Universitat Autònoma de Barcelona

2019/2020

Function of Biomolecules in Health and Illness

Code: 42888
ECTS Credits: 9

Degree	Type	Year	Semester
4313772 Advanced Biotechnology	OT	0	A
4313794 Biochemistry, Molecular Biology and Biomedicine	OT	0	A

Contact

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Use of Languages

Principal working language: catalan (cat)

External teachers

Ramon Deulofeu

Prerequisites

Those required by the Master. Lectures will be mostly in Catalan, but also will be taught in Spanish. Lectures could be in English when students ask for it in advance, and consensus agreement exists between the professor and the group of students.

Objectives and Contextualisation

At the end of the module, the student will be able to:

1) Planning experiments for the identification, expression, purification and functional characterization of biomolecules.

2) Analyze the structure and function of proteins by bioinformatic techniques.

3) Relate structural and functional changes of biomolecules with pathologies.

4) Select and apply the methodology for the design of enzyme inhibitors.

5) Identify and characterize enzyme inhibitors such as drugs.

6) Use the enzyme technology to the biomedical and biotechnological applications.

7) Recognize biomolecules associated with human pathologies and use them as therapeutic targets.

8) Relate certain diseases with the accumulation of misfolded proteins.

9) Know the molecular basis of disease due to dynamic mutations and epigenetic changes.

10) Evaluate the functional role of the membrane lipids and their participation in certain pathologies.

11) Know the main techniques and facilities of a reference clinical biochemistry laboratory.

12) Use the yeast species as model for the study of biomolecules.

Competences

Advanced Biotechnology

- Apply techniques for modifying living beings or parts of these in order to improve pharmaceutical and biotechnological processes and products or develop new products. (Specialisation in molecular and therapeutic biotechnology)
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Integrate the contents of the metabolic paths of living beings in normal conditions, pathological conditions, or conditions that are modified exogenously (specialisation in molecular and therapeutic biotechnology)
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Synthesise, weigh up alternatives and engage in critical discussion.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use and manage bibliography and IT resources related to biotechnology responsibly.

Biochemistry, Molecular Biology and Biomedicine

- Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications.
- Analyse research results to obtain new biotechnological or biomedical products to be transferred to society.
- Apply techniques for modifying living beings or parts of these in order to improve pharmaceutical and biotechnological processes and products or develop new products.
- 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 acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- 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. Analyse research results to obtain new biotechnological or biomedical products to be transferred to society.
2. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
3. Continue the learning process, to a large extent autonomously.
4. Describe processes and methodologies for designing or transforming biomolecules for application in therapy.
5. Descriure els processos i les metodologies per al disseny o transformació de biomolècules per a la seva aplicació terapèutica.
6. Develop critical reasoning within the subject area and in relation to the scientific or business context.
7. Identificar mecanismes moleculars responsables de malalties.
8. Identificar molècules que intervenen en funcions biològiques importants i la seva variació en situacions de malaltia.

9. Identify molecular mechanisms responsible for diseases.
10. Recognise the molecular mechanisms of important functions in biomedicine.
11. Reconèixer els mecanismes moleculars de funcions rellevants en biomedicina.
12. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
13. Synthesise, weigh up alternatives and engage in critical discussion.
14. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
15. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
16. Use and manage bibliography and IT resources related to biotechnology responsibly.
17. Use bioinformatic procedures to analyse the active centre of enzymes and design drugs.
18. Use scientific terminology to account for research results and present these orally and in writing.
19. Utilitzar procediments bioinformàtics per a l'anàlisi del centre actiu dels enzims i el disseny de fàrmacs.

Content

Introduction

Block 1: Identification, obtaining and purification of biomolecules. Functional characterization.

- Practical concepts for the purification of proteins.
- Methods of identification of substrates or potential inhibitors, and detection of the enzymatic activity.
- Practical considerations on the enzymatic tests. Applied aspects of enzyme kinetics.
- Identification of the functional regions of enzymes by means of bioinformatic tools. Practical session in Computer lab.
- Structural and functional analysis of enzymatic inhibitors that act like drugs. Practical session in Computer lab.
- Drug recovery: Identification and development of new uses of existing grugs

Block 2: Enzymes associated to human pathologies. Diagnostic and therapeutic applications-

- Role of oxidoreductases in the metabolism of alcohols and aldehydes. Relationship with alcoholism.
- Enzymes of retinoid metabolism. Associated pathologies.
- Enzymes which modify chromatine and their role human pathologies.
- Enzyme replacement therapy. Enzyme activators. Pharmacoperones or farmacological chaperones. Therapeutic applications.
- Enzymes and nanomedicine. Enzyme encapsulation. Controlled drug release.
- The role of infectious proteins in degenerative diseases.
- Strategies in the treatment of the lisosomal diseases: enzymatic, cellular and gene therapy.
- Proteases and proteases inhibiting enzymes. Biomedical applications, and tight-binding kinetics.
- Yeast as a model organism. Three applications in the characterization of biomolecules: interactions protein-lipid, protein-protein and genetic interactions.

