federal state budgetary educational institution

higher education

Orenburg State Medical University

Ministry of Health of the Russian Federation

**GUIDELINES**

**FOR THE TEACHER**

**FOR THE ORGANIZATION OF THE STUDY OF THE DISCIPLINE**

Chemistry

(name of the discipline)

in the direction of training (specialty)

31.05.01. General Medicine (Faculty of Foreign Students)

(code, name of the direction of training (specialty))

It is part of the main professional educational program of higher education in the direction of training (specialty)

31.05.01. General Medicine (Faculty of Foreign Students)

approved by the Academic Council of the FSBEI HE ORGMU of the Ministry of Health of Russia

Minutes No. 8 dated March 25, 2016

Orenburg

**1. Methodical recommendations for the lecture course**

**Module No. 1**...General chemistry. The structure of matter. The doctrine of solutions

**Lecture № 1**

**Topic**: Modern interpretation of the periodic law of D. I. Mendeleev based on the electronic theory of the structure of the atom.

**Purpose:** generalize and systematize knowledge aboutchemical elements, arranged in a table based on their atomic numbers, electronic configurations (electron shell model) and periodically repeating chemical properties of these elements.

**Abstract of the lecture.** The lecture reflects the periodic law and the periodic properties of chemical elements. The main properties of chemical elements by groups of the periodic table are disclosed.

**Lecture organization form** traditional, survey, with the use of interactive technologies.

**Methods used in the lecture** the technology of contextual learning (context-informational) is used.

**Means of education:**

- didactic: presentation.

- logistic chalk, blackboard, multimedia projector).

**Lecture № 2**

**Topic**: The doctrine of solutions. Preparation of solutions with a given mass fraction. Colligating properties of solutions. Osmosis.

**Purpose:** to formulate in students knowledge about solutions, preparation of solutions with a given mass fraction... To form concepts about the colligative properties of solutions, about osmosis.

**Abstract of the lecture.** The lecture presents the main provisions on solutions: types of solutions, their solubility, the effect of temperature and pressure on solubility, their preparation with a given mass fraction. The concepts of colligative properties of solutions and osmosis have been formed.

**Lecture organization form** traditional, survey, with the use of interactive technologies.

**Methods used in the lecture** the technology of contextual learning (context-informational) is used.

**Means of education:**

- didactic: presentation.

- logistic chalk, blackboard, multimedia projector).

**Lecture № 3**

**Topic**: Buffer systems.

**Purpose:** to formulate knowledge of the students about buffer solutions, the mechanisms of action of buffer systems... To form concepts about the acid-base state of the body.

**Abstract of the lecture.** The lecture reflects:

1. Buffer systems:

definition

composition

classification

examples.

2. Henderson-Hasselbach equation for calculating the pH of buffer systems:

acid buffer systems

basic buffer systems.

3. The mechanism of action of buffer systems:

when adding acid (for example, acetate, ammonia and protein)

when adding alkali (for example, acetate, ammonia and protein)

dilution with water.

4. Blood buffer systems:

composition

classification

pH

mechanism of action of bicarbonate, phosphate and protein buffer systems when interacting with acids and alkalis (ionic form).

5. The concept of the acid-base state of the body:

definition

mechanisms

regulation.

alkaline blood reserve (%, mmol / l)

correction of CBS in case of its violations.

**Lecture organization form** traditional, survey, with the use of interactive technologies.

**Methods used in the lecture** the technology of contextual learning (context-informational) is used.

**Means of education:**

- didactic: presentation.

- logistic chalk, blackboard, multimedia projector).

**Module № 2. Biologically important classes of organic compounds. Biopolymers and their structural components.**

**Lecture № 4**

**Topic**: Carbohydrates, structure and chemical properties. Monosaccharides, structure and chemical properties.

**Purpose:** To form and consolidate students' knowledge of the stereochemical structure of tautomeric forms and the most important properties of monosaccharides as a basis for understanding their role in the metabolic processes of the body.

