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Institute of Fundamental Medicine and Biology

Approved

Vice-rector for Academic affairs

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2025



BIOLOGY ENTRANCE TEST PROGRAM
FUNDAMENTALS OF HUMAN BIOLOGY

Speciality: General Medicine

Dentistry

2025

Approval of the entrance test program

Head of the Department of Bioecology, Hygiene and Public
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Examination Committee _____ **K.K.Ibragimova, A.A. Valeeva**

The program of the entrance test was discussed and approved at the meeting of the IFMB
Biology Examination Committee, Protocol No. 1 of September 2025.

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Introduction

1.1 The purpose and objectives of the entrance exams

The purpose of the exam in Fundamentals of Human Biology is to determine the level of professional training of the applicant and compliance with the requirements for knowledge, skills and abilities in the subject area corresponding to the profile of training, to identify the participants' level of knowledge and skills at the basic and profile level, to determine the degree of readiness to study at the university. The exam diagnoses the abilities of logical biological thinking, the possibility of applying theoretical knowledge in solving tasks with standard and non-standard conditions.

At the exam, the applicant must show:

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

1.2. General requirements for the organization of entrance exams

Citizens of foreign countries who have successfully completed training in the educational programs of the basic general compulsory and have a state-issued document: a certificate are allowed to enter the entrance tests. The management of the organization and conduct of entrance examinations is carried out by members of the examination commission, who bear full responsibility for compliance with the legislation of the Russian Federation, the requirements of the Federal State Educational Standard, local documents on the preparation and conduct of entrance examinations. Entrance examinations are conducted in accordance with the principles of respect for the rights and freedoms of citizens established by the legislation of the Russian Federation, transparency and openness of the results of entrance

examinations, objectivity of assessment of the abilities of applicants and uniformity of assessment of entrance examinations. Admission to educational programs is carried out on a competitive basis based on the results of the exam.

1.3. Description of the form of entrance exams

The entrance test in biology is conducted in writing (in person) in the form of a Unified State Exam (USE).

1.4. Duration of entrance exams

The duration of the written exam is 2 hours.

1.5. Structure of entrance exams

The content of the examination task is established in accordance with the program of the entrance test, developed on the basis of the Federal State Educational Standard of secondary (full) General Education, approved by Order of the Ministry of Education and Science No. 413 of 17.05.2012, 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 17.12.2010. The structure of the examination task and the evaluation criteria corresponds to the Specification of the control measuring materials of the Unified State Exam in Biology.

The maximum score is 100.

PROGRAM CONTENTS

Biology as a Science.

Biology is the science of living nature. 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, growth, self-reproduction, heredity and variability, irritability, self-regulation.

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.

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 and Translation. 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 metabolism.

Reproduction and individual development of organisms.

Cell division. 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. 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 Selection.

Genetics is the science of heredity and variability of organisms. Basic methods of genetics. Basic concepts of genetics: gene, allele, feature, homozygote and heterozygote, 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 selection. 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. The main systematic categories: kingdom, phylum or division, class, order, family, genus, species. Features of the structure and functioning of representatives of the main kingdoms of living nature: bacteria, plants, animals and fungi.

The bacteria kingdom. The main features of the structure and life of bacteria, their reproduction. Spores. 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 fungi kingdom. Forms of the vegetative body of fungi. Hat mushrooms, their structure, nutrition, reproduction. 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 plants kingdom. 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 (Ulotrix) 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. The main groups of plant tissues. 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 escape. Plant buds. Stem. 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 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.

The kingdom animal. 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.

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

Human 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.


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. 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. 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.

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.

FUND OF EVALUATION FUNDS

3.1. Instructions for performing the work

The examination paper consists of two parts, including 29 tasks. Part 1 contains 22 tasks with a short answer. Part 2 contains 7 tasks with a detailed answer. It takes 2 hours (120 minutes) to complete the biology exam paper. The answers to the tasks of Part 1 (1-22) are a sequence of digits, a number or a word (phrase). Write down the answers according to the samples given below in the answer field in the text of the work without spaces, commas and other additional characters, and then transfer them to the answer form No. 1.

