Universitat Autònoma de Barcelona

2021/2022

Biomolecular Chemistry

Code: 100878
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OT	4	0

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

Prerequisites

The courses Fundamentals of General Chemistry and Organic Chemistry of Biochemical Processes must have been passed

Objectives and Contextualisation

The overall objective of the course Biomolecular Chemistry is to provide the students with an overview of natural products (biosynthesis, structural and ecological features, applications as source of bioactive compounds). Basic understanding about the chemical structures and biosynthesis of natural products will be provided, as well as their function and utility as pharmaceuticals or agrochemical agents.

The objectives of the course can be summarized as follows:

1. To Understand and know the structures of natural products of secondary metabolism and their biosynthesis.
2. To Understand the importance of natural products for their biological and pharmacological activities
3. To Know the ecological, pharmacological and agrochemical importance of natural products
4. To be able to propose reasonable biosynthetic pathways for natural products

Competences

- Design experiments and understand the limitations of experimental approaches.
- Identify molecular structure and explain the reactivity of the different biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Interpret experimental results and identify consistent and inconsistent elements.
- Use ICT for communication, information searching, data processing and calculations.
- Write an article on a scientific or technical topic aimed at the general public.

Learning Outcomes

1. Apply various experimental techniques to the study of metabolic pathways and the structure of metabolites.

2. Design experiments and understand the limitations of experimental approaches.
3. Explain the biosynthesis of natural products (secondary metabolites), especially those with biological activity.
4. Identify mechanisms of chemical attraction, communication and defence in living beings.
5. Interpret experimental results and identify consistent and inconsistent elements.
6. Use ICT for communication, information searching, data processing and calculations.
7. Write an article on a scientific or technical topic aimed at the general public.

Content

Biosynthetic pathways

Primary and secondary metabolism. Main biosynthetic pathways: shikimate, acetate, mevalonate. Determination of biogenetic sequences. Detection of biologically active metabolites. Bioassays. Isolation and separation. Summary of reactions.

Fatty acids and polyketides

Carbohydrates. The acetate hypothesis. Saturated fatty acids. Unsaturated fatty acids. Prostaglandins. Aromatic polyketides. Macrolides.

Terpenoids

Structural classification. The route acetate-mevalonate. Monoterpenes. Sesquiterpenes. Diterpenes. Steroids. Carotenoids.

Derivatives of shikimic acid

Phenolic compounds. Aromatic amino acids (tryptophan, phenylalanine, tyrosine) and derivatives. Transamination, NIH shift. Cinnamic acids and derivatives. Pharmacological applications: L-DOPA, chloramphenicol, salicin as a model of aspirin. Lignans and lignin. Flavonoids.

Semiochemicals

Ecological chemistry. Classification of semiochemicals. Plant-insect interactions. Allelopathy. Phytoalexin. Pheromones. Types of pheromones. Structural diversity. Isolation. Practical applications of insect pheromones.

Secondary metabolism of amino acids

Prebiotic formation of amino acids. Beta-lactamic antibiotics, penicillins, cephalosporins; biogenesis and synthetic approaches.

Alkaloids I

Alkalois derived from ornithine, lysine and nicotinic acid. Alkaloids derived from the shikimate pathway (from phenylalanine and tyrosine). Physiological effects and pharmacological applications of alkaloids such as cocaine, nicotine, hyoscyamine, hyoscine, atropine, ephedrine, mescaline.

Alkaloids II

Alkaloids of type benzylisoquinoline: papaverine,tubocurarin (curare).

Alkaloids of modified benzylisoquinoline: opium alkaloids or morfinans (thebaine, morphine, codeine), biosynthesis and physiological effects.

Simple alkaloids derived from tryptophan (serotonin).

Alkaloids derived from tryptophan: the ergot alkaloids (lysergic acid).

Alkaloids derived from tryptophan of type indole-terpenoid (brucine, strychnine).

Alkaloids derived from tryptophan of type quinoline (quinine against malaria).

Purine alkaloids: caffeine.

Alkaloids derived from anthranilic acid.

Alkaloids derived from histidine.

