Universitat Autònoma de Barcelona

2021/2022

Structural Biochemistry and Molecular Biology

Code: 103596
ECTS Credits: 6

Degree	Type	Year	Semester
2502442 Medicine	FB	1	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

José Miguel Lizcano de Vega
José Rodríguez Álvarez
Carles Gil Giró
Jordi Ortiz de Pablo
Carlos Alberto Saura Antolin
Montserrat Solé Piñol
Jose Manuel Lopez Blanco
Alberto Fernández de Arriba
Belen Ramos Josemaria
Maria Antonia Baltrons Soler
Roser Masgrau Juanola
Alfredo Jesús Miñano Molina

Prerequisites

There are no official prerequisites. However, it is convenient to review the following subjects of the baccalaureate program:

- Chemical binding types

- Chemical balance. Acid-base balance

- Formulation of organic chemistry

- Types of chemical reactions

- Structure and components of eukaryotic cells

Objectives and Contextualisation

The subject is programmed in the first year of the Degree in Medicine (first semester) and forms part of the group of basic education skills. It is, therefore, part of the scientific basis necessary for the training of medical graduates. Its general objectives are the study of the chemical basis of life, specifically applied to the composition and function of the human organism, and the knowledge of the main biochemical elements that contribute to the improvement of medical practice. The subject has a close relationship and complementarity with Biophysics and Cell Biology subjects, both programmed in the first year of the degree.

The achievement of its objectives, in addition to its general importance in the degree, is essential as a basis for the Metabolic Biochemistry subject, scheduled in the second semester of the first course, and is also relevant for several later subjects such as those corresponding to the fields of Physiology, Pharmacology, Genetics, Immunology and Endocrinology.

Competences

- Communicate clearly, orally and in writing, with other professionals and the media.
- Critically assess and use clinical and biomedical information sources to obtain, organise, interpret and present information on science and health.
- Demonstrate basic research skills.
- Demonstrate knowledge of the principles and physical, biochemical and biological processes that help to understand the functioning of the organism and its disorders.
- Demonstrate understanding of the basic sciences and the principles underpinning them.
- Demonstrate understanding of the importance and the limitations of scientific thought to the study, prevention and management of diseases.
- Demonstrate understanding of the mechanisms of alterations to the structure and function of the systems of the organism in illness.
- Demonstrate understanding of the organisation and functions of the genome, the mechanisms of transmission and expression of genetic information and the molecular and cellular bases of genetic analysis.
- Demonstrate understanding of the structure and function of the body systems of the normal human organism at different stages in life and in both sexes.
- Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
- Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
- Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
- Use information and communication technologies in professional practice.

Learning Outcomes

1. Communicate clearly, orally and in writing, with other professionals and the media.
2. Demonstrate basic research skills.
3. Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
4. Describe the basic molecular mechanisms of storage, transmission and expression of hereditary information.
5. Describe the molecular basis of the structure of the biological macromolecules and of how this structure conditions their activity.
6. Describe the role of of the biomolecules that participate in the life processes of the human organism.
7. Explain the mechanisms and relate the molecular processes that can be the cause or the consequence of pathological manifestations in the organism.
8. Explain the molecular significance of the structure and function of the systems of the human organism.
9. Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
10. Identify the basic processes of life on various levels of organisation: molecule, cell, tissue, organ, and individual.

11. Identify the biochemical tools that help to improve medicine.
12. Identify the chemical bases that help to understand the functioning of the organism, at both cell and tissue level.
13. Identify the mechanisms of enzymatic transformation of biomolecules.
14. Identify the rules that govern energy transfer in the chemical processes of the human organism.
15. Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
16. Make correct use of biochemistry terminology.
17. Relate alterations to the structure and function of biomolecules to structural and functional alterations to systems of the human organism.
18. Relate the molecular and cellular processes that can be the cause or the consequence pathological manifestations in the organism.
19. Relate the molecular mechanisms that can generate pathological manifestations in the organism.
20. Use information and communication technologies in professional practice.
21. Use specific bibliographic sources and databases on biochemistry to work independently on acquiring further knowledge.

