants in the structure of the ecosystem and their significance for humans. Classification of plants. Lower and higher plants. Life cycle in plants, alternation of generations of sporophyte and gametophyte. Evolution of the life cycle in plants. Lower plants (Algae). Evolution and

forms of the vegetative body. The main divisions of algae are Green, Brown and Red. The structure and activity of unicellular algae (Chlamydomonas). Filamentous algae (Ulothrix) and algae with lamellar thallus. Algae reproduction and life cycles. The role of algae in the biosphere and its significance for humans.

The emergence of plants on land. The concept of tissues and organs in plants. Characteristics of the Bryophytes (Psilophyta) department.

Department of Mossy. Green mosses. The structure, reproduction and life cycle of the cuckoo flax. Sphagnum moss, features of its structure. Peat formation, its significance.

Departments Pteridophytes-like, Horsetail, Fern-like: characteristics, main representatives, their structure and biology. Fern life cycle and reproduction.

Department of gymnosperms: characteristics of structure and reproduction. Distribution of conifers. The biological significance of the seed. The role of gymnosperms in the biosphere and significance for humans.

Department of Angiosperms (flowering). The structure of the flower. The germ. Double fertilization. Seed and fruit formation. The role of angiosperms in the biosphere and significance for humans. Classification of Angiosperms: classes of Dicotyledons and Monocots, their features. Distinctive features of plants of the main families; their biological characteristics (families Cruciferae, Rosaceae, Legumes, Solanaceae, Compositae, Liliaceae, Cereals).

The main groups of plant tissues (epithelial, integumentary, mechanical, conductive, basic).

Vegetative organs of higher plants. The structure and functions of the root, types of roots, types of root system, modification (metamorphosis) of the root. The shoot. Kidneys. Stem. Branch of the shoot. The structure and function of the stem, the modification of shoots (rhizome, tuber, bulb). Leaf structure and functions, types of leaves, leaf arrangement, types of venation.

Generative organs of flowering plants. The structure of the flower in connection with the methods of pollination. Flowers are unisexual and bisexual. Flower formula. Inflorescences and their biological significance. Structure and classification of seeds (for example, monocotyledonous and dicotyledonous plants) and fruits. Types of seed



germination, nutrition and seedling growth. Distribution of fruits and seeds. The value of flowers, fruits and seeds in nature and human life. four

The origin of plants. The main stages in the evolution of the plant world: the emergence of photosynthesis, the emergence of unicellular and multicellular algae, the emergence of plants on land (psilophytes), the emergence of spore and seed plants. Phylogenetic relationships in the plant kingdom.

*The animal kingdom.* The simplest animals. General characteristics of protozoa: cell structure, nutrition, respiration, excretion, movement, behavior and reproduction. Variety of protozoa: common amoeba, euglena green and heterotrophic flagellates, ciliates and others. Differences between protozoa and multicellular animals. Their importance in nature and human life. Parasitic protozoa are the causative agents of human and animal diseases.

Multicellular animals. Features of the structure of multicellular animals. Major tissues, organs and their systems. Types of symmetry of the body of animals. Two-layer and three-layer animals.

Types of intestinal worms, flatworms, roundworms, annelids. Characteristics of their structure and basic life processes (external structure, integumentary system, movement and muscles, nutrition and digestive system, respiration, secretion and excretory system, distribution of substances in the body, body cavity, nervous system, behavioral features, reproductive system and methods of reproduction) ... Life cycles of the most important representatives. Characteristics of the main classes. Role in ecosystems and human life. Parasitic representatives of flat and round worms, their importance for health and agriculture. Prevention of parasitic diseases.

Type Arthropods. Characteristics of the structure and basic life processes. Classes: Crustaceans, Arachnids, Insects. Features of arthropods in connection with the development of the ground-air habitat. The main orders of insects: Orthoptera, Coleoptera, Lepidoptera, Diptera, Hymenoptera. Insects with complete and incomplete transformation. The variety of insects, their role in ecosystems and human life. Methods for controlling insects - agricultural pests and disease vectors. Insect protection.



Shellfish type. Characteristics of the structure and basic life processes, the main classes (Gastropods, Bivalves, Cephalopods). The role of molluscs in aquatic and terrestrial ecosystems.

Type Chordates. General characteristics of the type. The main classes of chordates are: Lancelet, Cartilaginous fish, Bony fish, Amphibians, Reptiles, Birds, Mammals. Characteristics of their structure and basic life processes in connection with the characteristics of the habitat and way of life. Origin of major classes and evolution of vertebrates. The emergence of vertebrates on land and the development of their terrestrial-air habitat. Characteristics of the main units. The role of various chordates in ecosystems and human life, protection and regulation of numbers. Main pets and farm animals: origin, biological basis of their maintenance, feeding, breeding.