Block 3: Conformational diseases.

- Proteostasis and conformational diseases.
- Therapies in development for conformational diseases: introduction of conformational diseases. Light-chain Amyloidosis. Alzheimer's disease.

Block 4: Membrane lipids in Biomedicine.

- Role of lipids in diverse functions and dysfunctions of biomembranes: dynamics of lipidic microdomains (lipid rafts, etc); endocytosis and exocytosis; oxidative stress; apoptosis. Techniques of study.

Block 5: Visit to a Clinical Biochemistry Laboratory, Hospital Clínic de Barcelona

- Visits to the automated rapid-response laboratory (lab CORE). Analysis of retinoids by HPLC. Inmunoenzymatic techniques in clinical biochemistry.

Methodology

The module consists of lectures, practical sessions in the Computer Lab, visit to a reference laboratory of Clinical Biochemistry, and the preparation/presentation of a seminar by the student.

Next, the organization and the teaching methodology that will be followed is described:

Lectures.

The content of the theory program will be presented mainly by the professors in the form of lectures with audio-visual support. The presentations used in class by the professor will be previously available in the Virtual Campus of the subject. It is recommended that the students have this material during the class. It is advised that the students regularly consult books recommended in the Bibliography section of this educational guide to consolidate and to clarify, if is necessary, the contents explained in class. Also, it is advisable that the students use the links that are indicated in teaching materials, containing videos and animations related to the processes explained in class.

Practical sessions in bioinformatics:

Students will be summoned directly in the classroom for the development of the session. The work will be individual, and it will be important that the student has previous slight knowledge of the software that will be used.

Visit to a laboratory of reference of Clinical Biochemistry:

The session will take place in the Service of Clinical Biochemistry of the Clinical Hospital of Barcelona, where the student will receive the explanations on the operation of the facilities and the used methodologies.

Seminar presentation:

The student will prepare and present a seminar in a subject chosen from a list provided by the professor.

Tutorial for the preparation of a seminar:

There will be a tutorial session in group, directed by the coordinator of the module, in order to distribute the seminar subjects and, to explain in draft the kind of work the student should present. Students will be able to have individual tutorial sessionswith the teacher directly involved in the subject of his/her work, in order to help to the student in the preparation of his/her material.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	44	1.76	5, 4, 12, 3, 11, 10, 14
Oral presentation of a seminar	5	0.2	5, 4, 6, 2, 11, 10, 16, 15
Practical sessions in the Computer Lab	8	0.32	6, 14, 19, 17
Visit to laboratories	4	0.16	11, 10, 14, 19, 17
Type: Supervised			
Preparation and presentation of student's work	20	0.8	5, 4, 6, 8, 9, 2, 3, 14, 16, 15, 18
Type: Autonomous			
Student's independent work	81	3.24	12, 3, 11, 10, 16, 15, 19, 17, 18

Assessment

* Attendance and active participation in class:

Apart from the attendance, the degree of participation, discussion, and answers provided to posed questions will be evaluated. Assessment of this activity will be performed after each class. This evaluation will be worth 20% of the final grade.

* Preparation and oral presentation of a seminar:

Presentation of a seminar in the class, with the subsequent discussion. This part will be worth 20% of the final grade by the students who presented it.

* Written tests:

The presentation of works, or any written assessment, will be worth 30% of the final grade in total.

In addition, overal achievement of the seminar sessions will be evaluated through a written test. This part will be worth 10% of the final grade.

* Practice in workshop

Delivered reports or practical works. This part will be worth 20% of the final grade.

To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score.

Attendance to practical sessions (or field practices) is mandatory. Students missing more than 20% of programmed sessions will be graded as "No Avaluable

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

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Attendance and active participation in class	20%	38	1.52	1, 13, 4, 6, 8, 9, 12, 2, 3, 11, 10, 14, 19, 17
Exams and assessment theory test:	30%	10	0.4	5, 4, 6, 7, 9, 8, 12, 2, 3, 11, 10, 16, 15, 19, 17, 18
Preparation and oral presentation of a seminar	20%	5	0.2	4, 6, 7, 9, 8, 2, 3, 11, 10, 14, 16, 15, 18
Test on seminars	10%	5	0.2	13, 5, 4, 6, 7, 9, 8, 12, 2, 3, 11, 10, 14, 16, 15, 18
Tests or work of classroom practices	20%	5	0.2	13, 6, 12, 2, 3, 16, 15, 18

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