SYLLABUS

GENOME STRUCTURE AND EVOLUTION

ACADEMIC YEAR2023-2024

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University**
1.2 Faculty	**Faculty of Biology and Geology**
1.3 Department	**Department of Molecular Biology and Biotechnology**
1.4 Field of study	**Biology**
1.5 Study cycle	**Master, 4 semesters**
1.6 Study programme / Qualification	**Molecuar Biotechnology/ Biologist**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)	**Genome structure and evolution** **Structura și evoluția genomului**						
2.2 Course coordinator	Prof. Dr. Horia Banciu						
2.3 Seminar coordinator	Prof. Dr. Horia Banciu						
2.4 Year of study	1	2.5 Semester	2	2.6. Type of evaluation	E	2.7 Type of discipline	C
2.5. Code of the discipline	**BMR1203**						

E – Wrtten exam; C – Compulsory.

3. Total estimated time (hours/semester of teaching activities)

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					30
Additional documentation (in libraries, on electronic platforms, field documentation)					24
Preparation for seminars/labs, homework, papers, portfolios and essays					24
Tutorship					16
Evaluations					4
Other activities:					

3.7 Total individual study hours	98
3.8 Total hours per semester	154
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1 curriculum	• Molecular genetics, Molecular and cell biology, Microbiology.	
4.2 competencies	• Basic understanding of using biological datanbases and bioinformatic tools; • Interpretation of biological data	

5. Conditions (if necessary)

5.1. for the course	• Online meeting platform • Beamer, projection screen, blackboard
5.2. for the seminar /lab activities	• Attendance of a minimum of 90% of practical/ seminar classes is mandatory for granting the participation at the written exam.

6. Aquired specific competencies

Professional competencies	• Ability to analyze, communicate and solve problems derived from the study of genomes; • Obtaining practical skills in the use of genomic databases and genomic analysis, applied in the investigation of different groups of organisms, including the investigation of evolutionary processes; • Ability to organize and carry out the complex laboratory activities, as researchers in laboratories/research units in the field of biotechnologies, biochemistry, cell and molecular biology, genetics.
Transversal competencies	• Ability to clearly and convincingly communicate scientific results appropriate to the level of understanding of the audience (specialists, the general public or decision-makers); • Use of theoretical notions in solving practical problems. • Ability to analyze and interpret scientific data and formulate pertinent conclusions; • Understanding the ethical implications of biological and biomedical research.

7. Objectives of the discipline (resulting from the table of acquired competencies)

7.1 General objective of the discipline	• The course aims to provide master students with an in-depth understanding of the fundamental principles and concepts underlying the organization, function, and evolution of prokaryotic, eukaryotic and organelle genomes.
7.2 Specific objectives	• Understanding the organization and structure of genomes: Students should be able to describe the different levels of organization of genomes, from nucleotide sequences to chromosomes, • Learning about genome sequencing and annotation: Students should be able to describe the techniques used for genome sequencing and annotation and understand challenges and limitations of these approaches; • Understanding genome evolution: Students should be able to describe the mechanisms of genome evolution, including mutations, recombination, horizontal gene transfer, gene duplication, exon-shuffling, etc., and understand how these mechanisms contribute to genome diversity and adaptation; • Learning about comparative genomics: Students should be able to compare and analyze genomes across different species, and understand how comparative genomics can provide insights into genome function, evolution, and biodiversity. • Understanding the role of genomics in medicine and biotechnology: Students should be able to describe the applications of genomics in medicine, including genomic medicine and personalized medicine, and in biotechnology, including genetic engineering and synthetic biology