**Lecture abstract:**

1. The concept of carbohydrates

2. Biological role

3. Classification

4. Stereoisomerism. Conformation

5. Examples of Fischer formulas (C5, C6)

6. Cyclic forms of MS according to Fisher and Heworth

7. Schemes of tautomeric transformations of D-glucose, D-fructose

8. Derivatives of MS:

amino sugar

sulfo derivatives

acylated derivatives

9. Chemical properties of carbohydrates:

alcohol formation

oxidation under mild and harsh conditions

glycoside formation

ester formation

formation of phosphates MC

10. Qualitative reactions to glucose

**Lecture organization form** traditional, survey, with the use of interactive technologies.

**Methods used in the lecture** the technology of contextual learning (context-informational) is used.

**Means of education:**

- didactic: presentation.

- logistic chalk, blackboard, multimedia projector).

**Lecture № 5**

**Topic**: Carbohydrates, structure and chemical properties. Disaccharides, structure and chemical properties.

**Purpose:** To form and consolidate students' knowledge of the stereochemical structure of tautomeric forms and the most important properties of disaccharides, oligo - and polysaccharides, as a basis for understanding their role in the metabolic processes of the body.

**Lecture abstract:**

1. The concept of disaccharides

2. Biological role

3. Classification

4. Stereoisomerism. Cyclo-oxo-tautomerism.

5. Derivatives of DS:

maltose;

cellobiose;

lactose.

9. Chemical properties of DS:

10. Polysaccharides: cellulose, starch, glycogen.

**Lecture organization form** traditional, survey, with the use of interactive technologies.

**Methods used in the lecture** the technology of contextual learning (context-informational) is used.

**Means of education:**

- didactic: presentation.

- logistic chalk, blackboard, multimedia projector).

**Lecture № 6**

**Topic**: Carboxylic acids.

**Purpose:** To acquaint students with the classification, nomenclature, isomerism of carboxylic acids, their reactivity, role in the body and application in medical practice. The study of this topic equips students with the necessary knowledge on the structure, reactivity of carboxylic acids, which play an important role in life processes.

**Lecture abstract:**

1. Carboxylic acids, their classification, nomenclature, isomerism, application.

2. Reactivity of carboxylic acids. Oxidation reactions, qualitative reaction for carboxylic acids.

3. The main natural higher fatty acids that make up lipids: palmitic, stearic, oleic, linoleic, linolenic, arachidonic. The concept of pentaenoic and hexaenoic higher fatty carboxylic acids.

**Lecture organization form** traditional, survey, with the use of interactive technologies.

**Methods used in the lecture** the technology of contextual learning (context-informational) is used.

**Means of education:**

- didactic: presentation.

- logistic chalk, blackboard, multimedia projector).

**Lecture № 7.8.**

**Topic**: Lipids Phospholipids

**Purpose:**To form knowledge of the structure and chemical properties of saponifiable lipids and their structural components to study the structure of biological membranes and lipid metabolism processes. Lipids are found in many tissues of living organisms, performing the function of structural components of the cell. They are suppliers and sources of biologically active substances: hormones, vitamins, unsaturated HFA. Lipids, especially TAGs, are involved in thermoregulation.

**Lecture abstract:**

1. Lipids, their classification, nomenclature, isomerism, application.

2. Chemical properties of lipids.

3. Neutral lipids. Natural fats as a mixture of triacylglycerols.

4. Phospholipids. Phosphatidic acids. Phosphatidylcolamines (cephalins), phosphatidylserines, phosphatidylcholines (lecithins) are structural components of cell membranes.

**Lecture organization form: traditional (thematic, explanatory).**

**Methods used in the lecture:**

* verbal: explanation, explanation;
* video method: viewing;
* explanatory and illustrative.

**Means of education:**

- Logistics: chalk, blackboard, multimedia projector.

**Lecture № 9. Amino acids. Peptides**

**Topic**: Amino acids Peptides.

**Purpose:** To form knowledge of the structure and properties of the most important α-amino acids and chemical bases of the structural organization of protein molecules

Amino acids are polyfunctional compounds, since their molecule contains one (or more) amino groups and one (or more) carboxy groups. According to the mutual arrangement of carboxy and amino groups, amino acids are divided intoα, β, γ- etc.

