GUIDE TO

MOLECULAR GENETICS

1st semester of 2013/2014 academic year

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The course is tailored to students of biological and medical sciences

Objective
Deeper knowledge about structure, function and regulation of the human genome and other eukaryotic genomes. Genome and disease. Pharmacogenetics. Cancerogenesis.

Programme and content
See Appendix

Place and time
The course will take place on Fridays at 14.30-17.30 (room 6M), from September 6 to December 20.

Form
The course includes 24 lectures (two lectures in a week), 3 tests and a seminar. The lectures cover most of the programme, but some points are left for self-education and will be discussed in seminar.

Prerequisites
Basic knowledge of molecular genetics, classical genetics, biochemistry, and cell biology is required.

Terms for passing the course
Students must pass three tests and participate in seminar with presentation on cancer or a genetic disease. Those who fail in tests will have to pass oral examination at the end of the course.

Conclusion of the course
No special conclusion planned.

Programme and content of the course, as well as lectures (ppt files) can be found in
internet: http://priede.bf.lu.lv/→ Studiju materiāli→ MolekularasBiologijas→ MolGen→ EN

Recommended literature

- Brown TA. Genomes 3. Garland Science, 2007.
- Watson JD et al. Recombinant DNA; Genes and Genomes – a short course. CSHL Press, 2007.
- Watson JD et al. Molecular Biology of the Gene. Benjamin Cummings, 2008.
- Alberts B et al. Molecular Biology of the Cell. Garland Science, 2008.
- Turnpenny P & Ellard S. Emery's Elements of Medical Genetics; 13th ed. Churchill Livingstone Elsevier, 2007.

Appendix: programme and content of the course.

MOLECULAR GENETICS

1. **Regulation of eukaryotic genes**
   Reminder of DNA replication, recombination, and repair mechanisms. Gene expression and the various effects of mutations (exercises).
   General transcription factors, gene regulatory proteins. Promoters, enhancers, silencers, insulators, and locus control regions. Gene silencing by chromatine modifications. Epigenetic inheritance. RNA interference. Alternative splicing. Post-transcriptional mechanisms.

2. **Eukaryotic genoma structure**
   Sequencing genomes. Sequence assembly by the shotgun method. Whole-genome shotgun, hierarchial shotgun (clone contig approach). The human genome projects.
   Organelle and nuclear components of genomes. Human mitochondrial genome. Eukaryotic nuclear genomes compared – size, gene number, and gene density.
   Organization of genes on chromosomes. Protein-coding genes. Non-coding RNA genes. Evolution of genes. Gene families. Pseudogenes and other evolutionary relics. Ribosomal RNA clusters. Globine gene family.
   The repetitive DNA content of the human genome. Tandemly repeated DNA. Minisatellites and microsatellites. Interspersed repeats. Transposons and retrotransposons. Genome instability. Repetitive DNA and disease.
   Variations of the human genome. Genome polymorphism. SNPs, linkage disequilibrium, haplotypes. SNP and haplotype maps of the human genome and their application.

3. **Genome and medicine**
   Finding ‘disease’ genes. Linkage analysis and positional cloning. Disclosing genetic basis of cystic fibrosis. Association studies - candidate gene approach and whole genome association. Genome data bases.
   Monogenic and complex diseases. Genetic and environmental factors in pathogenesis. Multifactorial inheritance, genetic predisposition. Threshold model of complex diseases. Predicting disease using genomics. Molecular genetics of coronary heart disease.
   Pharmacogenetics and personalized medicine. Gene variations and drug metabolism. Cytochromes P450 - functions and evolution. Genotype-phenotype relationships of the CYP2D6-polymorphism. Dose adjustment according to the genotype. Drug transporters, drug targets, and disease associated pathways. Etiology-specific drugs.

4. **Self-education for seminar. Make a presentation for 15-20 min on topic of your choice.**
   Cancer. Cancer as microevolutionary process. Oncogenes. Tumor suppressor genes.
   Epigenetics and cancer. Genetics of common cancers (colorectal cancer, breast cancer etc)…etc
   Immunogenetics. Immunoglobulin genes. Generation of antibody diversity…etc
   Monogenic or complex disease. Molecular-genetic basis of any disease.