



**JESSENIUS FACULTY  
OF MEDICINE IN MARTIN**  
Comenius University  
Bratislava

# JFMED admission exam

## Biology

## Preparing for the JFMED admission exam

JFMED admission exam is held [online](#) and in two subjects; chemistry and biology. During the exam, you will be presented with 40 multiple-choice questions in each subject with only one correct answer. For each correct answer you receive one point. Points are not deducted for incorrect answers. The exam lasts two hours.

The admission exam is structured around the content and scope of the learning covered at the secondary (high school) school in Slovakia. This document offers a range of biology topics that the exam is likely to be structured around as well as some mock questions selected from the previous entry exams.

# Biology

**CYTOLOGY: Basic characteristics of the cells:** Prokaryotic and eukaryotic cells – principal differences. Inorganic and organic components in the cell, their basic structure and function – carbohydrates, proteins, lipids, nucleic acids. **Biomembranes:** Composition, orientation of membrane macromolecules, characteristics of the plasma membrane. Transport of molecules across the membrane – osmosis, diffusion and active transport; effect of osmosis on the plant and animal cells. Endocytosis (phagocytosis, pinocytosis) and exocytosis – steps and characteristics. Principle of cell signalling. **Structure of the prokaryotic cell:** Organisation of DNA (chromosome, plasmids), membranous and non-membranous structures, cell surfaces (plasma membrane, cell wall, capsule), flagella, pili. Bacteria and archaeobacteria – their shape and classification. Transfer of genetic information in bacteria – conjugation, transformation, transduction. Human diseases caused by bacteria. **Structure of the eukaryotic cell:** Genetic information of the cell – nuclear and extra-nuclear DNA. Membranous structures of the cell – characteristics and function (nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles). Non-membranous structures of the cell – characteristics and function (ribosomes, cytoskeleton). **Metabolism:** Catabolic and anabolic processes, energy exchange in the cell, aerobic and anaerobic metabolism. The cell as an energetically autonomous unit. Autotrophy and heterotrophy. **Cell division:** Amitosis vs. mitosis. Cell cycle and characteristics of its phases (G<sub>0</sub>, G<sub>1</sub>, S, G<sub>2</sub>, M), regulation of the cell division. **Meiotic division:** Characteristics and phases of meiosis I. and II. **Viruses:** Characteristics of viruses, reproduction (lytic and lysogenic cycle) and classification. Diseases caused by viruses.

**PLANTS: Plant cell:** Composition and function of the cell wall, membranous and non-membranous organelles. **Plant tissues:** Characteristics and types – meristematic tissues; parenchyma, collenchyma, sclerenchyma; transport tissues; dermal and secretory tissues. **Plant organs:** Vegetative organs (root, stem, leaf) – their structure and functions. Generative organs (flower, stamen, pistils) – structure and function, characteristics of fertilisation in plants. **Metabolism:** Catabolic and anabolic processes. Photosynthesis and plant breathing. Lifestyles in plants – saprophytism, semiparasitism, parasitism, mixotrophic nutrition. **Plant growth:** Nutrition and hormonal regulation. **Reproduction:** Vegetative and sexual.

**ANIMALS: Unicellulars:** General characteristics, taxonomic division, representatives of individual classes with respect to the diseases which they cause, their life cycle and type of reproduction. **Digestive system:** Metabolism and energy flow in the organism. Mechanisms of nutrition and processes of digestion. Evolution of digestive system. **Respiratory system:** Gas exchange between tissues and the environment in different classes of animals. **Circulatory system:** Types of body fluids in animals. Systems of open and closed blood circulation, flow of the blood in blood vessels; blood groups and blood clotting. Evolution of the circulatory system. **Excretory system:** Evolution of the excretory system, structure and function of the nephron, secretion and composition of the urine. **Hormonal regulations:** Mechanisms of direct and indirect effect of hormones, regulation of hormone level in body fluids. **Nervous system:** Characteristics of nervous regulations and the types of nervous systems in different classes of animals. The structure and the function of the neurone. Central nervous system in vertebrates. Instincts, conditioned and unconditioned reflexes, origin and stability of conditioned reflexes, memory and memory traces, learning and thinking. **Muscles:** Structure and function of muscle fibres; characteristics of muscle types (smooth, striated, heart

muscles), classification of muscles according to the content of myoglobin, energy sources for muscle activity, muscle fatigue. Mechanism of muscle contraction. Evolution of locomotion in animals. **Immune system:** Immune responses in animals. Non-specific and specific immunity. Passive and active immunisation. **Reproductive system:** Types of reproduction in animals (sexual, parthenogenesis, hermaphroditism) and their lifecycles. Origin and types of gametes, isogamy and anisogamy.