Content

In addition to the basic physicochemical principles, the contents of the course include the description of the structure and functional roles of biological macromolecules, with special emphasis on the relationship between chemical structure and biological function. It also incorporates the acquisition of skills in some basic techniques of the biochemical laboratory and the conceptual and methodological language of molecular biology.

Thematic blocks of theory and seminars:

Topic I. MOLECULAR CHARACTERISTICS OF LIVING MATTER (2 h)

- Chemical elements of living matter

- Biomolecules

- Composition and characteristics of the extracellular and intracellular environment

- Acid-base chemistry. Role of the bicarbonate system in maintaining blood pH

At the end of the topic there will be a seminar session (2 h)

Topic II. BIOENERGETICS (3h)

- General principles: Variation of free energy in chemical reactions

- Role of ATP and other compounds in energy transfers

- Energetics of redox reactions

At the end of the topic there will be a seminar session (2 h)

Topic III. STRUCTURE AND FUNCTION OF PROTEINS (5h)

- Composition, structural levels, functions and classification

- Aminoacids

- Covalent structure of peptides and proteins

- Three-dimensional structure of proteins

- Relationship between structure and function: myoglobin and hemoglobin as exemples

When finishing the subject there will be two seminar sessions (4 h)

Topic IV. ENZYMES (4h)

- General concepts

- General mechanisms of enzymatic catalysis

- Kinetics of the enzymatic reactions

- Regulation of the enzyme activity

Topic V. MEMBRANES ANDTRANSPORTATION (1h)

- Transport through membranes

At the end of topics IV and V there will be two seminar sessions (4 h)

Topic VI. MOLECULAR BIOLOGY (10h)

- Nucleotides and Nucleic Acids.

- Genes and Genomes. Cloning of DNA

- Replication of DNA.

- DNA transcription and RNA maturation.

- Genetic Code and Translation.

- Regulation of gene expression.

- Molecular Biology Techniques Applied in Medicine.

When finishing the subject there will be three sessions of seminars (6 h)

LABORATORY PRACTICES

1.- Separation techniques of biomolecules: Fractionation of serum proteins in cellulose acetate and determination of molecular weights by electrophoresis in SDS-polyacrylamide. 5.5 h

2.- Molecular Biology: Detection of polymorphisms by PCR. 4 h

****Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.***

Methodology

The teaching methodology will consist of theoretical classes (conferences), seminars (in which they will discuss problems and practical and clinical cases) and laboratory practices. The main teaching material for these activities will be provided through the virtual campus of the UAB.

The theoretical classes will be taught in the form of lectures for each group of full enrollment, in which teachers will also comment on the material available for the other activities, including materials for self-learning.

At the end of each topic, students will be tutored in smaller groups (6 per enrollment group) to discuss problems and cases of practical or clinical application. In this activity, the students will have a script with questions, problems and cases that they will have to solve previously to the class, in which they will discuss them with their classmates and with the tutor.

The laboratory practices will be carried out following a script and will include a list of questions that the students will have to solve after the practice.

Additionally, students will have specific personal tutoring within the terms agreed upon with the lecturer professor.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

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			
LABORATORY PRACTICES (PLAB)	9.5	0.38	1, 2, 3, 6, 4, 5, 9, 11, 15, 17, 16, 21, 20
SEMINARS (SEM)	18	0.72	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
THEORY (TE)	25	1	6, 4, 5, 8, 7, 13, 10, 12, 11, 14, 19, 18, 17, 16, 21
Type: Supervised			
ORAL PRESENTATION / EXPOSITION OF WRITTEN WORKS	15	0.6	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
Type: Autonomous			
SELF STUDY / PREPARATION OF WRITTEN WORKS	75	3	3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20

Assessment

EXAMS FORMAT

The exams will consist of written tests designed to reflect the achievement of competences, as well as the recognition of concepts. The exams may contain questions related to all the activities carried out in the subject.

The course will be evaluated by two exams and a final exam (if necessary). All exams are scored from 0 to 10.

In all cases, the day and time of the exam reviews will be announced along with the qualifications.

FIRST EVALUATION (55% of the final grade for the course) - teaching units 1 to 5 and the first six seminars.

