Universitat Autònoma de Barcelona

2020/2021

Basic Molecular and Cell Biology

Code: 102493
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	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

Name: Marta Martín Flix
Email: Marta.Martin@uab.cat

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

Ester Boix Borrás

Teresa Anglada Pons

Prerequisites

Although there are no prerequisites to attend it, it is recommended that the student have previous knowledge of:

1. Biomolecules and their functions
2. The structure and the basic functions of cell organelles

Moreover, taking into account that most up-to-date sources of information in the field of Molecular and Cell Biology are in English, it is highly recommended that the students who study this subject have a basic knowledge of this language.

Objectives and Contextualisation

The subject *Fonaments de Biologia Molecular i Cel·lular*, is a subject of the 1st semester of the 1st year of the Chemistry Degree .

Objectives of the subject:

1) To understand the basic structural features of biomolecules.

2) To know the mechanisms of expression and transmission of genetic information.

3) To know the methods of analysis and manipulation of biomolecules, as well as the basic techniques in biochemistry and molecular biology.

4) To explain the cell structure and ultrastructure.

5) To describe the functions of cell organelles and other cellular structures and to understand that their coordinated functioning is essential for the cell tasks' development .

6) To understand the processes of differentiation, specialization and cell death, their importance for the correct functioning of an organism and to identify the cellular bases of certain pathologies associated with cell functioning errors.

Competences

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Apply knowledge of chemistry to problem solving of a quantitative or qualitative nature in familiar and professional fields.
- Communicate orally and in writing in ones own language.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Have numerical calculation skills.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Apply knowledge of biology to solve problems in biological chemistry.
2. Communicate orally and in writing in ones own language.
3. Describe the molecular mechanisms responsible for the replication and transcription of DNA, as well as the translation of mRNA and the regulation of genic expression.
4. Describe the processes of cellular differentiation, specialisation and death, as well as the cellular bases of pathologies associated to functional errors.
5. Have numerical calculation skills.
6. Identify structural protein domains and motifs and their functional and evolutionary relationships.
7. Integrate the functions of the different organelles and cell structures with the overall functioning of the cell.
8. Interpret the results of experiments performed in the biology laboratory.
9. Learn autonomously.
10. Make bibliographic enquiries in the field of biology in the English language.
11. Manage the organisation and planning of tasks.
12. Master the basic techniques for manipulating and analysing nucleic acids.
13. Properly describe the basic structural and functional characteristics of biomolecules.
14. Reason in a critical manner
15. Relate the methodologies used in cell biology to the knowledge these can provide, handle laboratory tools and make cell cultures
16. Relate the structure of the different parts of a cell to their functioning.
17. Select the most suitable experimental approaches to studying the structure and function of biomolecules
18. Use IT to treat and present information.
19. Use specific bibliographic sources on cellular biology to develop and expand the acquired knowledge.
20. Work in a team and show concern for interpersonal relations at work.

Content

THEORETICAL CLASSES PROGRAM*

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

- Biochemistry and Molecular Biology

Unit 1. Molecular organization of living beings: General concept of Biochemistry. Chemical elements in living matter. Structural hierarchy of biomolecules. Biological importance of water. Non-covalent interactions in aqueous medium.

Unit 2. Proteins: Primary structure and biological functions: Protein types and functions. Chemical structure, properties and classification of amino acids. Peptides and peptide bond.

Unit 3. Three-dimensional structure of proteins: Structural levels of proteins. Description of the α-helix and β-sheets. Fibrous proteins. Globular proteins. Quaternary structure.

Unit 4. Biological catalysts: Nature and function. Classification and nomenclature. Bases of enzymatic action. General mechanisms of enzymatic catalysis. Enzyme kinetics. Cofactors. Regulation of enzyme activity.

Unit 5. Carbohydrates: Types of carbohydrates and their functions. Monosaccharides: description and properties. Glycosidic bond. Oligosaccharides. Structural and reserve polysaccharides. Glycoproteins: glycoproteins, proteoglycans and glycolipids.

Unit 6. Lipids: Types of lipids and functions. Storage lipids. Structural membrane lipids. Other lipid structures.

Unit 7. Nucleic acids: Types of nucleic acids and functions. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick models and alternative structures. Tertiary structure. DNA-protein complexes: chromosome organization.

