Sylabi of courses

Biology

Lectures 2h, Seminars 3h

Coordinator: Doc. MUDr. Iva Slaninova

Week number	Topic
1	General characteristics of living systems. Origins of the live. Origin of the cells. Basics of Evolution. Chemical evolution. Paleontological evidence of the earliest forms of life. Darwinian evolution. Classification of living systems. Acellular organisms. Viruses.
2	Cells. Cell theory. Chemical composition of the cell. Structure and function of proteins, nucleic acids, saccharides and lipids. Prokaryotic and eukaryotic cell – basic differences. Prokaryotic cell – characteristics. Bacteria. Cyanobacteria. Medically important prokaryotic cells.
3	Eukaryotic cell. Plant, fungal, animal cells. Structure and function of biomembranes. Osmosis. Transport of molecules into and out of the cell. Endocytosis and exocytosis.
4	Organelles of the cell. Structure and function of nucleus, ER, GA, mitochondria, lysosomes. Cytoskeleton and cell movement.
5	Genetic information. DNA. Chromosome. Replication. Expression of genetic information – transcription, translation. RNA. Proteins.
6	Cell division. Cell cycle. Cancer cell. Mitosis. Meiosis.
7	Basics of genetics. Gene. Mendel´s laws. Mutations. Karyotype.
8	Autosomal and gonosomal inheritance.

	Excursion Mendel museum - 3h 1 afternoon at 8th or 9th week
9	Ecology. Abiotic and biotic factors. Biosphere. Ecosystems. Population explosion. Building of sustainable society. Evolution of *Homo sapiens.*
10	Medically important organisms- yeasts, molds, plants, protozoa, worms and insects. Milestones in biology and medicine.
11	Introduction into somatology. Tissues of the human body. Skin and its function. Body temperature and its maintance.
12	Skeleton and muscles.
13	Blood. Blood groups and transfusion. Defense mechanisms.
14	Digestive system and nutrition.
15	Respiratory system and its function.
16	Circulatory system. Lymph and its circulation.
17	Urinary system. Male genital system.
18	Female genital system. Human development.
19	Endocrine glands.
20	Nervous system. Senses.

Chemistry

Lectures 2 x 2h, Seminars 3h

Coordinator: Doc.RNDr. Josef Tomandl

Week number	Topic
1	Atoms and molecules. Subatomic particles, atomic and mass numbers. Relative atomic mass of an element, molecular mass of a compound. Amount of a substance, the mole of an element or a compound, Avogadro´s constant. Diatomic elements. The molar mass of a compound, the molar volume of gases at standard temperature and pressure.
2	Names and formulas of common inorganic ions and compounds (translation of a name to a formula, naming of a compound given the formula). Stoichiometric calculations. Chemical equations, balancing equations, mass relations in chemical reactions.
3	Atomic structure, the electron configuration of elements The Periodic Table of elements. The periodicity of the properties of the elements. The positions of the representative elements in the table.
4	Chemical bonds. The octet rule. Single and multiple covalent bonds, coordinate covalent bond. Polar covalent bond, electronegativity, polar and nonpolar molecules. The ionic bond and ionic compounds. Weak intermolecular bonding (the hydrogen bond).
5	Solutions - expressing the composition of solutions: mass fraction (percentage by mass), amount-of-substance concentration (molarity), and mass concentration, calculations. Solutions of nonelectrolytes and electrolytes, dissociation and ionization of electrolytes, strong and weak electrolytes. Concentrations of ions in solutions of strong electrolytes.
6	Types of chemical reactions. Protolytic reactions. Strong acids and bases. Weak acids and bases, ionization constants. Ionization of water, the ionic product of water. pH value - calculations (for a given concentration or pH value). Hydrolysis of ions.
7	Oxidation-reduction reactions, oxidizing agents and reducing agents. Balancing