The evolution of the animal world. Origin of Protozoa and Multicellular Animals. The origin of the main types of the animal kingdom. Complication of the structure and life of animals in the process of evolution. The position of man in the system of the animal kingdom, evidence of his systematic affiliation. five

### **Man and his health.**

General overview of the human body: major tissues and organ systems. The value of knowledge about the structure, life of the body and human hygiene for the protection of his health. Organs and systems of human organs.

Covering system. The structure and function of the skin. Derivatives of the skin: hair and nails. The role of the skin in thermoregulation, hardening of the body. Skin hygiene, prevention and first aid for burns, frostbite, and mechanical injuries.

Musculoskeletal system and movement. The main elements of the human musculoskeletal system. Parts of the skeleton: axial skeleton, skeleton of the limbs and their belts. Bone structure and function. The main types of bones and their connections. Joints. Cartilage, tendons, ligaments. Muscle structure and function. The main muscle groups of a person. First aid for bruises, sprains, fractures and dislocations.

Blood and circulation. The concept of the internal environment of the body, the meaning of the constancy of the internal environment. Blood, lymph and tissue fluid. Composition of human blood: blood plasma and various corpuscles, their structure and functions. Immunity and its types. Antigens and antibodies. The role of I.I. Mechnikov in the creation of the doctrine of immunity. Infectious diseases and the fight against them. Vaccinations and their role in the prevention of infectious diseases. Blood groups. Blood transfusion, donation. Blood clotting. The structure of the circulatory system: heart and blood vessels (arteries, capillaries, veins). Large and small circles of blood circulation. Prevention of cardiovascular diseases. First aid for bleeding. The harmful effects of smoking, alcohol and drug use on the cardiovascular system.

Respiratory system and gas exchange. The main components of the respiratory system. The structure of the lungs, the mechanism of inhalation and exhalation, gas exchange. The meaning of breathing. Respiratory hygiene. Respiratory diseases and their prevention. Prevention of the spread of infectious diseases. Air purity as a health factor. First aid techniques for carbon monoxide poisoning and rescue of a drowning man.

Digestive organs and nutrition. The structure and function of the digestive system. Divisions of the digestive tract and their functions. Digestive glands. The role of enzymes in digestion. Regulation of digestion, studies by I.P. Pavlova. Foods and nutrients: proteins, lipids, carbohydrates, minerals, water, vitamins. Hygiene of the digestive system, balanced nutrition. The importance of nutrition and digestion. Metabolism and energy in the human body, prevention of metabolic disorders. The role of vitamins in the body, their content in food. Prevention of food poisoning, intestinal infections and parasitic diseases.

The structure of the human urinary system. Organs of the urinary system and their functions. The formation of primary and secondary urine. Disease prevention. The role of other organ systems in the excretion of metabolic products.

Male and female reproductive systems, their structure and function. The formation of germ cells. The main stages of individual human development. The reasons for the violation



of individual development; hereditary diseases, their causes and prevention. Sexually transmitted infections, their prevention.

Nervous and humoral regulation of vital processes. The main endocrine glands and their importance for growth, development and regulation of body functions. Basic human hormones. The structure of the nervous system, its divisions: the central and peripheral nervous system. The structure and function of the brain and spinal cord. 6

Somatic and autonomic nervous system. Sense organs, their structure and functions. Analyzers. Analyzer malfunctions and their prevention. Conditioned and unconditioned reflexes, reflex arcs. Higher nervous activity, speech and thinking. Consciousness as a function of the brain. Social and biological conditioning of human behavior. The role of I.M. Sechenov and I.P. Pavlov in the creation of the doctrine of higher nervous activity. Disorders of the nervous system and their prevention. Sleep, its meaning and hygiene. The relationship between the processes of nervous and humoral regulation.

### **The evolution of the organic world.**

Evidence for the evolution of wildlife. History of evolutionary teaching; C. Linnaeus, J. Cuvier, J.-B. Lamarck and their role in the development of science. The main provisions of the theory of Charles Darwin, its significance.

Populations and their structure. Population size, age and sex composition, forms of coexistence of individuals. Variability in populations. Factors (driving forces) of evolution. Natural selection is the guiding factor in evolution. Forms of natural selection (driving, stabilizing, breaking). Struggle for existence. The role of ecology in the study of the mechanisms of evolutionary transformations. The emergence of fitness, its relative nature.