8. Contents

8.1 Curs	Teaching methods	Observations
Genes and genomes: the evolution of concepts and their current meaning.	Frontal lecture; discussion.	2 hrs
Principles of genomic analysis; genome projects and	Frontal lecture; discussion;	4 hrs

genome databases; Sequencing strategies for genes and whole genome: principles, applications and limitations	problem solving.	
Functional genomics by transcriptomics. DNA microarrays, serial analysis of gene expression (SAGE), RNA-Seq.	Frontal lecture; discussion; case study.	2 hrs
Functional genomics by proteomics. Principles and examples of mass-spectrometry for proteins	Frontal lecture; discussion; case study.	2 hrs
Structure and evolution of prokaryote genomes; diversity of prokaryotes reflected by their genomes, mechanisms of prokaryotic genome evolution (horizontal gene transfer, gene mutation and duplication, gene loss, etc.)	Frontal lecture; discussion; problem solving.	4 hrs
Origin and evolution of mitochondrial and plastid genomes. Cytonuclear integration and endosymbiotic gene transfer.	Frontal lecture; discussion; problem solving.	2 hrs
The structure and evolution of nuclear genomes in eukaryotes; particularities of eukaryotic genomes.	Frontal lecture; discussion; problem solving.	4 hrs
The human genome compared to other vertebrate genomes. Evolution of eukaryotic genomes; how often do new genes appear in genomes?	Frontal lecture; discussion; case study.	6 hrs
Structure of plant genomes; poliploidy and transposable element drivers of plant genome evolution.	Frontal lecture; discussion; problem solving.	2 hrs

Bibliography

Bernardi, G. Structural and Evolutionary Genomics. Natural Selection in Genome Evolution, Elsevier, Amsterdam, 2005.

Caetano-Anolles Gustavo, Evolutionary genomics and systems biology. Hoboken, N. J. : Wiley-Blackwell, 2010.

Craig N.L., Cohen-Fix O., Green R., Molecular biology : principles of genome function. Oxford University Press, 2010.

Gregory T. R., The evolution of the genome. Elsevier Academic Press, Amsterdam, 2005.

Lesk A.M., Introduction to genomics. Oxford : Oxford University Press, 2017

Lynch, M. The origins of Genome Architecture, Sinauer Assoc., Sunderland, 2007.

Mülhardt, Cornel, Molecular biology and genomics. Academic Press, Amsterdam, 2007

Watson J.D., Baker T.A., Bell S.P., Molecular biology of the gene. Cold Spring Harbor Laboratory Press, 2008

Slides (pdf / pptx) are provided to the students through the dedicated team channel within MS Teams application.

8.2 Seminars / laboratory	Teaching methods	Observations
Organizing and introducing seminar tasks	Discussion	2 hrs
Susținerea de referate pe teme atribuite individual (studii de caz, metodologii, mecanisme de evoluție genomică la procariote, fungi, plante și animale).	Eurystic conversation; discussion, problem solving.	22 hrs
(week 11 or 13)		
Evaluation of an essay written based on the gained knowledge during seminars	Evaluation	2 hrs

Bibliography

(1) Scientific papers (as pdf) available through the University librairies as open access or paid online subscription to main publishers.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course has a similar contents to the courses in other European universities and takes into account the level of training of the students;
- The course is fundamental for the development of work skills in research laboratories and/or in biotechnological research units.

10. Evaluation

Tip activitate	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Pshare in the final grade (%)
10.1 Course	Knowledge of information from the topics of the course	Written exam	40 %
10.2 Seminars/laboratory	Skills to understand and synthesize scientific information.	Conceiving and writing an eaasy within the topic of the course	30 %
	Skills for presenting/ communicating scientific information	Oral presentation of a scientific paper by Powerpoint or similar presentation app	30%
10.3 Minimum performance standards			
• Knowledge of at least 50% of the information contained in the course; • Writing at least one essay on an individually assigned topic; • Making at least one presentation on an individually assigned topic.			

Date	Signature of course coordinator	Signature of seminar coordinator
10.01.2023	**Prof. Horia BANCIU**	**Prof. Horia BANCIU**

Date of approval by Department — Signature of Head of Department

17.01.2023 — **Assoc. Prof. Beatrice KELEMEN**