Institute for Language
and Preparatory Studies
Charles University

BIOLOGY

1. **Introduction**
   - 1.1 Basic division of biological sciences
   - 1.2 General characteristics of living systems
   - 1.3 Elementary classification of life forms

2. **Cytology**
   - 2.1 Prokaryotic cell – structure, organelles and function
   - 2.2 Eukaryotic cell
     - 2.2.1 Organelles – structure and function: cytoplasm, nucleus, chromosome, nucleolus, semiautonomous organelles, endomembrane systems, compartments, secretory organelles, vesicular formations, nonmembrane bound organelles, cytoskeleton, cell surfaces, membrane properties
     - 2.2.2 Plant cell
     - 2.2.3 Animal Cell
   - 2.3 Cell division
     - 2.3.1 Prokaryotic cell division
     - 2.3.2 Eukaryotic cell division – karyokinesis, cytokinesis
       - 2.3.2.1 Chromosome structure – Macroscopic
       - 2.3.2.2 Sexual and asexual reproduction, diploid and haploid Cell characteristics
       - 2.3.2.3 Mitosis – phases, cytokinesis, cell cycle, Meiosis – phases, crossing-over, cytokinesis, cell cycle periodicity

3. **Genetics**
   - 3.1 Chromosome – microscopic structure
     - 3.1.1 DNA – chemical composition, nucleic bases, base complementarity, chemical bonds in the molecule of DNA
     - 3.1.2 RNA – composition, RNA types, function
   - 3.2 Gene – types of genes, codons, exons, introns, genetic code, regulatory proteins
   - 3.3 Gene expression, replication, transcription, translation
   - 3.4 Genetic terminology – genome, locus, allele, types of genes, traits, dominance, recessiveness, codominance, genotype, phenotype …
   - 3.5 Asexual reproduction
   - 3.6 Sexual reproduction
     - 3.6.1 Gamete, zygote, breeding, hybrid
     - 3.6.2 Mendel's laws, genotypic and phenotypic ratios, dihybrid cross,
     - 3.6.3 Gene linkage, Morgan's Laws
     - 3.6.4 Gene interactions
   - 3.7 Inheritance of sex-linked traits
     - 3.7.1 Autosome, gonosome (homo-, hetero -, hemizygote)

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3.7.2 X-linked inheritance – protanopia, haemophilia, ….
3.7.3 Chromosomal determination of sex, Drosophila, Abraxas, Protenor, patrilineality
3.7.4 Coefficient of kinship
3.8 Extranuclear inheritance – matrilineality
3.9. Mutations – spontaneous, induced, gene, chromosomal, genomic, somatic, gametic, mutagens(epigenetics, carcinogens), mosaicism, heterosis
3.10 Population genetics
3.10.1 Autogamous population
3.10.2 Allogamous population, panmictic population, genotype ratios, Hardy-Weinberg equilibrium, heritability
3.10.3 Selection, migration, genetic drift, founder effect, inbreeding
3.11 Human Genetics – research methods, genealogy, pedigrees, proband, eugenics, euphenics
3.12 Diseases
3.12.1 Autosomal recessive inheritance
3.12.2 Autosomal dominant inheritance(incl. Down syndrome)
3.12.3 Gonosomal recessive inheritance
3.12.4 Syndromes caused by a deviation in the number of gonosomes
3.12.5 Hereditary predispositions, diseases of affluence
3.13 Genetic engineering – gene therapy, DNA probes, transgenesis, patrilineality

4. **Viruses** – division, virion, bacteriophage, viral reproduction, vector molecules, viroids, prions, viral diseases

5. **Bacteria** – archaea, eubacteria, division by shape / cell wall / ecology, bacterial reproduction, parasexual recombination, bacterial diseases, blue-green algae (*Cyanobacteria*)

6. **Fungi** – characteristics, phyla of fungi, reproduction, Zygomycota – examples, Ascomycota – examples, Basidiomycota – examples

7. **Plants** – plant systematics, taxonomy
7.1 Tissues and organs
7.2 Algae
7.3 Water management
7.4 Growth, plant hormones
7.5 Movement and sensitivity
7.6 Reproduction, flower, seed, fruit
7.7 Plant life cycle
7.8 Ferns, mosses

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8. **Animals** – examples of main animal species, development of organ systems
   8.1 Unicellular –Protozoa, structure, reproduction, significant species, evolutionarily significant organelles, diseases
   8.2 Multicellular
      8.2.1 Diblastica – Radiata - cleavage, 2 embryonic layers, cell differentiation, evolutionarily significant species, development of organ systems
      8.2.2 Triblastica – Protostomia, gastrulation, 3 embryonic layers, evolutionarily significant species, morphology, development of organ systems, reproduction, diseases, Flatworms, Cycloneuralia, Molluscs, Annelids, Arthropods
      8.2.3 Triblastica – Deuterostomia, neurulation, chorda dorsalis evolutionarily significant species, morphology, development of organ systems, reproduction, diseases, Echinoderms, Tunicates, Acrania, Vertebrates
         (cartilaginous fish, fish, amphibians, reptiles, birds, mammals)
      8.2.4 Summary – embryogenesis, organogenesis, development of organ systems, foetal membranes, direct and indirect development, metamorphosis

9. **Human – Anatomy and Physiology**
   9.1 Types of tissues, extracellular matrix
   9.2 Skeletal system, bone structure, cartilage, bone connections, diseases
   9.3 Muscular system, structure and activity of muscles, myocardium
   9.4 Respiratory system, structure and function, lungs, mechanics of respiration, respiratory control, diseases
   9.5 Cardiovascular system, structure and function, structure and activity of the heart, cardiac rhythmicity, diseases
   9.6 Body fluids, extracellular fluid, lymph, blood – composition, function, diseases
      9.6.1 Immunity – specific, non-specific, cellular, humoral, transplantation
      9.6.2 Antigen system ABO and Rh factor
   9.7 Digestive system
      9.7.1 Structure and function
      9.7.2 Liver, pancreas, gallbladder
      9.7.3 Biochemistry of digestion, enzymes, biogenic elements, metabolism of carbohydrates, lipids and proteins
      9.7.4 Teeth
   9.8 Excretory system – Structure and function, diseases
   9.9 Sensory organs, receptors
      9.9.1 Skin, taste, smell
      9.9.2 Eye, sight
      9.9.3 Ear, hearing, vestibular organ
      9.9.4 Homeostasis and thermoregulation
   9.10 Endocrine system – tissue and glandular hormones, their mutual relationship, function, hypo- and hyperfunction disorders

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9.11 Nervous system – Nerve cell, excitation, function and division of the nervous system, motor, sensory, vegetative, central nervous system, diseases
9.12 Reproductive system – sex organs, hormones, ovulation and menstrual cycle, oogenesis, spermiogenesis, prenatal and postnatal development
9.13 Vitamins – overview, chemical composition, effect on the organism

10. **Geological evolution of the Earth and evolution of life on Earth, human phylogenesis**
11. **Fundamentals of Ecology**
    population characteristics, ecosystem, abiotic and biotic conditions of life, food chains, importance of ecology
12. **Biochemical processes in the cell(in association with chemistry)**
13. **Prominent Czech and foreign scientists**

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