It will consist of 2 exams:

✓a test with selection items (27.5% of the final qualification for the course) (multi-choice test)

✓ an essay test (27.5% of the final qualification for the course) (short conceptual questions or problems)

SECOND EVALUATION (40% of the final grade for the subject) - teaching unit 6.

It will consist of 2 exams:

✓a test with selection items (20% of the final qualification for the course) (multi-choice test)

✓ an essay test (20% of the final qualification for the course) (short conceptual questions or problems)

REQUIREMENTS TO APPROVE

To pass the course it is necessary to obtain at least a 5

The final qualification for the subject will be the qualification from the first evaluation multiplied by 0.55 plus the qualification from the second one multiplied by 0.4. This requires:

a) an average mark of the first evaluation (teaching units 1 to 5) equal to or greater than 4.5 out of 10,

b) an average mark of the second evaluation (teaching unit 6) equal to or greater than 4.5 out of 10.

IMPORTANT: To this note, 0.5 points will be added in those cases that have attended the practices (classroom and laboratory). Failure to attend ONE of the practices will not allow the assigment of the 0.5 points mentioned.

Formula calculation:

Final mark = first evaluation mark x 0.55 + second evaluation mark x 0.4 + 0.5 points for attending all practices

REQUIREMENTS TO PASS IN RECOVERY

Students who have not passed any of these parts can recover them in the final recovery exam, examining the part or parts not passed.

In the case of obtaining a minimum of 4.5, the final grade will be calculated with the following formula:

Final mark = first evaluation mark (or its recovery) x 0.55 + second evaluation mark (or its recovery) x 0.4 + 0.5 points for attending all practices (classroom and laboratory)

If the grade is less than 4.5, the previous formula will not be applied and the course will be suspended.

All students have the option of evaluating the entire subject through the final make-up exam, renouncing all grades previously obtained.

FINAL EVALUATION

It will consist of 2 tests:

✓a test with selection items (50% of the final grade for the course) (multi-choice test)

✓ an essay test (50% of the final grade for the course) (short conceptual questions or problems)

Formula:

Final mark = [(test mark + short questions mark): 2] x 0.95 + 0.5 points for attending all the practices (classroom and laboratory)

* The proposed evaluation may undergo some modification depending on the presence restrictions imposed by the health authorities.

The "not-assessable" will reflect the non-attendance to the final recovery exam for students who have not previously passed the course.

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

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory and classroom attendance	5%	0.4	0.02	1, 2, 3, 6, 5, 8, 9, 11, 15, 17, 16, 21, 20
Written assessments through essay tests	27,5%	2.3	0.09	1, 2, 3, 6, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
Written assessments through objective tests	40%	2.5	0.1	1, 2, 3, 6, 4, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20
Written assessments through selection items	27,5%	2.3	0.09	1, 2, 3, 6, 5, 8, 7, 9, 13, 10, 12, 11, 14, 15, 19, 18, 17, 16, 21, 20

Bibliography

Books

1. Nelson DL, Cox MM. Lehninger principios de Bioquímica, 7ª ed. Barcelona: Omega; 2018.

2. Baynes JW, Dominiczak MH. Bioquímica Médica, 5ª ed. Barcelona: Elsevier; 2019.

3. Devlin TM. Bioquímica con aplicaciones clínicas. 4th ed. Wiley; 2015

4. Lieberman M, Marks A, Peet A. Bioquímica médica básica: un enfoque clínico. 5ª ed. Madrid: Wolters Kluwer/Lippincott Williams & Wilkins; 2018

5. Stryer L, Berg JM, Tymoczko J. Bioquímica con aplicaciones clínicas, 7ª ed. Barcelona: Reverté; 2015.

Digital books

Bioquímica : con aplicaciones clínicas / Lubert Stryer, Jeremy M. Berg, John L. Tymoczko ; con la colaboración de Gregory J. Gatto, Jr. ; versión española por Miguel Ángel Trueba

Bioquímica médica / [editores:] John W. Baynes, Marek H. Dominiczak ; Revisión científica: Dra. Maria Josefa Sabrià Pau

Bioquímica médica básica : un enfoque clínico [de] Marks / Michael Lieberman, Alisa Peet

Software

no need for specific software