The species and its criteria. Speciation mechanisms. Isolation and its types, the role of geographic isolation.

Microevolution and macroevolution, the ratio of their mechanisms. The role of the study of ontogenesis in the knowledge of the mechanisms of evolution of the organic world. Biogenetic law. Biological progress and regression. Aromorphosis, idioadaptation, general



degeneration; the ratio of the paths of evolution. Evolutionary parallelisms and convergence, their reasons. Homologous and similar organs.

The main stages of the evolution of life. The origin of life on Earth. The most important aromorphoses in the evolution of living nature.

The origin and evolution of man. Evidence of human ancestry from animals. Stages of human evolution. The driving forces of anthropogenesis. The emergence of human races. Biological and social in human nature.

### **Organism and environment. Ecosystems. Biosphere.**

Ecology is the science of the relationship between organisms and the environment, the importance of ecology.

The concept of the environment and the ecological factor, the classification of environmental factors. The action of environmental factors. Limiting factors. Ecological niche concept. The main abiotic factors: light, temperature, humidity, their role in the life of organisms. Periodic phenomena in the life of nature: biological rhythms, photoperiodism. Types of interspecies relationships: competition, predation, parasitism, symbiosis.

Diversity of populations, their age and sex structure. Population dynamics and its causes.

Biological communities - multi-species systems, the relationship of organisms in the community. Ecosystem and biogeocenosis. Species and spatial structure of ecosystems. The role of rare species in nature and measures for their protection. Trophic structure of ecosystems: producers, consumers, decomposers. Rule of the ecological pyramid. Food chains and networks. The cycle of substances and the conversion of energy in ecosystems. 7

Self-regulation of ecosystems. External and internal causes of changes in ecosystems, ecological succession.

Human influence on natural ecosystems, the specificity of the action of anthropogenic factors. Comparison of natural and artificial ecosystems. Agroecosystems and urban ecosystems. The importance of biological diversity for the normal functioning of natural ecosystems, conservation of biological diversity. The value of environmental protection measures and rational use of natural resources.

The biosphere as a global ecosystem, its boundaries. V.I. Vernadsky's contribution to the development of the doctrine of the biosphere. Functions of living matter. Features of the distribution of biomass in the biosphere. Biological circulation. Evolution of the biosphere. Global changes in the biosphere and their causes. The influence of human activities on the evolution of the biosphere.

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1. Select two correct answers from five. What features are characteristic only of living organisms?

- 1) Ability to move
- 2) Unable to breathe and eat
- 3) Unable to reproduce
- 4) Can grow and reproduce
- 5) Weak variability

2. Select two correct answers from five. Functions of human subcutaneous adipose tissue

- 1) Plays the role of energy reserve
- 2) Keeps warm
- 3) Serves as a bone support.
- 4) Provides blood flow
- 5) Changes blood pH

3. Establish a match. For each position in the first column, select the appropriate position from the second column.

CHARACTERISTIC	ORGANOIDS
A) provides intracellular digestion	1) Golgi apparatus
B) represents a single-membrane vesicle	2) lysosome
C) intended to remove substances	
D) represents a disk-like membranous sacs	

4. Select the three correct answers that apply to the organ of hearing.

- 1) Auricle
- 2) Eye retina
- 3) Eardrum
- 4) Eustachian tube
- 5) Optical nerve
- 6) lens

5. Establish a match. For each position in the first column, select the appropriate position from the second column.

COMPOUND	THE CHEMICAL COMPOSITION OF CELLS
A. Water	1. Organic compound
B. Organic acid	2. Inorganic compound
C. Mineral salt	
D. Fats	
E. Proteins	



6. Select two correct answers from five. What functions are performed by leukocytes?
- 1) Protection against infection
  - 2) Oxygen transfer
  - 3) Coagulation
  - 4) Formation of immunity
  - 5) The transfer of carbon dioxide
7. Select two correct answers from five. The cell nucleus includes:
- 1) Nucleus membrane
  - 2) Golgi apparatus
  - 3) Nucleolus
  - 4) Cellulose
  - 5) Starch
8. Establish a match. For each position in the first column, select the appropriate position from the second column.

PROPERTIES	IMMUNITY TYPE
A. Transmitted by inheritance	1. Innate
B. Exists since birth	2. Passive
C. It occurs as a result of blood transfusion	
D. Formed as a result of vaccination	

9. Select two correct answers from five. Functions of sweat glands.
- 1) Milk production and secretion
  - 2) Thermoregulatory sweating
  - 3) Excretory function
  - 4) Form a fat
  - 5) Give hair elasticity
10. Establish a match. For each position in the first column, select the appropriate position from the second column.

