Universitat Autònoma de Barcelona

2023/2024

Membrane biophysics

Code: 101899
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OT	4	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Ramon Barnadas Rodriguez

Mario Lopez Martin

Prerequisites

General concepts related to biochemistry and physical chemistry.

Objectives and Contextualisation

To interpret the properties derived from the composition and molecular organization of biological membranes.

To know the structural and dynamic characteristics of the major components of biological membranes: lipids and proteins.

To establish the relationships between the molecular structure of lipids and proteins with their physiological functions and diseases.

To know the molecular mechanisms of signal transduction through cell envelopes or the transport of molecules through biological membranes.

To know methods and techniques used in the study of biomembranes.

To relate the composition of the components of lipid drug delivery systems with their properties.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Display knowledge of the basic life processes on several levels of organisation: molecular, cellular, tissues, organs, individual and populations.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Analyse the molecular mechanisms of compartmented intracellular transport by means of molecular motors and of their extrapolation to cell and tissue motility.
3. Identify the molecular and cellular mechanisms for transporting different types of substances (lipids, gases, metals) between tissues.
4. Identify the molecular principles that are common to the selective transport of substances through the plasma membrane and their regulation.
5. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
6. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
7. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
8. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
9. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
10. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
11. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
12. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

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.

1.5. Lipidic drug delivery systems.

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 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	2, 3, 4, 12
Seminars regarding subject main topics. Discussion of topics.	7	0.28	3, 4, 12
Type: Supervised			
Laboratory practical sessions	8	0.32	
Tutoring sessions	6	0.24	3, 12
Type: Autonomous			
Autonomous study	53	2.12	3
Bibliography search and seminar preparation	30	1.2	3, 4
Deliverables	2	0.08	

Assessment

1. CONTINUOUS EVALUATION

It consists of the following parts:

(a) Two eliminatory partial exams of theoretical knowledge subject (35% of the final grade each).

b) An evaluation of the laboratory practices (14%). Attendance to the practical sessions is mandatory. The student will obtain the grade of "Not evaluable" when the absence is higher than 20% of the scheduled sessions.

c) An evaluation of evaluable work proposed throughout the course (10%).

d) An evaluation of the seminars (6%), in case of complying with the attendance indicated in *Methodology* (equal or superior to 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 any of them, and who have been evaluated in a set of activities whose weight is equivalent to a minimum of 67% of the total grade of the course, may take a recovery exam that will consist of the parts not passed.

The student will obtain the grade of "Not Evaluable" when the evaluation activities carried out have a weight of less than 67% in the final grade.

Configuration of the tests

As for the two eliminatory exams, they will consist of multiple-choice questions and short questions.

The evaluation of the laboratory practices will be based on the work and the results obtained, which will be presented in a report (14 %).

It is necessary to deliver throughout the course the works that will be proposed (10 %).

The evaluation of the seminars will be based on the evaluation of the presentation sessions (6 %).

2. SINGLE EVALUATION

Students who take advantage of the single evaluation must carry out the laboratory practices. An attendance of less than 80% of the scheduled sessions isnot allowed.

Regarding the evaluation, it will be donecoinciding with the last continuous evaluation test.

The test will consist of the following parts:

(a) An exam on lipids and on proteins (35% each). To pass the course it is indispensable to have obtained a minimum grade of 4 in each of these parts.

b) The delivery of the practical report (14%).

c) An oral test on the work proposed throughout the course (10%).

d) The presentation and oral discussion of an article with the professors (6%).

3. FINAL MARK

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

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