Universitat Autònoma de Barcelona

2022/2023

Advanced Genomics and Proteomics

Code: 43473
ECTS Credits: 9

Degree	Type	Year	Semester
4313794 Biochemistry, Molecular Biology and Biomedicine	OT	0	1

Contact

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Use of Languages

Principal working language: catalan (cat)

Other comments on languages

approx 50% of the lectures

Teachers

Francesc Xavier Avilés Puigvert

Antoni Barbadilla Prados

Enric Querol Murillo

Jaime Martinez Urtaza

Julia Lorenzo Rivera

Sònia Casillas Viladerrams

Prerequisites

The Catalan, English or Spanish languages will be mostly used depending of the lecturer that will give a particular topic and the conjoint of attendees.

Addressed to post-graduate students in Biochemistry, Biotechnology, Biology, Biomedicine, Genetics, Microbiology, Chemistry, Informatics/Bioinformatics, Pharmacy, Medicine and Veterinary.

Objectives and Contextualisation

The overall aim of the subject is provide students with an overview of Genomics and Proteomics including fundamentals, current techniques and applications. The specific objectives of GENOMICS include understanding the following aspects. the diversity and complexity of eukaryotic genomes, the historical and evolutionary perspective of genomic content, the meaning and consequences of intraspecific variability, techniques commonly employed in studies of genomics and transcriptomics and applications derived from the knowledge provided by this science.

The aim of the PROTEOMICS lectures is provide students with an overview of the advanced methods of Proteomics and Interactomics (Proteogenomics annotation, MS Imaging…) and applications (biomarkers in biomedicine, differential proteomics for drug and vaccine target identification, network pharmacology and toxicology…). The first draft of the human Proteome and the Proteome Atlas will be introduced and discussed.

Competences

- Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications.
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning within the subject area and in relation to the scientific or business context.
- Identify and use bioinformatic tools to solve problems in biochemistry, molecular biology and biomedicine.
- Integrate contents in biochemistry, molecular biology, biotechnology and biomedicine from a molecular perspective.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
- Use scientific terminology to account for research results and present these orally and in writing.

Learning Outcomes

1. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
2. Continue the learning process, to a large extent autonomously.
3. Develop critical reasoning within the subject area and in relation to the scientific or business context.
4. Identify and describe the different components in prokaryotic and eukaryotic genomes and proteomes.
5. Identify molecular mechanisms responsible for diseases.
6. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
7. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
8. Use scientific terminology to account for research results and present these orally and in writing.
9. Use the different methodologies, techniques and tools commonly used in genome sequencing, assembly and annotation.
10. Use the different methodologies, techniques and tools commonly used in proteomics and interactomics and metabolomics.

Content

GENOMICS: Introduction to Genomics. The human genome project. Genomic technologies. Transposable elements. Comparative genomics nucleotide-level changes. Comparative genomics: chromosomal changes. Population genomics: Theory. Population genomics in model species. Nucleotide variation in humans. Structural variation. Association Studies/System genetics. Functional Genomics and Transcriptomics. Epigenomics.

PROTEOMICS: Proteomics and proteogenomics. Proteogenomic annotation. How many proteins and proteoforms are in a mammal cell? Instrumentation and methods of the proteomics. Practical session. Atlas and first draft of the human proteome. Interactomics: methods and applications. Proteomics and protein function. Genomics and proteomics of parasitic organisms: malaria and leishmania. Proteomics and post-translational modifications (PTMs). Molecular imaging by mass spectrometry and applications. Biomedical and biotechnological applications of the proteomics: Biomarkers in biomedicine; Identification of drug and vaccine targets by differential proteomics, surfomics and immunomics; pathogen microorganisms identification ("BioTyper"). MS for protein structure/function analysis. Metabolomics. Networks and applications in pharmacology and toxicology.

Methodology

Subject teaching includes three types of activities:
- Lectures. PowerPoint presentations accompany spoken explanations of the subject to be learned to help students visualize questions and answers.
- Reading and discussion. Students are expected to read a number of research papers during the course and participate in the critical discussion of the papers in the classroom.
- Oral presentations. Students will prepare a subject and make an oral and PowerPoint presentation of the subject to their peers.
15 minutes of a class will be dedicated to answer the institutional surveys of the UAB

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	45	1.8	5, 6, 8
Type: Supervised			
Oral presentations	40	1.6	1, 7, 8
Type: Autonomous			
Student work and learning	137	5.48	3, 5, 6, 2, 7, 8

Assessment

Final grades are a weighed average of items:

- Attendance and participation in the classroom (20%)
- Oral presentation and defense (40%)
- Exam (40%)
The student will be "not qualifiable" when the number of evaluable tests/tasks/activities done by he student do not reach to a global minimal qualification of 5.0

Important: If plagiarism is detected in any of the works submitted, the student will fail the whole module.

"*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

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Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exams	40%	2	0.08	4, 3, 5, 6, 1, 2, 9, 10, 8

Lecture attendance	20%	0	0	6, 1
Oral presentation	40%	1	0.04	6, 1, 7

Bibliography

Basic books
- Gibson, G. i S. V. Muse. A Primer of Genome Science. Sinauer, Massachusetts. USA. 2009, 3rd edition.
- Brown, T. A. Genomes. Garland Science, UK. 2009, 3rd edition.
- Kraj, A. & Silberring J. Introduction to Proteomics. Ed. Wiley, UK 2008.
- Lovrik, J. Introducting Proteomics: From concepts to sample separation, mass spectroetry and data analysis. Ed. Wiley-Blackwell, UK, 2011.
- Klipp, E. et al. Systems Biology: A textbook. Ed. Wiley-Blackwell, UK, 2009.
- Baldwin, G. et al. Synthetic Biology: A primer. Imperial College Press, UK, 2012
- Belinda Pitman. Proteomics: Proteome and proteomics analysis. Ed Syrawood 2019
- Manual de Proteómica. Ed. Sociedad Española de Proteómica. Pdf 15€ en https://payhip.com/b/FNt7
Additional journal references will be commented in thelectures
Useful links
UAB Virtual Campus: https://cv2008.uab.cat/
Entrez Genome Database: http://www.ncbi.nlm.nih.gov/genome

Expasy: http://www.expasy.org

Human Proteome Map: http://www.humanproteomemap.org/

ProteomicsDB: : http://www.proteomicsdb.org/

Software

None