**GENETICS: Basic genetic terminology:** Genes (regulatory and structural genes, genes for RNAs), allele, multiple alleles, genotype, phenotype, qualitative and quantitative traits, homozygous and heterozygous individuals, autosomes and sex chromosomes, genome, karyotype. **Genetic information:** DNA replication. Gene expression (transcription and translation). Comparison of genes in prokaryotes and eukaryotes. Genetic information in prokaryotic and eukaryotic cell, types of human chromosomes. **Inheritance of qualitative traits:** Relations between alleles (complete dominance, incomplete dominance, codominance). Mendel's laws – monohybrid and dihybrid cross, backcrossing. Inheritance of blood groups in humans. Characteristics of autosomal dominant and autosomal recessive inheritance. **Gonosomal inheritance:** Modes of chromosomal sex determination (*Drosophila*, *Abraxas*), homogametic and heterogametic sex. Characteristics of human sex chromosomes X and Y. Characteristics of X-linked dominant, X-linked recessive and Y-linked inheritance. Sex-influenced and sex-limited traits. Examples of human diseases caused by gonosomal genes. **Genetic linkage:** Morgan's rules. Complete vs. non-complete linkage. Importance of genetic linkage. **Mutations:** Mutagens (chemical, physical, biological). Classification of mutations. Gene mutations (substitution, insertion, deletion). Structural chromosomal mutations (deletion, duplication, inversion, translocation). Numerical chromosomal mutations (aneuploidy, polyploidy). Examples of human disorders caused by mutations. **Interactions between non-allelic genes:** Epistasis, additive effect. **Population genetics.** Definition of the population. Hardy-Weinberg law and the genetic equilibrium in population. Autogamy and random mating populations. Factors influencing the equilibrium in population (selection, migration, genetic drift, mutations). **Human genetics:** Methods used in human genetics, genetic diseases and dispositions, genetic counselling.

**HUMAN BIOLOGY: Bones:** Structure, function, types, connections. Bones of the human body. **Muscles:** Types of muscles, muscle systems, muscle innervation. **Blood:** Composition, function, volume of blood. Blood cells – their origin, shape and function. Sedimentation, types of haemoglobin, blood systems (ABO, Rh factor), blood clotting, blood transfusion. **Heart:** Structure of the heart, activity, innervation, blood supply. Minute volume of the heart, heart stroke, regulation of heart activity. **Arteries, veins, capillaries:** Their structure and function, blood circulation, blood pressure, regulation of blood circulation, lymph production and function, haemostasis, emboly, thrombosis. **Respiration:** Airways, structure and function of lungs. Mechanism of inspiration and expiration, internal and external gases exchange. Breathing regulation, respiratory defence reflexes and respiratory diseases. **Digestion:** Composition and function of digestive system. Glands of digestive system and their products, intestinal juice and its composition. Metabolism and energy exchange, digestion of different foods. Liver and its function. Defecation reflex, starvation, malnutrition and obesity. Vitamins – names, their role, deficiency effects, hypovitaminosis and avitaminosis. **Excretion:** Kidneys – their structure and function, structure of nephron. Primary and secondary urine – composition and amount, regulation of kidney function. Urinary tracts – ureters, bladder, urethra. Role of the skin in excretion. **Regulation of body functions:** neural and chemical regulation, their interrelationship. **Endocrine glands:** Characteristics of endocrine glands and their hormones, regulation of hormone secretion into

blood, most important effects of hormones. **Neural system:** Structure and function of neurone, synaptic junction. Central nervous system – brain (its parts and functions), spinal cord, spinal nerves. Reflex circuit, spinal somatic reflexes, sympathetic and parasympathetic nervous system, higher nervous activity. **Receptors:** Types of receptors and their characteristics – exteroceptors, interoceptors and proprioceptors; radioreceptors, chemoreceptors, mechanoreceptors and photoreceptors. Stimulus, adaptation to stimuli. **Immunity:** Organs and cells of immune system. Mechanism of innate and acquired immunity. Allergy. **Reproduction:** Female reproductive system – organs, ovarian and uterine cycles. Fertilisation, pregnancy, prenatal ontogenesis. Male reproductive system – organs, development of sperm cells.

