

Molecular basis of metabolism

test keypoints

Test I

1. Structure and characteristics of amino acids included in proteins. Classification of amino acids according to the structure and properties of their side chains (e.g. polar, nonpolar, aliphatic, aromatic, containing specific functional groups, neutral, acidic, basic). Amphoteric properties of amino acids, zwitterions. Structure of some amino acid derivatives (such as selenocysteine, 4-hydroxyproline, 5-hydroxylysine). Structure of some non-protein amino acids of physiological importance (homocysteine, homoserine, ornithine, citrulline, β -alanine, γ -aminobutyric acid, β -aminoisobutyric acid). Structure and peptide binding properties. Structure and function of biologically important peptides (glutathione, peptide hormones, peptide antibiotics). Biosynthesis and insulin structure.
2. Proteins - classification, characteristics of the I, II, III and IV structure, properties and functions. Detailed construction of α -helix and β -sheet. Amino acids that stabilize, destabilize and "break" α -helix. Types of bonds involved in the formation of the correct protein conformation (hydrogen, ion, electrostatic, hydrophobic, van der Waals bonds). Post-translational modification of proteins. Structure of ribonuclease. Construction and synthesis of collagen. Prions as an example of the medical significance of proper folding of the polypeptide chain.
3. Correlation between protein structure and its function - myoglobin, hemoglobin and immunoglobulins. The physiological role of hemoglobin and myoglobin. The mechanism of combining oxygen with myoglobin and hemoglobin. Changes in the structure of hemoglobin occurring at various stages of human development. Glycosylated hemoglobin. Hemoglobinopathies.
4. Functions performed by blood. Organic and inorganic components of plasma. Characteristics and functions of plasma proteins. Structure and functions of erythrocytes. Buffering properties of blood - carbonate buffer and the role of hemoglobin in buffering (Bohr and Halden effect). The physiological role of hemoglobin and myoglobin in the transport and storage of oxygen, the oxygen dissociation curve, respectively. The mechanism of combining oxygen with myoglobin and hemoglobin (the role of distal and proximal histidine, cooperativity). Influence of temperature, pH, CO₂ and 2,3-BPG on the oxygen dissociation curve Hb.

Test II

1. The enzyme - structure, features, ways to create enzyme-substrate complexes. The specificity of the enzyme relative to the substrate and the type of catalyzed reaction. The concept of isoenzyme, coenzyme, cofactor. Physical and chemical properties of isoenzymes. The significance of isoenzymes in diagnostics. Classification of enzymes.
2. Kinetics and mechanism of enzymatic reaction of Michaelis-Menten and allosteric enzyme (activators and allosteric inhibitors, examples of allosteric enzymes, concerted and sequential model of allosteric protein, kinetics of the allosteric enzyme reaction); regulation by feedback and its examples in the human body; covalent modification of enzymes: phosphorylation and specific, limited proteolysis (proenzymes, zymogens, autocatalysis). The influence of physical and chemical factors on enzyme activity (temperature, pH, enzyme, substrate and product concentration). Kinetics of enzymatic reaction: initial and maximum rate of enzymatic reaction, Michaelis constant, Michaelis-Menten equation, Lineweaver-Burk plot. Regulation of enzyme activity. Types

of inhibition with examples of inhibitors used in medicine: acetylsalicylic acid, penicillin, fluorouracil, methotrexate, allopurinol. Units of enzymatic activity.

3. Vitamins soluble in water and fats - structure and importance in metabolic processes. The structure of coenzymes and functions performed by coenzymes in enzymatic reactions.
4. The role of enzymes in the digestion of carbohydrates, lipids, proteins and nucleic acids. Composition and role of digestive juices. The role of bile acids in the digestive process. The mechanism of the synthesis of hydrochloric acid by the parietal cells of the stomach. Diversified role of hydrochloric acid. Biosynthesis of bile acids and regulation of this process. Hepatic-intestinal circulation of bile acids. Molecular mechanisms of absorption of digestive products.