Tasks of Part 2 (23-29) require a full answer (to give an explanation, description or justification; to express and argue your own opinion). In the answer form No. 2, specify the task number and write down its complete solution.

The points received for completed tasks are summed up. After completing the work, make sure that the answer to each task in answer forms No. 1 and No. 2 is written under the correct number.

3.2. Sample assignments for entrance exams

1. Choose one correct answer. Photosynthesis takes place in cells
 - 1) roots
 - 2) fruit pulp
 - 3) cabbage seeds
 - 4) apple tree leaves

2. Choose one correct answer. Ringworms are descended from the ancient
 - 1) parasitic flatworms
 - 2) free-living roundworms
 - 3) free-living flatworms
 - 4) coelenterates

3. Choose one correct answer. The mechanical function of the human skeleton includes
 - 1) hematopoiesis
 - 2) mineral salt exchange
 - 3) shock mitigation when walking
 - 4) participation in immunity

4. Choose one correct answer. Excess or lack of hormones in the blood is perceived
 - 1) the cerebral cortex
 - 2) liver
 - 3) hypothalamus
 - 4) cerebellum

5. Choose one correct answer. What function does the pupil of the eye perform?
 - 1) converts light energy into a nerve impulse
 - 2) regulates the luminous flux
 - 3) focuses the image on the retina
 - 4) provides transmission of nerve impulses to the central nervous system

6. Choose one correct answer. The signal for the onset of leaf fall in plants of the temperate zone is
 - 1) increase in air temperature
 - 2) reducing the length of daylight
 - 3) increasing the humidity of the environment
 - 4) lowering the air temperature

7. All but three of the signs listed below are used to describe the processes occurring in mitochondria. Choose the three signs that "drop down" from the general list
 - 1) photolysis of water
 - 2) protein biosynthesis

- 3) cleavage of glucose to two PVC molecules
- 4) electron transport by carriers in the membrane
- 5) electron excitation by light
- 6) synthesis of ATP molecules

8. Match a correspondence between the arthropod feature and the class.

ARTHROPODS FEATURE	CLASS
A) The body has three divisions: head, thorax, and abdomen	1) spiders 2) insects
B) The body consists of a cephalic thorax and an undivided abdomen	
C) respiratory organs - trachea and lung sacs	
D) four pairs of walking legs	
E) there are three pairs of legs on the chest, many have wings	

9. All of the following attributes (except three!) can be used to describe the processes that occur in the prophase of the first division of meiosis. Identify the three traits that "fall out" of the general list.

- 1) formation of two centrioles
- 2) bivalence divergence
- 3) Convergence of homologous chromosomes
- 4) exchange of sections of homologous chromosomes
- 5) chromosome despiralling
- 6) destruction of the nuclear membrane

10. Correlate the characteristics of an organism belonging to a particular kingdom.

PROPERTY	KINGDOM
A) Nuclear-free organisms	1) Plants
B) Murein cell wall	2) Bacteria
C) ATP is synthesised in plastids and mitochondria	
D) create carbohydrates from water and carbon dioxide	
E) the genetic apparatus is contained within the ring chromosome	
F) there are photo- and chemosynthetics	

11. Choose three correct answers out of six. In which case can animal behaviour be attributed to instincts?

- 1) fish spawning migrations

- 2) reactions of infusoria to table salt
- 3) nectar and pollen collection by bees
- 4) Euglena greenspot moving into an illuminated area
- 5) Aquarium fish reaction to tapping the feeder
- 6) cuckoo laying eggs in the nests of strange birds

12. Match the characteristics with the types of human tissue.

CHARACTERISTICS	TISSUE TYPE
A) Lining the airways	1) Bony
B) Solid intercellular matter	2) Blood
C) Cells are able to move around on their own	3) Ciliated epithelium
D) Participates in gas exchange	
E) The cells are tightly attached to each other	
F) Contains osteocytes and osteoblasts	

13. Set up a sequence of systematic groups of animals, starting with the highest rank. Record the corresponding sequence of numbers.