Mock questions. The correct answers are located at the end of the document.

1. What is the portion of water in embryonal cells:
- the same as in all cells of adult organism and ranges from 10- 50%.
  - markedly lower than in cells of adult organism and ranging from 15- 40%.
  - markedly higher than in cells of adult organism
  - different and changes by influence of environment from 15- 60%.
  - the same as in all cells of adult organism and ranges from 20- 40%.
  - none of above-mentioned answers is correct

2. When we put the animal cell into hypertonic solution:
- water will flow out of cell into its surrounding and the cell will shrink
  - cell will not react to hypertonic solution
  - water will flow out of the cell and the cell will burst
  - shape of the cell will not be changed, but the cytoplasm thickens up
  - water will flow into cell and the cell will shrink
  - water will flow into cell into and the cell will burst

3. What does the term fagocytosis express:
- intake of all substances which enter the cell
  - intake of drops of solutions by rearrangement of plasma membrane
  - general exchange of substances between cell and surrounding
  - the term involves all forms of passive transport
  - intake of solid substances by rearrangement of cytoplasmic membrane
  - the term involves all forms of passive transport

4. ATP is a nucleotide consisting of:
- aminoacids and 3 phosphate groups
  - glucose, amino acids and 3 phosphate groups
  - ribose, nitrogen base adenin and 3 phosphate groups
  - deoxyribose, one of four known bases and 3 phosphate groups
  - ribose, amino acids and 3 phosphate groups
  - hexose, amino acids and 3 phosphate groups

5. Mycobacterium is a causative agent:
- of rabbies
  - of foot-and-mouth in cattle
  - of tuberculosis
  - of hepatitis
  - of AIDS
  - of influenza

6. What type of Archae live in hot sulphur springs:
- metanoarchae
  - haloarchae
  - ferroarchae
  - nitroarchae
  - termoarchae
  - none

7. What are the contractile elements of the cytoskeleton:

- a. all
- b. microtubules
- c. microfilaments
- d. intermediate filaments
- e. tubuline filaments
- f. spectrin filaments

8. Segregation of homologous chromosomes occurs during:

- a. prophase of 1st meiotic division
- b. metaphase of 1st meiotic division
- c. anaphase of 1st meiotic division
- d. telophase of 1st meiotic division
- e. anaphase of 2nd meiotic division
- f. telophase of 2nd meiotic division

9. One of the main cell cycle checkpoints is:

- a. G<sub>1</sub> checkpoint
- b. S checkpoint
- c. anaphase checkpoint
- d. telophase checkpoint
- e. answers „a“ and „c“ are correct
- f. answers „a“ and „d“ are correct

10. Formation of spindle fibres starts in:

- a. S phase
- b. G<sub>2</sub> phase
- c. prophase
- d. metaphase
- e. anaphase
- f. telophase

11. Bacterial cells divide by:

- a. mitotic division
- b. binary fission
- c. heterotypic division
- b. homeotypic division
- c. reduction division
- d. DNA replication

12. Which muscles are formed by uninuclear cells:

- a. smooth muscles
- b. skeletal muscles
- c. striated muscles
- d. striped muscles
- e. all types of muscles
- f. none

13. Lysosomes contain:

- a. enzymes of Creb's cycle
- b. hydrolytic enzymes

- c. ATP synthases
- d. enzymes of respiratory chain
- e. oxygenases
- f. fatty acid synthases

14. What pigment is synthesised in the proces of hemoglobin breakdown after destruction of senescent red blood cells:

- a. muscle pigment myoglobin
- b. bile pigment urochrome
- c. bile pigment urobilin
- d. bile pigment bilirubin
- e. hepatal pigment stercobilin
- f. melanin

