Universitat Autònoma de Barcelona

2022/2023

Membrane Biophysics

Code: 100906
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OT	4	1

Contact

Name: Ramón Barnadas Rodriguez
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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Ramón Barnadas Rodriguez
Alex Peralvarez Marin

Prerequisites

General concepts related to physiology, biochemistry and physical chemistry.

Objectives and Contextualisation

Study of the components of biological membranes and their molecular organization.

Structural and dynamic features of the two main components of biological membranes: lipids and proteins.

Establishing the links between their molecular structure and physiological functions and possible associated pathologies.

Unravel the molecular mechanisms of signal transduction through cellular envelopes or the transport of molecules across biological membranes.

Methods and techniques used for the study of biomembranes.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Be able to self-evaluate.
- Clearly perceive current advances and possible future developments by reviewing scientific and technical literature in the area of biochemistry and molecular biology.
- Collaborate with other work colleagues.
- Define the structure and function of proteins and describe the biochemical and molecular bases of their folding, intracellular traffic, post-translational modification and replacement.
- Design experiments and understand the limitations of experimental approaches.

- Explain the structure of cell membranes and their role in signal transduction processes, the transport of solubles and the transduction of energy.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Read specialised texts both in English and one's own language.
- Think in an integrated manner and approach problems from different perspectives.
- Understand the language and proposals of other specialists.
- Use the basics of mathematics, physics and chemistry that are required to understand, develop and evaluate the chemical procedures of living matter.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Be able to self-evaluate.
3. Collaborate with other work colleagues.
4. Compare the methods and findings that have led to the establishment of the structure and function of biological membranes.
5. Design experiments and understand the limitations of experimental approaches.
6. Explain in detail the biophysical methods used to reveal the dynamic structure and properties of proteins.
7. Identify fundamental issues in present-day biophysics.
8. Identify scientific and technical advances in biophysics.
9. Interpret experimental results and identify consistent and inconsistent elements.
10. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
11. Read specialised texts both in English and one's own language.
12. Think in an integrated manner and approach problems from different perspectives.
13. Understand the language and proposals of other specialists.

Content

MEMBRANE BIOPHYSICS

1. LIPIDS

1.1. Introduction. Overview of lipid classification.

1.2. Structure and function relationship of the different types of lipids.

1.3. Lipid properties and study techniques.

1.3.1. Hydrocarbon chains.

1.3.2. Interfacial region.

1.3.3. Polar head.

1.4. Lipid polymorphism. Study techniques.

1.4.1. Properties of lipid aggregates at the nanometric range.

1.4.2. Type, preparation and applications of lipid aggregates.

1.4.3. Liposomes, micelles, bicelles.

2. MEMBRANE PROTEINS

2.1. Classification of membrane proteins.

2.2. Modifications of membrane proteins.

2.3. Structural principles and topology of membrane proteins.

2.4. Biogenesis and folding of membrane proteins.

2.5. Experimental and computational techniques for the study of membrane proteins:

2.5.1 Expression, analysis, purification and characterization of membrane proteins.

2.5.2 Interaction of membrane proteins with biological membranes.

3. Specialized seminars performed by students

Methodology

The theory classes will be in complete groups.

There will be seminars in which students will present individually or in small groups, subjects related to different aspects of the structure and function of the biological membranes.

Attendance at the seminars will be monitored, and the mark obtained will be considered only when attendance is equal to or greater than 80 % of the seminars.

The practical classes will consist of 2 laboratory sessions:

1.- Obtaining phospholipid / surfactant phase diagram (4 hours).

2.- Quantification of the entrapment of a hydrophilic molecule into liposomes (4 hours).

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			
Master class with IT support	35	1.4	3, 4, 5, 13, 6, 8, 7, 9, 11, 12, 2
Seminars regarding subject main topics. Discussion of topics.	7	0.28	3, 4, 13, 6, 8, 7, 11, 12
Type: Supervised			
Laboratory practical sessions	8	0.32	4, 5, 6, 8, 7, 12, 2
Tutoring sessions	6	0.24	4, 13, 6, 8, 7, 11, 12
Type: Autonomous			
Autonomous study	53	2.12	

Bibliography search and seminar preparation	30	1.2	
Deliverables	2	0.08	3, 9, 11, 12, 2

Assessment

The evaluation will consist of four parts that make up a continuous evaluation process which includes:

a) two partial exams of the theoretical knowledge subject (70 %).

b) the laboratory practices (14 %).

c) the works proposed throughout the course (10 %).

d) the seminars (6 %), in the case of complying with the assistance indicated in *Methodology* (equal to or greater than 80 % of the seminars).

A minimum passing grade of 4 in each one of the two theoretical exams is required to pass the subject.

Students who have not passed some of them will take a new exam about of the parts not passed.

Students who want to upload the grade can take a global exam of the whole subject, which will provide the final grade.

Test
The exams will combine multi-choice test questions (60 %) with short questions (4 0%) about the master classes.

Laboratory practices will be evaluated by a report (14 %).

In relation to the evaluation of works to be delivered throughout the course and a bioinformatic work supervised with a questionnaire that must also be submitted (10 % of the final grade).

The seminars will be evaluated based on the work presented by the student (6 % of the final grade).

Final mark

Weighted mean of a) to d). To pass the subject the overall mark should be 5.0 or higher.

Exam Review

On-demand exam reviewing will be done individually with the student.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluation of deliverables	10%	2	0.08	3, 4, 5, 13, 6, 8, 7, 9, 10, 11, 12, 2

Evaluation of oral presentations	6%	3	0.12	1, 3, 4, 5, 13, 6, 8, 7, 9, 10, 11, 12, 2
Evaluation of practical sessions	14%	1	0.04	3, 4, 5, 13, 6, 9, 10, 12, 2
Evaluation of theoretical knowledge. Short answer test and multiple-choice test.	70% (Multiple-choice 60% + Short-answer 40%)	3	0.12	4, 5, 13, 6, 8, 7, 9, 11, 12

Bibliography

Research articles that are part of the teaching materials.

Software

UCSF Chimera

https://www.cgl.ucsf.edu/chimera/

VMD (Visual Molecular Dynamics)

https://www.ks.uiuc.edu/Research/vmd/