BIO-373

Genetics and genomics

Deplancke Bart, Fellay Jacques

Cursus	Sem.	Type
Life Sciences Engineering	BA5	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	1 weekly
Project	1 weekly
Number of positions	

Summary

The theoretical part of this course covers classical genetics and contemporary genomics. Because the programming language R has become important for genomic research, the course also includes an introduction to R, followed by practical applications to genomic analyses, including a group project.

Content

- Normal and abnormal chromosomes; major chromosomal diseases.
- Different modes of transmission: Mendelian, non-Mendelian, risk factors.
- Importance and limitations of genetic analyses.
- Different types of genetic variants and effect on the individual and the population.
- Examples of the most frequent hereditary diseases, genotype-phenotype correlation.
- What does it mean to be genetically different? What are genomic variants and how can they impact phenotypes?
- Ethical guidelines on genetic research and gene therapy.
- Composition and organization of the genome
- Regulatory networks: what are their components, their architecture and how do they work?
- How is the genome structured in the nucleus of the cell; what is the impact of structural features on the function of the genome?
- Overview of high-throughput sequencing technologies
- How are regulatory networks fine-tuned, and what are the current methodological challenges?
- What is a minimal genome? How can the genome be modified for biotechnological applications?
- What is the future of genomics in the context of personalized medical applications?

Learning Outcomes

By the end of the course, the student must be able to:

- Elaborate on the social and ethical implications of genetics and genomics, including genetic testing and gene therapy
- Assess / Evaluate the differences between mutations, risk factors and genetic variations
- Examine the basics of population and quantitative genetics, evolutionary and conservation genetics
- Describe the architecture of a genome and its function with a specific focus on creating a knowledge base of how the genome interacts with the proteome
- Analyze the structural and functional properties of gene regulatory networks and how these networks coordinate differential gene expression

- Explain how solving the human genome sequence is paving the way for personalized medicine
- Perform basic genomic analyses using R (alignment, differential expression, association study etc.)

Teaching methods

Ex cathedra, exercices and group project

Expected student activities

Exercises + group project in "R"

Assessment methods

Written exam + report on a project in "R"

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Concepts of Genetics / Klug - 10th edition, ISBN 978-0-321-72412-0
Genomes / Brown - 3rd Edition ISBN 0 8153 4138 5