From a biological point of view, α-amino acids, a number of which can be obtained from natural material by hydrolyzing proteins - meat, skin, gelatin, wool, hair, feathers, proteins of protoplasm and the nucleus of any plant or animal cell, casein from cottage cheese, a number of hormones like insulin, enzymes (for example, pepsin), etc. Amino acids are the simplest building blocks in the structure of the IUD - proteins, without which no life exists.

**Lecture abstract:**

1. Amino acids that make up proteins. Structure, nomenclature. Stereoisomerism. Acid-base properties, bipolar structure. Classification taking into account various signs: by the chemical nature of the radical and the substituents contained in it (aliphatic, aromatic, heterocyclic, containing a hydroxyl, carbonyl or amide group, sulfur-containing), by the polarity of the radicals, by acid-base properties, biological classification.

2. Chemical properties of α-amino acids. Formation of intracomplex salts. Reactions of esterification, acylation, alkylation, formation of imines, amides: asparagine, glutamine (ASN, GLN). Interaction with nitrous acid and formaldehyde, the importance of these reactions for the analysis of amino acids.

3. Biologically important reactions in our body.

I. on the α-NH2 group: a) transamination; b) deamination

II. decarboxylation for α-COOH group (formation of biogenic amines);

III. specific transformations of amino acids (for example, methionine);

IV. peptides.

**The form of organization of the lecture is traditional (thematic, explanatory).**

**Methods used in the lecture:**

* verbal: explanation, explanation;
* video method: viewing;
* explanatory and illustrative.

**Means of education:**

- Logistics: chalk, blackboard, multimedia projector.

**Lecture № 10. Nucleic acids**

**Topic**: Nucleic acids.

**Purpose:** To form knowledge of the structure and chemical properties of nucleic acids and their monomeric units - nucleotides as a chemical basis for the assimilation of various levels of structural organization of nucleic acid macromolecules and the action of nucleotide coenzymes.

**Lecture abstract:**

1. Nucleic bases that are part of nucleic acids: pyrimidine - uracil, thymine, cytosine; purine - adenine, guanine. Aromatic properties. Lactam-lactam tautomerism. Deamination reactions. Complementarity, hydrogen bonds in complementary nucleic acid base pairs.

2. Nucleosides. The nature of the bond of the nucleic base with the carbohydrate residue: the configuration of the glycosidic center. Nucleoside hydrolysis.

3. Nucleotides. The structure of mononucleotides that form nucleic acids. Nomenclature. Hydrolysis.

4. Primary structure of nucleic acids. Phosphodiester bond. Ribonucleic and deoxyribonucleic acids. Nucleotide composition of RNA and DNA. Nucleic acid hydrolysis.

5. The concept of the secondary structure of DNA. The role of hydrogen bonds in the formation of the secondary structure.

**The form of organization of the lecture is traditional (thematic, explanatory).**

**Methods used in the lecture:**

* verbal: explanation, explanation;
* video method: viewing;
* explanatory and illustrative.

**Means of education:**

- Logistics: chalk, blackboard, multimedia projector.

**2. Methodical recommendations for conducting laboratory studies**

*Module # 1. General chemistry. The structure of matter. The doctrine of solutions*

**Topic 1.** Basic concepts and laws of chemistry.

**Type of training session** (laboratory work).

**Purpose:** study the fundamental concepts and laws of chemistry and apply them to solve relevant problems.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Basic concepts and laws of chemistry. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (written survey). |
| 3 | **The main part of the training session.**  1. The law of conservation of mass and energy.  2. The law of constancy of composition and its modern interpretations.  3. The law of several relationships.  4. Avogadro's number.  5. Application of the Mendeleev-Klaiperon ideal gas equation of state.  6. Equivalent mass of simple and complex substances. Equivalent gas.  7. The law of equivalents.  8. Equivalent mass of oxidizing agent and reducing agent. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal; |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical (chalk, board.).

**Topic 2.** Structure of connections. Basic theoretical provisions on the structure of the atom. Chemical bond theory. Molecule structure. Modern interpretation of the periodic law of D. I. Mendeleev based on the electronic theory of the structure of the atom.