- 1) Nile crocodile
- 2) Crocodiles
- 3) Chordates
- 4) Vertebrates
- 5) Caymans
- 6) Reptiles

14. Choose three correct answers out of six. The internal environment of the human body is formed by

- 1) the contents of the mouth
- 2) cytoplasm and nucleus
- 3) tear fluid
- 4) tissue fluid
- 5) lymph
- 6) with blood

15. Match the parts of the nervous system with the functions they perform.

FUNCTION	NERVOUS DEPARTMENT	SYSTEM
A) directs impulses to skeletal muscles	1) autonomic	
B) regulates lung function	2) somatic	

C) regulates the salivary glands D) enables the body to move in space E) innervates smooth muscle F) increases intestinal peristalsis	
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16. Identify the sequence of the nerve impulse along the reflex arc. Write the corresponding sequence of numbers.

- 1) Transmission of excitation to the operating body
- 2) the occurrence of an impulse in the receptor
- 3) impulse transmission to the insertion neuron
- 4) impulse transmission by motor neuron
- 5) impulse transmission by the sensory neuron

17. Choose three correct answers out of six. Examples of idioadaptations in plants are:

- 1) the emergence of adaptations to the spreading of seeds by wind or animals
- 2) the emergence of the flower
- 3) differentiation of tissues into covering, mechanical and conductive
- 4) emergence of generative organs
- 5) the emergence of a mosaic arrangement of leaves

18. Make a correspondence between the examples and the factors of anthropogenesis

PROCESS EXAMPLES	FACTORS OF ANTHROPOGENESIS
A) polysacral manifestation B) vaulted foot C) speech D) labour activity E) second signaling system F) combinative variation	1) biological 2) social

19. Choose three correct answers out of six. Artificial ecosystems include

- 1) A banana plantation
- 2) paddy field
- 3) a forest lake
- 4) a city park
- 5) coniferous forest
- 6) a birch grove

20. Match the characteristics and names of the functions of living matter in the biosphere (according to Vernadsky).

CHARACTERISTIC	FUNCTION OF LIVING MATTER
A) limestone formation	redox
B) accumulation of silicon salts in horsetail cells	gas
C) formation of water and carbon dioxide in the breathing process of aerobes	concentration
D) reduction of carbon dioxide during photosynthesis	
E) release of methane into the atmosphere as a result of the activity of denitrifying bacteria	

21. Identify the sequence of processes that occur in the nitrogen cycle, starting with atmospheric nitrogen entering organisms. Write the corresponding sequence of numbers.

- 1) Urea in the soil
- 2) Nitrogen compounds entering the plants
- 3) Food eating by animals
- 4) Nitrogen fixation by nodule bacteria
- 5) Denitrification by soil bacteria
- 6) Protein synthesis in plants

22. Analyse the table. Fill in the empty cells of the table using the terms given in the list. For each cell labelled with a letter, choose the appropriate term from the suggested list.

Title	Location: the bones to which they are attached	Function
Chewables	(A)	Jaw movement
(B)	Sternum, ribs, some vertebrae	Breathing movements
Deltoid muscle	(C)	Performs rotary movements of the shoulder

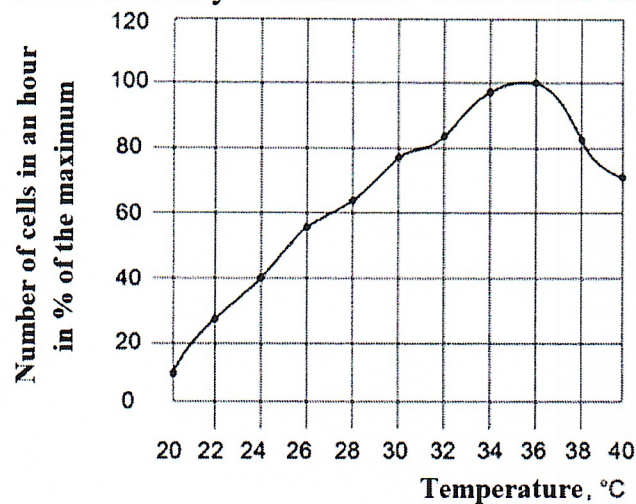
List of terms:

