

**Basic Research Skills in Biochemistry, Molecular
Biology and Biomedicine**

Code: 42894
ECTS Credits: 9

Degree	Type	Year	Semester
4313794 Biochemistry, Molecular Biology and Biomedicine	OB	0	A

Contact

Name: David Garcia Quintana

Email: davidg.quintana@uab.cat

Use of Languages

Principal working language: english (eng)

Other comments on languages

All classes, discussions, materials, the instructors' responses to questions, and the students' assignments will be in English. Therefore an upper-intermediate level of English is required.

Teachers

Joaquín Ariño Carmona

Ester Boix Borrás

Jaume Farrés Vicén

Antonio Casamayor Gracia

Miguel Chillon Rodriguez

Enrique Claro Izaguirre

Assumpció Bosch Merino

Elena Galea Rodríguez de Velasco

Carlos Alberto Saura Antolin

Jose Ramon Bayascas Ramirez

David Reverter Cendros

Irantzu Pallares Goitiz

Natalia Sánchez Groot

Marc Torrent Burgas

External teachers

Irene Roman

Martí Aldea

Oscar Zaragoza

Prerequisites

Graduates in Biochemistry, Biotechnology, Biology, Biomedical Sciences, Genetics, Microbiology, Medicine, Chemistry, Pharmacy, Computing Sciences, Physics, or Veterinary Medicine.

English is the only language used in the course. That includes class explanations by the instructors, tutorials, discussions in the classroom, materials, oral presentations by the students, and evaluated assignments. Therefore, an upper-intermediate level (B2, Cambridge First, TOEFL 87-109) is highly recommended.

Objectives and Contextualisation

The global objective of the course is for the student to acquire fundamental competencies in Biochemistry, Molecular Biology, and Biomedical research, to gain a solid grounding as a biomolecular scientist. Specific objectives are detailed in the Content section.

Competences

- Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications.
- 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.
- Conceive, design, develop and synthesise scientific and/or biotechnological projects within biochemistry, molecular biology or biomedicine.
- 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 propose scientific solutions to problems in molecular-level biological research and show understanding of the biochemical complexity of living beings.
- 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.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- 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.
- Work individually and in teams in a multidisciplinary context.

Learning Outcomes

1. Acknowledge the contribution of technical innovations to progress on the frontiers of knowledge.
2. Analyse and correctly interpret the molecular mechanisms operating in living beings.
3. Analyse the state of the art in a particular area in order to formulate a relevant research question.
4. Apply knowledge of methods that are of use in solving problems in biochemistry, molecular biology and biomedicine.
5. Apply knowledge of molecular mechanisms operating in living beings to identify experimental applications, whether basic, translational or of economic interest.
6. Assess the social and economic importance of research in biochemistry, molecular biology and biomedicine.
7. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.

8. Conceive, design, develop and synthesise scientific and/or biotechnological projects to test a hypothesis.
9. Continue the learning process, to a large extent autonomously.
10. Develop critical reasoning within the subject area and in relation to the scientific or business context.
11. Formulate correct conclusions.
12. Identify available emerging methods within biomolecular research.
13. Identify emerging fields in research into biochemistry, molecular biology and biomedicine.
14. Identify the most appropriate organism for tackling a particular experimental problem.
15. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
16. Make an appropriate choice in the context of an experimental study.
17. Propose, based on findings, new experiments to take the research further .
18. Recognise molecular mechanisms in a research context.
19. Show mastery of the different methodologies used to modify living organisms in research and their uses.
20. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
21. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
22. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
23. Use bioinformatic resources and databases as research tools.
24. Use inductive reasoning and deductive methods to test a hypothesis and predict results.
25. Use scientific terminology to account for research results and present these orally and in writing.
26. Work individually and in teams in a multidisciplinary context.

Content

1- At the bench

1.1- Experimental Design

Instructor

David G. Quintana

Objectives

For the student to understand experimental design and data analysis processes.

Contents

- A brief introduction to the epistemology of Science.
- The problem/question framework: Defining the research objective and the best-suited question to address it. What would be an acceptable answer? Defining the experimental project.
- Hypothesis-driven research. Inductive vs deductive reasoning. The need for a testable, falsifiable hypothesis. The new paradigm: Question-driven research. Data-driven research.
- Experimental design. Choosing the optimal experimental system and sample. Instrument calibration and controls. Types of experiments. Variables. Controls. Time courses. Reproducibility.
- Data analysis and interpretation. Analysis of statistical significance. and confidence. Correlation vs causation. Sources of bias. Model formulation; validating the model through predictions that can be tested experimentally.

1.2- Clinical Research

Instructor

Irene Roman

Objectives

For the student to understand the specifics of the different clinical research approaches.

Contents

- Observational studies. Descriptive, ecological, case report/case series. Descriptive and analytic, cross-sectional, case-control, cohort. Mixed.
- Experimental studies, randomized clinical trials.
- Integration of individual studies. Systematic review. Meta-analyses.
- Screening tests. Screening criteria. Reliability. Validity.
- Causality, interaction, confusion.

1.3- Lab Life Basics

Instructors

Oscar Zaragoza, Jaume Farres, Antonio Casamayor, David G. Quintana.

Objective

An overview of general Biolab organization and procedures.