**Type of training session** (laboratory work).

**Purpose:** study the electronic theory of the structure of the atom. Knowledge of the topic allows students to find any valence of elements, oxidation state and characterize the properties of this element.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Structure of connections. Basic theoretical provisions on the structure of the atom. Chemical bond theory. Molecule structure. Modern interpretation of the periodic law of D. I. Mendeleev based on the electronic theory of the structure of the atom. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (testing). |
| 3 | **The main part of the training session.**  1. Bohr's postulates.  2. The movement of electrons in an atom. Atomic orbitals.  3. Electronic energy levels. Quantum numbers: features, importance (orbital form s, p, d, f - orbitals, magnetic).  4. Principles and rules for filling atomic orbitals with electrons: the principle of the lowest energy, Pauli's principle. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 3.** Classes and nomenclature of inorganic compounds.

**Type of training session** (laboratory work).

**Purpose:** study the classes and nomenclature of inorganic compounds.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Classes and nomenclature of inorganic compounds. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (oral questioning). |
| 3 | **The main part of the training session.**  1. Simple substances: metals and non-metals.  2. Complex substances: oxides, their classification, nomenclature.  3. Hydroxides: classification, examples.  4. Acids: classification, nomenclature.  5. Salts: classification, nomenclature. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. * testing. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 4.** The doctrine of solutions. Preparation of solutions with a given mass fraction. Colligative properties of solutions. Osmosis.

**Type of training session** (laboratory work).

**Purpose:** To form knowledge of the theory of solutions as a basis for understanding the electrolyte homeostasis of the human body, and the role of solutions in vital processes.

**Lesson plan**

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| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  The doctrine of solutions. Preparation of solutions with a given mass fraction. Colligative properties of solutions. Osmosis. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (written survey). |
| 3 | **The main part of the training session.**  one. The role of water and solutions in life. Physicochemical properties of water, which determine its unique role as the only biosolvent.  2. Autoprotolysis (autoionization) of water. Constant of auto-protolysis (autoionization) of water: conclusion, dependence on temperature. Hydrogen exponent.  3. Colligative properties of dilute solutions of non-electrolytes. Raoult's law: formulations, calculation formulas.  four. Corollary from Raoult's law: lowering the freezing point of the solution, increasing the boiling point of the solution.  five. Osmosis. Osmotic pressure. Van't Hoff's law for osmotic pressure. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 5.** Buffer systems.

**Type of training session** (laboratory work).

**Purpose:** To form knowledge of the composition, properties and mechanisms of action of the buffer systems of the body for understanding to understand their biological role.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Buffer systems. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (testing). |
| 3 | **The main part of the training session.**  1. Buffer systems: definition, composition, classification.  2. The Henderson-Hasselbach equation for calculating the pH of acidic and basic buffer systems.  3. The mechanism of action of buffer systems with the addition of acid and alkali (for example, acetate, ammonia and protein), dilution with water.  4. Buffer capacity and factors affecting it. Buffer zone. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

*Module № 2. Biologically important classes of organic compounds. Biopolymers and their structural components.*

**Topic 6.** Carbohydrates, structure and chemical properties. Monosaccharides, structure and chemical properties.

**Type of training session** (laboratory work).

**Purpose:** To form knowledge of the stereochemical structure of tautomeric forms and the most important properties of monosaccharides as a basis for understanding their transformations in the body.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Carbohydrates, structure and chemical properties. Monosaccharides, structure and chemical properties. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (testing). |
| 3 | **The main part of the training session.**  1. Monosaccharides. Classification.  2. The structure of the most important representatives of trios (3FGA, PDA), pentoses (ribose, xylose, deoxyribose), hexoses (glucose, galactose, fructose).  3. Stereoisomerism of monosaccharides. D- and L-stereochemical series. Open and cyclical forms. Fisher's formulas and Hewors' formulas.  4. Oxidation of monosaccharides. The regenerative properties of aldoses. Glyconic, glycaric, glucuronic acids.  5. Reduction of monosaccharides: xylitol, sorbitol, galactitol. Formation of phosphoric acid esters of monosaccharides |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 7.** Oligo - and polysaccharides, structure and chemical properties.