15. Gases such as O<sub>2</sub> and CO<sub>2</sub> ca pass through the plasma membrane:

- a. by simple diffusion
- b. by exocytosis
- c. by transport proteins
- d. by phagocytosis
- e. by pinocytosis
- f. by transcytosis

16. Primary urine of mammals is produced:

- a. in glomerulus
- b. in loop of Henle
- c. in Bowman capsule
- d. in proximal convoluted tubules
- e. in distal convoluted tubules
- f. in collecting ducts

17. Nerve impulse is transmitted from one neuron to the following:

- a. by sodium ions
- b. by potasium ions
- c. by calcium ions
- d. by manganese ions
- e. by chemical mediators - neurotransmitters
- f. answers „a“ and „b“ are correct

18. Double helical model of DNA was proposed by:

- a. Miescher
- b. Mendel
- c. Watson and Crick
- d. Darwin
- e. Morgan
- f. Lamarck

19. Double stranded nucleic acids are:

- a. mRNAs
- b. tRNAs
- c. rRNAs



- d. DNAs
- e. answers „a“ and „d“ are correct
- f. answers „b“ and „d“ are correct

20. The scientific study of genes and heredity is:

- a. genomics
- b. generics
- c. genesis
- d. genetics
- e. genotype
- f. genome

21. Gene expression is realised through:

- a. trancription
- b. replication
- c. translation
- d. answers „a“ and „b“ are correct
- e. answers „a“ and „c“ are correct
- f. answers „b“ and „c“ are correct

22. Resistance to antibiotics in bacteria is determined by genes located in:

- a. bacterial chromosome
- b. plasmids
- c. mitochondria
- d. plastids
- e. ribosomes
- f. resistance is not regulated by genes

23. According to the ratio of chromosomal arm length, chromosomes are classified as:

- a. metaphasic, submetaphasic, acrophasic and telophasic
- b. prophasic, metaphasic, anaphasic, telophasic
- c. metacentric, submetacentric, acrocentric and telocentric
- d. procentric, metacentric, anacentric and telocentric
- e. procentric, metacentric, submetacentric, anacentric and telocentric
- f. pericentric, metacentric, submetacentric, acrocentric and telocentric

24. Intermediarity in Mendels rules means:

- a. complete equality of alleles in phenotype of dominant homozygous individuals
- b. complete recessivity of both alleles in phenotype of recessive homozygous individual
- c. complete dominance of dominant allele in phenotype of heterozygous individual
- d. complete dominance of both alleles in phenotype of dominant homozygousc individuals
- e. complete recessivity of both alleles in phenotype of dominant homozygous individual
- f. partial phenotypic effect of dominant as well as recessive allele in heterozygous individuals

25. Recessive alleles show their effect if:

- a. individual has two recessive copies of the allele
- b. individual has two dominant copies of the allele
- c. individual has one dominant and one recessive copy of the allele
- d. individual has one dominant copy of the allele
- e. individual has one recessive copy of the allele
- f. none of above-mentioned answers is correct

26. Sickle-cell anemia in humans is a result of:

- a. structural mutation
- b. numeric mutation
- c. gene mutation
- d. gene transcription
- e. answers „a“ and „c“ are correct
- f. answers „b“ and „c“ are correct

27. Cells of cartilage are called:

- a. osteocytes
- b. fibrocytes
- c. chondrocytes
- d. myocytes
- e. monocytes
- f. macrocytes

28. How many vertebrae are in the human spine:

- a. 7 cervical, 12 thoracic, 6 lumbal, 5 sacral and 3-5 coccyx
- b. 7 cervical, 12 thoracic, 5 lumbal, 5 sacral and 4-5 coccyx
- c. 7 cervical, 11 thoracic, 5 lumbal, 5 sacral and 3-4 coccyx
- d. 7 cervical, 12 thoracic, 4 lumbal, 6 sacral and 4-5 coccyx
- e. 12 cervical, 7 thoracic, 4 lumbal, 6 sacral and 4-5 coccyx
- f. 12 cervical, 7 thoracic, 4 lumbal, 5 sacral and 4-5 coccyx