Unit 8. Basic Concepts of Molecular Biology: DNA replication. Transcription of DNA. RNA processing. Regulation of gene expression. Translation: the genetic code, the ribosome and mechanism of protein synthesis.

- Cell Biology

Unit 9: Plasma membrane. Structure and transport mechanisms.

Unit 10. Cytosol. Intracellular compartments. Intracellular protein trafficking.

Unit 11. Nucleus. Structure and nucleus-cytoplasm transport.

Unit 12: The internal membranous system. Vesicular transport. Endoplasmic reticulum, synthesis and modification of lipids and proteins. Golgi apparatus, structure and modifications of proteins. Selection and distribution of proteins for vesicular transport. Lysosomes and Endosomes.

Unit 13: Mitochondria. Structure and functions.

Unit 14: Cytoskeletal elements. Role in cell functioning and tissue maintenance. Microfilaments, structure and function. Microtubules, structure and function. Intermediate filaments, structure and function. Cell junctions.

Unit 15. Cell Cycle and its control. Cell cycle and its control. Mitotic and meiotic cell division.

Problems (classroom practices)

- Biochemistry and Molecular Biology

The content of this section consists of two parts. In the first, the most relevant aspects for the purification and characterization of proteins will be discussed. The second will be focused in buffer systems, methods of purification and analysis of macromolecules and enzyme kinetics. The problem statements will be delivered in the form of a dossier at the beginning of the semester.

- Cell Biology

The dossier of problems will be available through the *Moodle* classroom of the Virtual Campus, 15 days before the clasrrom practices sessions. Students should try to solve them, autonomously, prior to the problem sessions, where they will be corrected.

LABORATORY PRACTICES

- Biochemistry and Molecular Biology

A four-hour laboratory session will be held: Separation of proteins by gelfiltration and by electrophoresis.

- Cell Biology

There will be two sessions of two hours:

· Introduction to the use of the optical microscope. Study of the plant cell.

· Introduction to the use of the optical microscope. Study of the animal cell.

Warning on laboratory safety: The student who is involved in an incident that may have serious security consequences may be expelled from the laboratory and suspended.

Methodology

The subject of ***Fonaments de Biologia Molecular i Cel·lular*** consists of Theoretical classes, classroom practices lessons, and Laboratory classes*.

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

Theoretical classes

The theoretical master classes will be accompained by a visual support material in *power point* format prepared by the teacher. This support material will be available to students in the *Moodle* classroom of the *Campus Virtual* of this subject. Students will be download this material and use it as a support when taking notes. In some subjects, videos or animations will also be projected to facilitate the understanding of certain processes.

Classroom practices

In the Classroom practices classes will solve experimental problems related to the contents of the theoretical classes. In these classes, each students' group of theroretical classes will be divided into two subgroups of approximately 30 students, whose students' lists will be made public at the beginning of the course. Students will attend the sessions programmed by their group.

Classroom practice classes are designed to work in small groups of students, with the objective to acquire group work and critical reasoning skills.

In the corresponding part of Biochemistry and Molecular Biology, the methodology for the purification and characterization of proteins and problems of buffer systems and enzyme kinetics will be treated.
In the part of Cell Biology (working in the same groups established by classroom practices on the part of Biochemistry and Molecular Biology) will have to solve, autonomously, the problems that will be later corrected in the classroom practices sessions.

Practical classes

The practical classes are designed to learn the use of laboratory instruments and as a complement the theoretical training. The students will perform a total of 3 sessions of practices, the first of 4 hours and the second and third of two hours each.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom practices	8	0.32	1, 2, 8, 14, 17, 20, 18, 19
Laboratory practices	8	0.32	11, 7, 8, 14, 15, 20
Theoretical classes	36	1.44	9, 2, 13, 3, 4, 11, 6, 7, 14, 10, 16, 17
Type: Autonomous			
Individual study	78.5	3.14	9, 13, 3, 4, 11, 6, 7, 14, 10, 16, 19
Problems resolution	12	0.48	1, 9, 2, 11, 8, 14, 10, 17, 5, 20, 18, 19

Assessment

To pass the subject requires the theory + problems + practices scores, to be at least of 5 points out of 10 possible.

The planned evaluation activities are*:

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

- THEORY: The theoretical part represents 70% of the final grade. To pass the course, the average of the 2 partial exams or the recovery exam must be equal to or higher than 3.5.