**Type of training session** (laboratory work).

**Purpose:** To form knowledge of the stereochemical structure of tautomeric forms and the most important properties of oligo - and polysaccharides as a basis for understanding their transformations and biological role in the body.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Oligo - and polysaccharides, structure and chemical properties. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (written survey). |
| 3 | **The main part of the training session.**  1. Disaccharides: maltose, lactose. Structure, cyclo-oxotautomerism. Restorative properties. Hydrolysis.  2. Disaccharides: cellobiose, sucrose. Structure. cyclo-oxo-tautomerism. The regenerative properties of cellobische Hydrolysis of disaccharides.  3. Polysaccharides. Homopolysaccharides: starch (amylose and amylopectin), glycogen, dextran. Hydrolysis. Pectins (polygalacturonic acid). Cellulose. Biological role.  4. The structure of the structural components of GAG - cyclic forms: glucosamine, galactosamine.  5.Acylation, sulfonation of amino sugars in the GAG.  6.Heteropolysaccharides: glucoseaminoglycans (GAGs), hyaluronic acid, chondroitin sulfates, heparin. Biological role. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 8.** Higher fatty acids. Lipids. Phosphoglycerides.

**Type of training session** (laboratory work).

**Purpose:** to form knowledge of the structure and chemical properties of saponifiable lipids and their structural components to study the structure of biological membranes and lipid metabolism processes.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Higher fatty acids. Lipids. Phosphoglycerides. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (testing). |
| 3 | **The main part of the training session.**  1. Neutral lipids. The concept of lipids, name, function.  2. Classification of lipids with examples (be sure to indicate representatives).  3. The concept of lipid peroxidation (by the example of oleic acid (fragment) in the composition of PL).  4. The concept of β-oxidation of HFA (scheme on the example of palmitic and stearic acids). Biological role.  5. FL. Representatives. Biological role. PL biosynthesis scheme.  6. The structure of the CS. Scheme of the formation of the ether XC. The biological role of cholesterol. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 9.** Amino acids. Peptides. Proteins.

**Type of training session** (laboratory work).

**Purpose:** to form knowledge of the properties of amino acids to explain the structure and function of proteins in living organisms.

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Amino acids. Peptides. Proteins. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (oral questioning). |
| 3 | **The main part of the training session.**  1. Amino acids that make up proteins. Structure, nomenclature. Stereoisomerism. Acid-base properties, bipolar structure. Classification taking into account various signs: by the chemical nature of the radical and the substituents contained in it (aliphatic, aromatic, heterocyclic, containing a hydroxyl, carbonyl or amide group, sulfur-containing), by the polarity of the radicals, by acid-base properties, biological classification.  2. Chemical properties of α-amino acids. Formation of intracomplex salts. Reactions of esterification, acylation, alkylation, formation of imines, amides: asparagine, glutamine (ASN, GLN). Interaction with nitrous acid and formaldehyde, the importance of these reactions for the analysis of amino acids. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.).*

**Topic 10.** Nucleic acids, composition, structure and biological significance.

**Type of training session** (laboratory work).

**Purpose:** To form knowledge about the biological role of nucleic acids (DNA and RNA), the structure of nucleic acids (primary, secondary and tertiary structure).

**Lesson plan**

|  |  |
| --- | --- |
| No.  p / p | Stages and content of the lesson |
| 1 | **Organizing time.**  Nucleic acids, composition, structure and biological significance. |
| 2 | **Input control, updating of basic knowledge, abilities, skills** (testing). |
| 3 | **The main part of the training session.**  1. The biological role of nucleotides in the body.  2. Primary structure of nucleic acids 3 / -5 / phosphodiester bond. Nucleic composition of RNA and DNA. Nucleic acid hydrolysis.  3. The concept of the secondary structure of RNA, DNA. The role of hydrogen bonds in the formation of the secondary structure. |
| 4 | **The final part of the lesson:**   * summing up the results of the lesson; * setting current grades in the educational journal. |

**Means of education:**

- didactic (tables, diagrams, handouts, etc.);

-material and technical *(chalk, board.)*