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PROGRAMME OF THE HUMAN BIOLOGY (MEDICAL BIOLOGY) COURSE

TEACHING PROGRAMME

Subject: **Biology for medical students**

For students of: **Medicine**

Subject is taught in year: **1st**

Subject is taught in semester: **1st and 2nd**

Examination after semester: **2nd**

The course length is: **135 academic hours**

DISTRIBUTION OF THE TEACHING HOURS

FORM OF TEACHING	HOURS			
	1st semester		2nd semester	
	total	per week	total	per week
Lectures	45	3	30	2
Practicals	30	2	30	2
ALL:	75 acad. hours		60 acad. hours	

A. LECTURES

Unit 1. Basic principles in the organization of living systems **8 h**

1.1. Subject, place and significance of biology. Basic methods in biology. 2 h

1.2. Molecular organization of the living matter 2 h

Proteins – structure and function. Nucleic acids – types and functions. Self-assembly of the macromolecular subunits. Biological importance of macromolecules for the organism.

1.3. Cellular basis of life. 2 h

Prokaryotic and eukaryotic cells – comparative structural and functional characterization. Origin and evolution of cells. The cell as an open biological system. Cell communications. Cell juctions. Cell receptors. Individual development of cells. Cell senescence

1.4. Cell reproduction. Cell growth and division 2 h

Cell (mitotic) cycle – interphase, mitosis. Phases and mechanism of mitosis. MPF description. Control of cell division in multicellular organisms.

Unit 2. Molecular and cellular mechanisms of inheritance and variation **26 h**

2.1. Molecular mechanisms of the basic genetic processes 10 h

Replication of DNA (DNA biosynthesis). Basic modes of replication. Transcription. RNA processing. Genetic code. Translation. Protein sorting into cellular organelles. Posttranslational modification of proteins. Senescence and degradation of proteins. Mutagenic factors and the mechanism of their action. DNA repair. Genome organization in prokaryotic and eukaryotic cells. Regulation of gene expression. Sumbicroscopic structure of the chromosomes. Microscopic structure of the chromosomes. Karyotype.

2.2. Laws of heredity 12 h

Heredity. Inheritance. Genotype and phenotype. Methods of genetic analysis – cytogenetic methods, molecular genetic methods. Allelic form of the genes. Interaction between genes. Basic types of inheritance. Inheritance of linked genes. Crossingover. Groups of linked genes in the human. Heredity and environment. Reaction norm. Phenocopies. Morphoses. Genocopies. Cytoplasmic heredity. Extrachromosomal heredity. Modificational and genetic variation. Hybrid and recombinational variation. Molecular mechanisms of crossingover. Mutational variation. Types of mutations. Gene mutations and disease. Chromosomal mutations. Genome mutations. Cytoplasmic mutations.

2.3. Genetic and gene engineering 4 h

Genetic engineering at the level of population. Genetic engineering at the level of organism. Genetic engineering at cellular level. Genetic engineering at subcellular level. Recombinant DNA technologies and gene engineering. Specific DNA cleavage. Most important enzymes in recombinant DNA techniques. DNA sequencing. DNA libraries. Nucleic acid hybridization. DNA cloning. Polymerase chain reaction. Gene engineering and gene therapy.

Unit 3. Immunobiology. The organism as a unified system. Immunological homeostasis **16 h**

3.1.Immune system 2 h

Central and peripheral organs of the immune system. Cells of the immune response. Complement system.

3.2. Antigens as inducers of the immune response 2 h

Human alloantigens: AB0 (H) system, Lewis system, biosynthesis of the A, B, H and Lewis antigens. Rhesus system. Origin and biological significance of the alloantigens.

3.3. Antibodies. 3 h

Immunoglobulins. Immunoglobulin classes. Genetic control of the antibody synthesis. Isotypic, allotypic and idiotypic determinants. V- and C-genes.

3.4. Immune response. 3 h

Cellular interactions during the immune response. Phases in differentiation of immunocompetent cells. Types of immune responses. Major histocompatibility complex. Genetic control of the immune response intensity.