29.  $Ca^{2+}$  ions play an important role in muscle contraction by:

- a. creating interaction between proteins actin and haemoglobin
- b. creating interaction between proteins actin and myoglobin
- c. creating interaction between proteins actin and myosin
- d. creating interaction between proteins myosin and haemoglobin
- e. creating interaction between proteins myosin and myoglobin
- f. creating interaction between proteins myosin, actin and myoglobin

30. The largest and heaviest muscle in the human body is:

- a. sartorius muscle
- b. gluteus maximus
- c. triceps brachii
- d. biceps brachii
- e. deltoid muscle
- f. triceps surae

31. Main components of human gastric juice are:

- a. hydrochloric acid, pepsin and trypsin
- b. hydrochloric acid, and enzymes - pepsin, lipase, chymosin
- c. hydrochloric acid, trypsin and chymosin
- d. hydrochloric acid, chymosin, trypsin and pepsin
- e. hydrochloric acid, amylase, trypsin and pepsin
- f. hydrochloric acid, amylase, lipase and pepsin

32. What is the normal respiratory rate of human adults:

- a. 5 – 8 breaths per minute
- b. 10 – 12 breaths per minute
- c. 12 – 14 breaths per minute
- d. 16 – 18 breaths per minute
- e. 20 – 22 breaths per minute
- f. 24 – 26 breaths per minute

33. What is an epiglottis:

- a. is a cartilage structure that sits in front of the larynx
- b. is a cartilage structure that sits above thyroid glands
- c. is a small bone that covers windpipe
- d. is a small cartilage that covers windpipe
- e. is a small bone which allows breathing
- f. is a small muscle which allows breathing

34. Coronary arteries take oxygen-rich blood:

- a. from right ventricle to lungs
- b. from left ventricle to lungs
- c. from right atrium to lungs
- d. from left atrium to the heart muscle
- e. from the aorta to lungs
- f. from the aorta to the heart muscle

35. Mitral valve separates::

- a. right atrium and right ventricle
- b. right atrium and left atrium
- c. right ventricle and left ventricle
- d. left atrium and the left ventricle
- e. right ventricle and aorta
- f. left ventricle and aorta

36. Antibodies are produced by:

- a. neutrophils
- b. B-lymphocytes
- c. T-lymphocytes
- d. monocytes
- e. basophils
- f. eosinophils

37. How does thyroid stimulating hormone act in human body:

- a. supports growth and function of parathyroid glands
- b. inhibits the production of *hormones* synthesised by the thyroid gland
- c. inhibits growth and function of thyroid glands
- d. inhibits growth and function of thyroid and parathyroid glands
- e. regulates the production of *hormones* produced by the thyroid gland
- f. regulates growth and function of pituitary glands

38. The most important glucocorticoids in human body are:

- a. cortisol and hydrocortisone
- b. adrenalin and noradrenalin
- c. cortisol and thyroxin
- d. hydrocortisone and oxytocin
- e. aldosterone and cortisol
- f. aldosterone and hydrocortisone

39. Progesterone is synthesised by:

- a. hypothalamus
- b. hypophysis
- c. pituitary glands
- d. follicular cells in ovaria
- e. corpus luteum in ovaria
- f. adrenal medulla

40. Rods and cones are located in the:

- a. cornea
- b. sclera
- c. pupil
- d. iris
- e. conjunctiva
- f. retina

### Correct answers

- |      |      |
|------|------|
| 1.c  | 21.e |
| 2.a  | 22.b |
| 3.e  | 23.c |
| 4.c  | 24.f |
| 5.c  | 25.a |
| 6.e  | 26.c |
| 7.c  | 27.c |
| 8.c  | 28.b |
| 9.a  | 29.c |
| 10.c | 30.b |
| 11.b | 31.b |
| 12.a | 32.d |
| 13.b | 33.d |
| 14.d | 34.f |
| 15.a | 35.d |
| 16.c | 36.b |
| 17.e | 37.e |
| 18.c | 38.a |
| 19.d | 39.e |
| 20.d | 40.f |



