



Medical biology

1. Structure and functions of proteins. Primary, secondary, tertiary and quaternary structures. Allostery.
2. Structure and functions of polysaccharides, chemically modified carbohydrates, glycoproteins and proteoglycans.
3. Structure and functions of glycerolipids (triglycerides and phosphoglycerolipids).
4. Structure and functions of nucleic acids (DNA and different types of RNA). Chromosomes, genes, alleles, the genetic code.
5. Vitamins. Classification and biologically active derivatives.
6. Reversible inhibition of enzyme activity. Physiological regulation of enzyme activity (allosteric regulation and covalent modifications).
7. Mechanism of semiconservative DNA replication. DNA polymerases. DNA repair mechanisms.
8. Transcription. The promoter and the initiation of transcription. RNA polymerases. Regulation of transcription.
9. Processing of eukaryotic mRNA. place and mechanism of translation.
10. Glucose oxidation. Aerobic and anaerobic energy metabolism.
11. Citrate cycle and the oxidative phosphorylation.
12. The origin of life. Chemical evolution, the RNA world. Characteristics of prokaryotic cells. Bacterial diseases.
13. Compartmentation of eukaryotic cells. Functions of some major cell organelles (nucleus, nucleolus, mitochondria)
14. Compartmentation of eukaryotic cells. Functions of some major cell organelles (endoplasmic reticulum, Golgi, lysosomes)
15. The Mendelian laws of inheritance. Sex-linked inheritance. Inheritance of mitochondrial genes.
16. Control of mitotic cell division, checkpoints in the cell cycle. The role of growth factors.
17. Cellular responses to signals. Cell surface and cytoplasmic/nuclear receptors. G proteins, second messengers, protein kinase cascades.
18. Endocrine, paracrine and autocrine effects. Hormones, neurohormones and their actions. Examples (hypothalamus, pituitary gland, adrenal gland, etc.).

19. Structure and function of the mammalian heart. The cardiac cycle. Generation and conduction of action potentials.
20. Structure and function of the human respiratory system. Gas exchange in the alveoli. Transport of oxygen and carbon dioxide in the blood.
21. Structure and function of the human digestive system. The major enzymes of carbohydrate, protein and lipid digestion. Absorption of nutrients.
22. Structure and function of the human kidney. The nephron. Filtration and reabsorption.
23. Mechanism of muscle contraction, the role of calcium ion. The structure of skeletal (striated), cardiac and smooth muscle tissues.
24. The nervous tissue. Nerve cells and glial cells. Generation and conduction of neuronal signals. Resting and action potential.
25. The human reproductive system. Male and female sexual organs and sexual hormones. The biological role of meiosis.
26. Cellular and humoral immune responses. T and B cells, plasma cells. Major histocompatibility complex. Immunoglobulins. Active and passive immunizations.
27. General design of viruses. Multiplication of bacteriophages and animal viruses. RNA replication and reverse transcription.

Medical chemistry

1. General structure of atoms. Chemical elements of the living organisms, their atomic orbitals and electron configurations.
2. Primary chemical bonds and secondary interactions. Covalent bonds in organic compounds.
3. Physical and chemical properties of water (intermolecular forces, self-ionization, etc.).
4. Solutions. Their components, and types of concentration.
5. Solubility of solid, liquid or gaseous solutes. Precipitation and the solubility product.
6. Acid-base reactions. Definition of pH, the pH scale. Examples for strong and weak acids or bases.
7. Chemical equilibria, Le Chatelier's principle, acid-base buffer solutions.
8. Redox reactions. Changes in the oxidation number and transfer of electrons. Voltaic cells.
9. Standard reduction potentials. The effect of temperature, pressure and concentrations on the reduction potential.
10. Redox reactions and Lewis acid-base reactions of iron and its different ions. The biological roles of heme.

11. Heat of the chemical reactions. Exothermic and endothermic reactions. The conservation of energy.
12. Changes in entropy and in free enthalpy. Driving force of natural processes. Entropy and the state of matter.
13. The rate of a chemical reaction, and its dependence on temperature. The activation energy and catalysis.
14. Carbon-carbon covalent bonds in organic chemistry. Saturated and unsaturated hydrocarbons, aromatic compounds.
15. Alcohols and phenols. Their reactions and physical properties.
16. Oxidized derivatives of alcohols. Biologically important aldehydes, ketones and carboxylic acids.
17. Amines and imines. Their types and most important chemical reactions.
18. Condensed bonds in organic compounds (ether, ester, amide, anhydride, Schiff base). Special roles of phosphate-esters in biology.
19. Sulfur atoms in bioorganic molecules (thiols, thioesters, disulfides).
20. Structure and biological functions of steroids (i.e., cholesterol and its derivatives).
21. Monosaccharides and disaccharides: definition, classification, most important representatives.
22. Proteinogenic amino acids: classification, examples, peptide bond.
23. Nucleotides and nucleic acids: building blocks, purines and pyrimidines, polymer structure, base pairing.