First theoretical partial exam: It will represent 35% of the final score. The contents of Molecular Biology will be evaluated. The exam will include test type questions and short answer questions.

Second theoretical partial exam: It will represent 35% of the final score. The contents of Cell Biology will be evaluated. The exam will include test type questions and short answer questions.

Recovery exam: This exam will be done to retrieve failed parts. Access to the recovery exam will only be granted to those students who had previously developed evaluation activities during the course that account for 2/3 of the final grade.

- PROBLEMS: The problems part represents 20% of the final score.

1) Problems of the part of Molecular Biology: It will represent 10% of the final score. The problems of this part will be evaluated by an examination the day of the first partial of the theorical exam. There will be a recovery exam the same day of the theory recovery exam.

2) Problems on the part of Cell Biology: It will represent 10% of the final score. This part will be evaluated by an examination the day of the second partial of the theorical exam. There will be a recovery exam the same day of the theory recovery exam.

- LABORATORY PRACTICES: They will represent 10% of the final score. To qualify the practices the attitude of the student in the laboratorywill be considered, as well as the correction of the questionnaires to be completed at the end of each practice. Attendance at laboratory practices is mandatory. The score of this part will be the average of the scores obtained in the practices of Cell Biology and in Biochemistry and Molecular Biology.

Warning on laboratory safety: The student who is involved in an incident that may have serious security consequences may be expelled from the laboratory and suspended.

Not evaluated: Students who perform less than 50% of the evaluation activities described above will be considered as not evaluated.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st Partial Examination. Biochemistry and Molecular Biology contents	35% of the global score	2.5	0.1	9, 2, 13, 6, 14
2nd Partial Examination. Cell Biology contents	35% of the global score	2.5	0.1	9, 2, 3, 4, 7, 14, 16, 19
Biochemistry and Molecular Biology Problems examination	10% of the global score	0.5	0.02	1, 12, 14, 17, 5
Cell Biology Problems examination	10% of the global score	0.5	0.02	9, 11, 14, 10, 5, 18
Laboratory practices	10% of the global score	1.5	0.06	2, 12, 11, 8, 15, 20, 18

Bibliography

Biochemistry and Molecular Biology

Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. 2015. Molecular Biology of the Cell. 6th Edition. Garland Science.

Berg, J.M., Tymoczko,J.L., Stryer, L. 2012. Biochemistry. 7ª ed. Freeman.

Berg, J.M., Tymoczko, J.L. i Stryer, L. 2013. Bioquímica. 7ª edició, Barcelona. Ed. Reverté . Traducció de la 7ª edició anglesa.

Mathews, Ch.K., van Holde, K.E. 2012. Biochemistry English 4ed.

Mathews, Ch.K., van Holde, K.E. 2013. Bioquímica. Castellà 4ed (accessible com ebook des de biblioteca UAB).

Nelson, D.L. i Cox, M.M. 2013. Lehninger Principles of Biochemistry. 6th ed. W.H. Freeman & Co.

Nelson, D.L. and Cox, M.M. 2015. Lehninger-Principios de Bioquímica. 6a Ed. Omega.

Voet, D., Voet, J.G. and Pratt, C.H. 2006. Fundamentos de Bioquímica. 2a ed. Ed. Panamericana. Traducció de la 2ª edició anglesa de l'any 2006.

Voet, D., Voet, J.G. 2010. Biochemistry. 4ª ed. Wiley.

Cell Biology

Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. 2016. Biología Molecular de la Célula. 6ª Edición. Editorial Omega.

Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P. 2015. Molecular Biology of the cell. 6th Edition. Editorial Garland Science.

Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Scott MP,. 2016. Biología Celular y Molecular. 7ª Edition. Editorial Panamericana.

Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Martin K,. 2016. Molecular Cell Biology. 8th Edition. EditorialFreeman.

Karp G. 2014. Biología Celular y Molecular. 7ª Edición. Editorial Mc Graw Hill.

Karp G. 2018. Karp's Cell Biology. Global Edition. Editorial Wiley.

Cooper GM, Hausman RE. 2017. La Célula. Edición 2017. Marbán Libros S.L. Madrid.

Cooper GM, Hausman RE. 2018. The Cell. A molecular approach. 7th Edition. Sinauer - Oxford Eds.

Cooper: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=cooper

Alberts: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4

Lodish: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mcb

Web page with simple animations recreating basic cellular processes:http://www.johnkyrk.com/index.esp.html