3.5 Immunobiological aspects of transplantation and anti-tumor immunity. Immune tolerance. 4 h

Laws for transplantation of tissues between inbred animal strains. Transplantation antigens in mouse and human. Host versus graft reaction. Immune tolerance. Graft versus host reaction. Anti-tumor immunity. Tumor antigens. Immune mechanisms directed against malignant tumors.

3.6. Regulation and control of the immune processes. Immunity theories. Evolution of immunity. 2 h

Unit 4. Reproduction and individual development **8 h**

4.1. Reproductive biology 4 h

Sex determination and differentiation. Reproduction of organisms. Sexual reproduction. Haploid-diploid cycle. Benefits of sexual reproduction. Cytological basis of sexual reproduction. Meiosis. Origin of germ cells. Gametogenesis. Oogenesis. Molecular mechanisms of oocyte maturation. Characteristic features of mature ova. Spermatogenesis. Characteristic features of male gametes. Fertilization. Stages of external fertilization. Mechanisms for blocking polyspermy. Completion of fertilization. Internal fertilization in mammals. In vitro fertilization and other reproductive techniques. Atypical forms of reproduction.

4.2. Developmental biology (individual development) 4 h

Embryonic period. Cellular and molecular mechanisms of gastrulation. Embryonic development of mammals and human. Differentiation. Differences between cells and cell memory in development. Postembryonic period. Ageing and death.

Unit 5. Biological evolution **4 h**

5.1. Population genetics and biology 2 h

Population. Phenotype, genotype and gene frequences. Types of mating. Hardy-Weinberg law. Factors influencing gene frequences. Mutations. Natural selection, balanced polymorphism, genetic homeostasis. Migration. Isolation. Quantitative traits.

5.2. Theory of evolution 2 h

Modern evolution theories. Microevolution. Types of natural selection. Species and speciation. Speciation mechanisms. Evolution of higher ranks (macroevolution). Major directions of evolution. Basic rules of microevolution. Molecular evolution.

Unit 6. Ecology and interactions between humans and environment **2 h**

Populations, communities and ecosystems. Interactions between organisms in communities. Humans and the biosphere. Biology of behaviour.

Unit 7. Invertebrate evolution with elements of medical parasitology **2 h**

Parasitism as a biological phenomenon. Parasites and hosts. Origin of parasitism. Parasite adaptation to the host. Host – parasite interactions. Ecology of parasitism.

Unit 8. Comparative anatomy and human evolution **10 h**

Systematics of chordates. Origin of vertebrates. Origin and evolution of skin, vertebral column, skull, digestive, circulatory, nervous system, sense organs and the urogenital system. Anthropogenesis. Paleontological record of humans. Human races. Origin of the human races. Factors of racial diversification. Racism