CHARACTERISTIC	ORGANOIDS
A. Green plastid	1. Chloroplast
B. Oxidation of organic compound	2. Mitochondria
C. Contain chlorophyll	
D. ATP synthesis	

11. Select two characteristics that are present in prokaryotic cells.
- 1) Nucleus

- 2) Mitochondria
- 3) Cell membrane
- 4) Golgi apparatus
- 5) Ribosomes

12. Establish a match. For each position in the first column, select the appropriate position from the second column.

CHARACTERISTIC	REPRODUCTION
A. Combining the genetic information from two individuals of different sexes	1. Sexual reproduction
B. Types of reproduction of animals and humans	2. Asexual Reproduction
C. Practiced by most single-celled organisms including bacteria, archaeobacteria and protists	
D. Organism makes more of itself without exchanging genetic information with another organism through sex	

13. Establish a match. For each position in the first column, select the appropriate position from the second column.

FUNCTION	LAYERS OF SKIN
A. Barrier	1. Epidermis
B. Skin color	2. Subcutaneous fat
C. Energy reserve	
D. Keeps warm	
E. Skin hydration	

14. Select two features that are used to describe the structure of plant cells.

- 1) Variety of plastids
- 2) Cellulose cell membrane
- 3) Absence of chloroplast
- 4) Heterotrophic type of nutrition
- 5) Fragile cell wall

15. Establish a match. For each position in the first column, select the appropriate position from the second column.

CHARACTERISTIC	BIOMASS
A. Trees with leaves prevail	1. Trees
B. Large area covered with sand	2. Desert
C. Virtually no plants	
D. Many dry lakes	

E. Fertile soil with different vegetation	
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16. Select two characteristics of the uterus.

1. Provides nutrition for the future child
2. Provides synthesis of bile acids
3. Normalizes blood glucose levels
4. Is the development of the embryo
5. Movement of food in the intestine

17. Establish a match between examples and types of sources of greenhouse gases. For each position in the first column, select the appropriate position from the second column.

EXAMPLES	THE TYPES OF SOURCES
A. Volcanic eruption	1. Natural
B. Natural gas combustion	2. Human influence
C. Kindling of fireplaces	
D. Oil combustion	
E. Organic rot in the swamps	

18. Select two correct answers from five. Functions of sebaceous glands:

- 1) Produce a fat
- 2) Lubricate the skin
- 3) Milk production and secretion
- 4) Thermoregulatory sweating

19. Select three correct answers from five Which of the following communities can be attributed to the communities that people created

- 1) Wheat field
- 2) Cherry orchard
- 3) Forest
- 4) Swamp
- 5) Water reservoir

20. Select two correct answers. Vacuoles serve to

- 1) Expand the plant cells
- 2) Sites for storage
- 3) Digestion
- 4) Non-specific function



## LIST OF REFERENCES AND INFORMATION SOURCES FOR PREPARATION FOR ENTRANCE EXAM

### *Main literature*

Borodin P.M., Vysotskaya L.V., Dymshits G.M. etc. Biology (profile level). 10-11 grade. In 2 parts. - M.: Education, 2014.

Dubinina N.V., Pasechnik V.V. Biology. Bacteria, fungi, plants. 6th grade.  
- M.: Bustard, 2014.

Kamensky A.A., Kriksunov E.A., Pasechnik V.V. Biology. General biology.  
10-11 grade. - M.: Bustard, 2014.

Kolesov D.V., Mash R.D., Belyaev I.N. Biology. Human. 8th grade. - M.: Bustard, 2014.

V.V. Pasechnik Biology. Grade 7 (series "Life Line"). - M.: Education, 2013.

Pasechnik V.V., Kamensky A.A., Shvetsov G.G. (under the editorship of Pasechnik V.V.) Biology. 8th grade. - M.: Education, 2013.

Pasechnik V.V., Sumatohin S.V., Kalinova G.S. (under the editorship of Pasechnik V.V.) Biology. 7 cl. - M.: Education, 2013.

### *Additional literature*

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Kalinova G.S., Nikishova, E.A., Petrosova R.A. (edited by G. S. Kalinova) Unified State Exam-2011. Biology: a workshop on preparation for the exam. Moscow: National Education, 2011.

Taylor D., Green N., Stout W. Biology. In three volumes. - M.: Mir, 2012.

### *Information reference and search systems*

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