Preparatory Course 2019
Curriculum

Biology

by Zbigniew Tabarowski

Suggested textbook: Biology, *Eldra Solomon, Charles Martin, Diana W. Martin, Linda R. Berg (2014, 10th edition); ISBN-10: 1285423585; ISBN-13: 978-1285423586*

The exact content of the course will be determined after discussion with participants in order to answer their specific needs.

Day 1. Cell biology
Day 2. Human anatomy and physiology
Day 3. Biochemistry
Day 4. Genetics
Day 5. Examples of biology test questions from previous years and their solutions, worked out step by step

1. CELL BIOLOGY EUKARYOTIC CELL
- a. Plasma Membrane
- b. Membrane-bound Organelles
- c. Nucleus and Other Defining Characteristics
- d. Cytoskeleton
- e. Cell Cycle and Mitosis
- f. Cell Death

2. OTHER FORMS OF LIFE
- a. Fungi
- b. Virus Structure
- c. Viral Life Cycle
- d. Prokaryotic Cell: Bacteria Structure
- e. Prokaryotic Cell: Growth and Physiology
- f. Prokaryotic Cell: Genetics

3. SYSTEMS OF THE BODY
- a. Nerve Cell/Neural
- b. Muscle Cell/Contractile
- c. Endocrine System: Hormones
- d. Circulatory System
- e. Immune System: Innate and Adaptive Immunity
- f. Digestive System
- g. Excretory System
- h. Skeletal System
- i. Respiratory System
- j. Reproductive System

4. BIOCHEMISTRY
- a. DNA Structure and Function
- b. Genetic Code
- c. Protein Synthesis
- d. Enzyme Structure and Function
- e. Basic Metabolism

5. GENETICS
- a. Mendelian Concepts
- b. Meiosis and Genetic Variability
- c. Evolution

Chemistry

by Anna Kolasa and Piotr Pietrzyk
Suggested textbook: Course manuscript

General and Inorganic Chemistry

1. Stoichiometry of chemical reaction
1.1 Amount of substance (mole, Avogadro constant, extensive properties)
1.2 Molar concentration
1.3 Mass concentration
1.4 Stoichiometry and yield of chemical reaction
Calculus includes: balancing chemical equations; atomic and molar mass; number of moles; molar and mass (percentage) concentrations; preparation of a solution of a given concentration via dilution or mixing standard solutions; volume and density of a solution; yields of chemicals reactions; limiting reagents.

2. Inorganic nomenclature
2.1 Acids, bases, salts, coordination compounds

3. The properties of gases
3.1 Ideal gas equation of state
3.2 The gas laws
3.3 Molar volume
Calculus includes: gas pressure; amount of gases in standard, normal, and given conditions; molar volume; use of gas laws and perfect gas equation.

4. Elements of thermodynamics
4.1 Work, heat, and energy
4.2 The First Law (internal energy)
4.3 Enthalpy
4.4 Thermochemistry (standard enthalpy changes, Hess's law, enthalpies of formation and combustion)
Calculus includes: heat in constant volume and pressure; standard enthalpy changes; use of Hess's law; enthalpy of reaction from formation enthalpy and combustion enthalpy.

5. Chemical equilibrium
5.1 The reaction quotient and equilibrium constant
5.2 Acid-base equilibria in water (definitions of acids and bases, dissociation degree, acidity constant, autoprotolysis constant, pH scale, hydrolysis)
5.3 Dissociation of ionic solids and reactions in water (solubility constants)
Calculus includes: equilibrium constant K; initial, equilibrium and final concentrations of reactants; pH of the solutions of strong and weak acids and bases; dissociation constant for weak acids (K_a) and bases (K_b); dissociation degree; concentration of ions and solubility constant of ionic substances.

6. Redox reactions
6.1 Oxidation number
6.2 Electrochemical cells (notation, half-reactions and electrodes, the cell reaction, the cell potential)
6.3 Standard potentials
6.4 The electrochemical series
Calculus includes: oxidation number for inorganic and organic compounds; balancing redox equations; standard cell potential; zero-current cell potential for galvanic and electrolyte concentration cell.

Schedule:
1st meeting – points 1
2nd meeting – points 2 and 3 and 4
3rd meeting – points 4 and 5
4th meeting – point 5
5th meeting – point 6

Organic Chemistry

1. Structure and bonding in organic chemistry
1.1 Hybridization and molecular shapes
1.2 Carbon skeletons with single and multiple bonds
1.3 Homologous series, isomerism
1.4 Functional groups
1.5 Lewis structures, formal charges, resonance
1.6 Structural and skeletal formulas of organic compounds
Problem-solving skills include: recognition of functional groups in biologically active compounds, drawing of structural formulas of various isomers, drawing Lewis structures for various molecules and resonance forms.

2. Classification and properties of organic compounds
2.1 Hydrocarbons and halogenated hydrocarbons
2.2 Alcohols, phenols, ethers
2.3 Aldehydes and ketones
2.4 Carboxylic acids and their derivatives
2.5 Amines and aminoacids
Problem-solving skills include: predicting the properties of a certain compounds on the basis of their structural formulas, comparing the acidity and basicity of various organic compounds.

3. Nomenclature of organic compounds
3.1 Hydrocarbons of various classes
3.2 Compounds with one functional group
3.3 Compounds with more functional groups, preferences in naming
Problem-solving skills include: Naming simple organic compounds, drawing structural formulas of certain organic compounds from their names.

4. Stereochemistry
4.1 Conformations
4.2 *Z/E* stereoisomers
4.3 Enantiomers and diastreomers
4.4 Models and notations to represent stereoisomers
Problem-solving skills include: usage of models to give examples of stereoisomers, suggesting various stereoisomers for one molecular formula, drawing the same stereoisomer in various representations.

5. Organic reactions
5.1 Nucleophiles and electrophiles
5.2 Mechanisms of organic reactions
5.3 Radical processes
5.4 Nucleophilic substitution versus elimination
5.5 Electrophilic substitution in aromatic compounds
5.6 Reduction and oxidation in organic chemistry
5.7 Rearrangements
Problem-solving skills include: giving examples of nucleophiles and electrophiles, showing nucleophilic and electrophilic centers in certain molecules, providing elements of retrosynthetic analysis for simple molecules.

6. Biomolecules
6.1 Peptides and proteins
6.2 Lipids
6.3 Carbohydrates
6.4 Heterocyclic bases, nucleotides and nucleic acids
Problem-solving skills include: interpreting the chemical structure of lipids, proteins and nucleic acids, writing the equations of certain fat or dipeptide formation.

Schedule:
1st meeting – point 1
2nd meeting – point 2
3rd meeting – point 3
4th meeting – point 4
5th meeting – points 5 and 6