B. PRACTICAL COURSE

1. Techniques for light microscopy. 2 h

2. Phylum Sarcomastigophora. Subphylum Mastigophora (Flagellata). *Trypanosoma brucei rhodesiense* and *Trypanosoma brucei gambiense*. *Trypanosoma equiperdum*. *Leishmania donovani*. *Leishmania tropica*. Subphylum Sarcodina. *Entamoeba histolytica*. 2 h
3. Phylum Sarcomastigophora. Subphylum Mastigophora (Flagellata). *Trichomonas hominis*. *Trichomonas vaginalis*. *Giardia lamblia (Lamblia intestinalis).* 2 h
4. Phylum Apicomplexa (Sporozoa). *Plasmodium vivax. Plasmodium malariae*. *Plasmodium falciparum*. 2 h
5. Phylum Apicomplexa (Sporozoa). *Toxoplasma gondii*. Phylum Ciliophora. Class Ciliata. *Balantidium coli*. *Paramecium caudatum.* Transition to Metazoa. Phylum Cnidaria (Coelenterata). Genus *Hydra*. Genus *Obelia*. 2 h
6. Phylum Platyhelminthes. Class Trematoda. *Fasciola hepatica*. *Dicrocoelium dendriticum*. *Opisthorchis felineus*. Genus *Schistosoma*. 2 h
7. Phylum Platyhelminthes. Class Cestoda. *Diphyllobothrium latum*. *Taenia solium*. *Taenia saginata*. *Hymenolepis nana*. *Echinococcus granulosus*. 2 h
8. Phylum Nematoda. *Ascaris lumbricoides*. *Enterobius vermicularis*. *Trichuris trichiura* (*Trichocephalus trichiurus). Trichinella spiralis*. *Strongyloides stercoralis*. *Ancylostoma duodenale*. 2 h
9. Phylum Nematoda. *Dracunculus medinensis*. *Wuchereria bankrofti*. *Loa loa*. Phylum Annelida. *Lumbricus terrestris*. *Hirudo medicinalis*. Phylum Arthropoda. Subphylum Crustacea. Genus *Cyclops*. Class Arachnida. Order Scorpiones. Genus *Euscorpius*. Order Araneae. Genus *Latrodectus*. 2 h
10. Class Arachnida. Order Acari. *Sarcoptes scabiei*. Genus *Dermatophagoides*. Ticks as vectors of transmissive diseases: *Ixodes ricinus, Dermacentor marginatus, Hyalomma plumbeum, Rhipicephalus sanguineus*. Class Insecta. *Pediculus humanus*. *Phthirius pubis*. 2 h
11. Phylum Arthropoda. Class Insecta. *Cimex lectularius*. *Pulex irritans*. Genus *Culex* and genus *Anopheles*. *Phlebotomus papatasii*. The role of insects as vectors of transmissive diseases and mechanical carriers of pathogens. 2 h
12. Comparative anatomy of skin, skin sense organs and urogenital system. 2 h
13. Comparative anatomy of central nervous system, eye and ear. 2 h
14. Colloquium with practical exam on slides. 2 h
15. Venomous animals, poisonous plants and fungi. 2 h
16. Comparative anatomy of skull. 2 h
17. DNA and chromatin. Giant chromosomes in larvae of dipteran insects. Barr body in oral mucosa cells. 2 h
18. Cell cycle. Mitosis. 2 h
19. Karyotype. Normal human karyotype. 2 h
20. Meiosis. Gametogenesis. 2 h
21. Fertilization. In vitro fertilization in a mouse model. 2 h
22. Early animal development: cleavage, gastrulation, organogenesis. 2 h
23. Cells and organs involved in immune response. Lymphocytes, phagocytes. Preparation and evaluation of lymphocyte suspensions. 2 h
24. Immunogenetics. AB0 (H) system. Blood group testing. Blood group inheritance. 2 h
25. Immunological methods. Agglutination – serum titration. Agglutination inhibition. Secretor status. Precipitation: ring test, Ouchterlony double immunodifusion in agar gel. ELISA. 2 h
26. Mendelian inheritance. Morbid risk. Solving genetic problems. 2 h
27. Methods in population genetics: qualitative traits. Phenotype, genotype and gene frequencies. Hardy – Weinberg law. 2 h
28. Mutation frequency. Natural selection. Migration. Isolation. Kinship and inbreeding coefficients. 2 h
29. Colloquium with problems. 2 h
30. Methods in population genetics: quantitative traits. 2 h

REQUIRED MINIMUM OF PRACTICAL SKILLS

1. Microscopic observation.
2. Preparation of temporary microscope slides.
3. Knowledge of methods for statistical analysis of the population.
4. Blood group determination.
5. Dissection of vertebrates.
6. Preparation and analysis of cell suspensions.
7. Knowledge of methods for detection of antigens and antibodies. Titration of immune serum.
8. Observation and recognition of parasites.
9. Knowledge of a mammalian in vitro fertilization model.
10. Recognition of normal human karyotype.
11. Solving problems in medical genetics.

The present programme is valid from the academic year 2013-14 onwards.