	redox equations. Half equations in redox reactions and the numbers of electrons lost or gained. Heats of reaction and other enthalpy changes. Hess´s law. Reaction rate, factors that influence reaction rates. Chemical equilibrium, equilibrium constants.
8	Hydrogen and oxygen, properties, ionic and covalent hydrides and oxides; acid-forming, basic, and amphoteric oxides. Water. Characterictics of some of the elements (chlorine, sulphur, nitrogen, phosphorus, carbon, silicon, alkali metals and alkaline earth metals, iron, copper, aluminium and zinc) and of their important compounds (oxides, hydroxides, covalent hydrides, oxyacids, and salts).
9	Bonds in organic compounds, typical properties of organic compounds. Types of reactions in organic chemistry. Isomerism – various types of structural isomerism and stereoisomerism. Nomenclature of organic compounds: Systematic IUPAC names – general principles in systematic nomenclature. The trivial (or semisystematic) names for the most common compounds.
10	Hydrocarbons, names for the groups derived from hydrocarbons. Saturated and unsaturated hydrocarbons, arenes – chemical formulas, typical reactions. Organic halides, nitrocompounds, amines – various types and important structures, basicity of amines, formation of amides. Alcohols and phenols – classification, typical reactions (esterification, ethers, oxidation of alcohols, quinones). Aldehydes and ketones - oxidation and reduction, formation of acetals.
11	Carboxylic acids – reactivity of the carboxyl group. Survey of the common names and structures of the most important carboxylic acids (monocarboxylic and dicarboxylic, saturated and unsaturated, hydroxyacids, ketoacids), names for acyls. Functional derivatives of carboxylic acids. Urea.
12	Heterocyclic compounds – names and structures of the various common types. The purine and pyrimidine bases of nucleic acids. Uric acid. Saccharides - classification, biological importance, structure of monosaccharides (acyclic oxo-forms, hemiacetal cyclic forms, anomers), formation of glycosides. Reducing and non-reducing disaccharides, polysaccharides.
13	Lipids - fatty acids bound in lipids, acylglycerols, hydrolysis of fats and oils, saponification, soap. Phospholipids. Structure of membranes.

14	Steroids – the structure of the steroid ring system, biological roles of some sorts of steroid compounds. Amino acids - structures, common and systematic names of the twenty standard (proteinogenous) amino acids, polarity of the side chains. Peptide bond. Peptides.
15	Proteins – the primary structure, general features of secondary, tertiary, and quaternary structure. Classificaton of proteins according to the shape, solubility, denaturation. Nucleosides, nucleotides, nuclic acids. The double helix of DNA.
16	The function of DNA and of three major types of RNA in transcription of the genetic code and protein biosynthesis. General features of enzymes. Factors affecting the rate of enzymatic reaction. Enzyme nomenclature and classification. Six classes of enzymes according to reaction type. Enzyme cofactors.
17	General features of vitamins. Fat soluble vitamins. Water soluble vitamins. Relations of vitamins to cofactors and other biochemical functions. The anabolic and catabolic character of metabolic pathways. Importance of biological oxidations in catabolism of nutrients – high-energy (macroergic) compounds and the energetic yield of metabolism.
18	The role of the citric acid cycle. The mitochondrial electron-transport chain and oxidative phosphorylation Metabolism of saccharides, the end products of anaerobic and aerobic glucose degradation.
19	Metabolism of lipids, digestion of dietary fat, ß-oxidation of fatty acids. Metabolism of proteins and amino acids, the nitrogenous end-products of amino acid and purine catabolism.
20	**Compensatory lessons, Final test**

Physics

Lectures 2+2h, problem solving exercise 3h

Coordinator: Prof.RNDr. Vojtěch Mornstein

Week number	
1	Introduction, why and how to work with mathematical expressions in physics Operations with algebraic expressions
2	Operations with algebraic expressions, processing/solving of equations Mathematical functions (logarithms, exponents)
3	Mathematical functions (goniometric etc.) Fundamentals of vector calculus as used in physics
4	System of units SI (quantities, units, vectors and scalars etc.) Kinematics of a particle
5	Kinematics of a particle (circular motion) Dynamics of solid bodies
6	Dynamics of solid bodies (circular motion) Dynamics of solid bodies (gravitational field)
7	Properties of solid bodies, Elasticity Periodic (harmonic) motion
8	Sound and ultrasound, hearing Hydrostatics and hydrodynamics
9	Surface phenomena Kinetic theory and the ideal gas
10	Thermodynamics I (concepts) Thermodynamics II (processes)

11	Thermodynamic laws and thermodynamic variables Phase transitions (gas-liquid-solid)
12	Electric charge a Coulomb law Electrostatic field
13	Electric current (Ohm law and Kirchhoff laws, resistors, condensers, electric power…) Semiconductors and their use
14	Electrolytes and electrolysis Magnetic field and its origin
15	Electromagnetism (induction etc.) Alternating current
16	Electromagnetic spectrum Fundamentals of geometric optics
17	Human vision and optical instruments Wave properties of light and photometry
18	Elements of the special and general theory of relativity Electron shell of atom and elements of quantum mechanics
19	Laser and x-rays Atom nucleus and radioactivity
20	Ionising radiation, properties, interactions, measurement and its importance for medicine Knowledge test and evaluation