- 1) scapula, clavicle, humerus
- 2) large thoracic
- 3) only to the skin
- 4) diaphragm
- 5) to the temporal bone and to the lower jaw

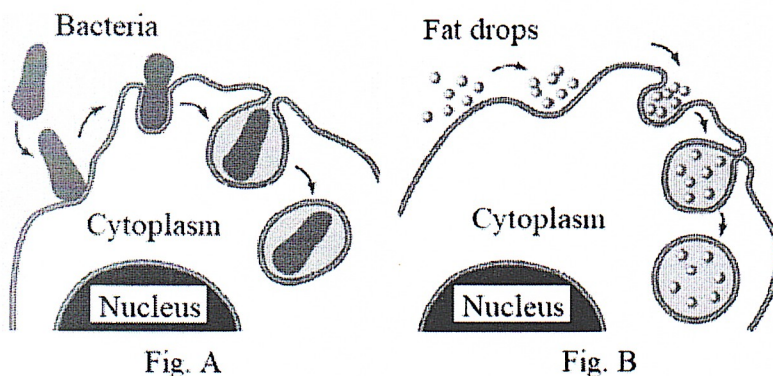
- 6) to the skull bones and to the skin
- 7) intercostal
- 8) pelvic bone, femur

23. An experimenter decided to study the effect of temperature on a colony of bacteria. He grow the bacterial colony on nutrient media. During the experiment, the experimenter changed the temperature and recorded the results of the experiment in the form of a graph (Figure A).

Which parameter is set by the experimenter (the independent variable) and which parameter changes in response to this (the dependent variable)? Explain the results of the experiment. How do changes in temperature affect a colony of bacteria? What could these changes be related to?



24. Which processes accompanying the feeding of the amoeba are shown in Figures A and B? Name the cell structure directly involved in these processes. What transformations with the bacterium will occur next in the amoeba cell (in Fig. A)?



25. Find three errors in the above text 'Human glands'. Give the numbers of the sentences in which the mistakes are made, correct them. Give the correct wording.

(1) All glands of the human body are divided into three groups: external, internal and mixed secretion glands. (2) The secretions produced in all the external secretion glands travel exclusively to the surface of the body through their ducts. (3) The secretions of the secretions of the secretion glands enter the blood stream through the ducts. (4) The endocrine glands secrete biologically active regulatory substances called hormones. (5) Hormones regulate metabolism, influence the growth and development of the organism, and participate in the regulation of all organs and organ systems and processes at the

cellular level. (6) Pancreatic hormone (insulin) regulates blood glucose levels. (7) Increased levels of thyroid hormone (adrenaline) cause the heart to beat faster.

26. *Tuffelia infusoria* are characterised by the process of conjugation. Why is it regarded as a sexual process, but not as sexual reproduction? What is the significance of conjugation for the adaptation of unicellular organisms? Explain the answer.

27. How is the concentration of oxygen and nitrogen in the atmosphere relatively constant? Identify four processes involving living matter in the biosphere.

28. The chromosomal set of somatic radish cells is 18. Determine the chromosomal set and the number of DNA molecules in the cells and nuclei of the root tip during metaphase and the end of telophase of mitosis. Explain what processes occur to the chromosomes during these phases.

29. When a maize plant with smooth, uncoloured seeds and a plant with wrinkled, coloured seeds were crossed, the entire progeny came out with smooth, coloured seeds. In the analytical cross of the hybrid offspring, four different phenotypic groups were obtained: 250, 247, 103, 101. Draw the schemes of the crosses. Identify the genotypes of the parents and the genotypes, phenotypes and number of offspring of each group in the two crosses. Explain the formation of the four phenotypic groups in the analytic cross.

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Information reference and search systems

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