Methodology

In accordance with the objectives of the subject, the student will be involved in a series of activities to achieve the established knowledge and skills. These activities can be grouped into three different types:

Master classes: In this case, students receive in person a series of knowledge articulated exclusively by the teacher. During these classes the teacher will transmit the basic knowledge of the subject; knowledge that will have to be complemented with the individual work of the student consulting the bibliography that the professor will indicate to him, as well as participating and realizing the programmed activities. The master classes are a type of activity that demands little interactivity with the student; they are conceived as a fundamentally unidirectional method of transferring the teacher's knowledge to the student. During the classes, students' participation will be encouraged through the dynamization of classes through the resolution of cases and questions in a regular way.

During the master classes, the exercises that students will have to solve throughout the course will be defined and delivered

Problem classes: A dossier of exercises will be given to the students to be solved during the course. A selected part of these exercises will be solved by the problem teacher so that the students learn the appropriate methodology to find the solutions. In these sessions, the solutions proposed by the students will be discussed, based on autonomous work developed individually or in groups, for exercises and problems previously considered. During this process, students' participation will be important. Teachers will help to develop the critical sense and logical reasoning, in order to increase the ability of the students to solve problems.

Resolution of exercises to be delivered (individual work)

Throughout the course, as the subjects are finished, the teacher will be giving out exercises that allow the student to reinforce and practice the basic knowledge of the subject that the teacher has shown in class. These exercises must be done individually and must be delivered in paper format. They will be part of the continuous evaluation of the course (compulsory activity).

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			

exercise and problems classes	10	0.4	1, 2, 3, 4, 5
master classes	30	1.2	1, 2, 3, 4
Type: Autonomous			
problems resolution	102	4.08	1, 6, 2, 3, 4

Assessment

The evaluation of this subject will be carried out in a continuous way, in order to achieve the principal objectives:

1.- Monitor the teaching-learning process, allowing both the student and the teacher to know the degree of achievement of the competences and correct, if possible, the deviations that take place.
2.- To encourage the student's continued effort to over-indulge, often useless, to study at the last minute for the final exam.
3.- Verify that the student has achieved the competences determined in the syllabus.

The assessment of the course will be done individually. This monitoring will consist of:

Exercises to deliver. Throughout the course, as lessons are being finalized, the teacher will give to the students exercises that will allow them to practice and reinforce some of the knowledge that they must be achieved;

these exercises will be collected on the Virtual Campus of the subject. The average of the mark obtained with this work will represent 15% of the overall grade of the subject.

First partial exam. Once about one third of the subject's course is taught, the first partial exam will be performed, that allows the students to check the expected knowledge.This exam will have a weight of 35% of the overall grade.

In order to be able to make an average with the other qualifications of the course, the students will have to attain a minimum of 4 marks of the exam over 10.

Second partial exam. Once the theoretical classes had finished, the second partial exam will be programmed, which will include the rest of the contents offered during the course. The weight in the final mark will be 50% of the overall grade.

In order to be able to make an everage with the other qualifications of the course, the students will have to attain at least 4 marks of the exam over 10.

In order to approve by course, the students should obtain a global grade equal to or greater than 5 taking into account all the continuous assessment activities, and they should not have a grade of less than 4 in any of the partial exams.

At the end of the course there will be a recovery exam for all students who have not passed by course or those who want to raise the qualification. It will consist of two parts, corresponding to each of the partial examinations.
The student may retrieve partial examinations separately, and examine of one or another part or of both parts.

To participate in the recovery, the students must have been previously evaluated in a series of activities the weight of which equals to a minimum of two thirds of the total rating of the subject or module.

Therefore, the students will obtain the qualification of "Not Evaluable" when the activities of evaluation carried out have a weighting less than 67% in the final grade.

Students who pass the subject: Students will be considered to have passed the subject only if they obtain an overall assessment average of 5 or more.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
delivery of exercises	15 %	3	0.12	1, 6, 2, 7, 3, 4, 5
two partial exams	85 %	5	0.2	1, 2, 3, 4, 5

Bibliography

The material of the course will be found in the moodle space of the UAB virtual campus. In this material you will find: general information, transparencies used in class or support, exercises to deliver, reinforcement exercises (if deemed necessary), qualifications of the partial examinations and any other information that is considered of interest for the students.

Medicinal natural products. A biosynthetic approach, P. M. Dewick, Wiley, 3rd edition, 2009. *ISBN: 978-0-470-74168-9. As E-book: ISBN: 978-1-119-96457-5,* 2011

Natural Products. Their Chemistry and Biological Significance. J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorphe and J. B. Harborne. Pearson Education Limited, 1994. ISBN 0-582-06009-5.

Software

No specific software is required