Blocks

- Organization of Biolabs.
- Handling of typical equipment and instruments.
- Your bench.
- Types of storage.
- The lab notebook.
- Lab safety. Good laboratory practices. Disposal of lab waste. How to react when facing spills and other accidents. Working with radioisotopes. Biosafety.

1.4- Scientific Integrity

Instructor

Oscar Zaragoza

Objective

For the student to become aware of the conflicts, tensions and uncertainties encountered in scientific research.

Contents

Case-based learning. Sources of pressure. Misconduct, fabrication, falsification, suppression, plagiarism. Misinterpretation, a priori convictions, insufficient reproducibility. Criteria for authorship.

2- Communication skills in Science

Instructors

Enrique Claro, Antonio Casamayor, Joaquin Arino.

Objectives

- For the student to acquire fundamental skills in written and oral communication of research results, in a concise, clear, honest manner.
- For the student to develop the ability to integrate knowledge and formulate reasonable conclusions from available information.

Blocks

- Oral skills.
- The research article.
- The MSc and PhD thesis.
- Posters.

3- Journal Clubbing

Instructors

Jose R. Bayascas, Ester Boix, Assumpcio Bosch, Miguel Chillon, Elena Galea, Irantzu Pallares, David Reverter, Carles Saura, Natalia Sanchez de Groot, David G. Quintana.

Objectives

An initiation to journal club as an essential, standard tool

- to develop the ability to analyze, reason, and discuss (defend and criticize) scientific results.
- to get acquainted with and understand advanced research work.
- to keep up with constant, fast progress in biomolecular sciences.
- to integrate MSc/PhD students' knowledge in Biochemistry, Molecular Biology, and Biomedicine.
- to practice preparing and delivering oral presentation and discussion/defense of experimental results.
- to serve as a way of identifying some of the current frontiers in biomolecular research, including emerging methods and techniques.

Blocks

- How to critically dissect a research article.
- Relevant articles will be proposed by the different tutors for the students to work on at home, and then present and discuss them in small groups.

4- Computer lab practices

Instructors

Marc Torrent, Martí Aldea.

Blocks

- Data representation and analysis, hypothesis testing.
- Systems biology, simulation, and design of biological systems (COPASI, Complex Pathway Simulator).

Methodology

This is an eminently practical course, as it is aimed at the acquisition of research competencies and self-confidence by the future biomolecular researcher. In consequence, all sessions are based on practical, experiential learning, where the student is the centre of her/his learning process. For the same reason, the load of (evaluated) work is significant.

In general, TE and SEM sessions will be developed as described below, although the instructor's specific needs will prevail at all times.

- Session 1:
 - Introductory presentation.
 - Supervised teamwork (so-called *peer instruction*), as a way to start developing the corresponding competencies, such as experimental design, solving safety cases and scientific integrity conflicts related to lab work, or oral and written communication tasks.
- Autonomous coursework, related to the supervised work begun in the classroom.
- Session 2:
 - Presentation of the homework. Learning through discussion.
 - Synthesis.

Presentation and discussion of *Journal Clubs*. The student must prepare the presentation and defence of 5 research articles of his/her choice among the 8 on offer.

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			
Full group classes (TE, double helix), split group seminars (SEM, Crick / Franklin), and computer lab practices (PLAB-I)	17	0.68	17, 3, 4, 8, 10, 16, 11, 14, 15, 20, 7, 9, 21, 26, 24, 23, 22, 25, 6
Type: Supervised			
Presentation of assignments and Journal clubs	10	0.4	17, 2, 3, 5, 4, 8, 19, 10, 16, 11, 12, 14, 13, 15, 20, 7, 9, 1, 18, 21, 26, 24, 23, 22, 25, 6
Supervised work in the classroom	50	2	17, 3, 5, 4, 8, 10, 16, 11, 12, 14, 15, 20, 7, 9, 21, 26, 24, 23, 25, 6
Tutorials	5	0.2	17, 3, 8, 10, 16, 11, 14, 15, 20, 7, 9, 21, 24, 25, 6
Type: Autonomous			
Work on assignments and on Journal Club	125	5	17, 2, 3, 5, 4, 8, 19, 10, 16, 11, 12, 14, 13, 15, 20, 7, 9, 1, 18, 21, 26, 24, 23, 22, 25, 6

Assessment

Continuous evaluation:

Specific details of the different assignments will be provided by the different instructors. The contribution of each block to the final grade is proportional to the workload.

- Experimental design (DGQ 23%)
- Clinical research (IR 8%)
- Scientific communication (EC 22%, JA 9%)
- Scientific integrity, safety, and good practices, biosafety (OZ 7%, JF 4%, AC 2%)
- Computer laboratory practices (MT 5%, MA 5%)
- Presentation and discussion of the Journal Clubs (15%)

Class attendance:

Instructors in Module 1 consider that hands-on, experiential learning is the most powerful learning strategy. For such reason, all face-to-face sessions involve in-class work, which cannot be recovered. Consequently, absences without a documented force majeure reason will average zero proportionally to the missed number of hours.

Late submission of coursework:

Written coursework delivered after the deadline without a documented force majeure reason, will be penalized with a deduction of 10% of the total grade per day of delay, with a limit of 5 days. After the 5 day-limit, a grade of zero will be awarded. This rule will cease to be applicable and the assignment will receive a zero whenever the instructor publishes the solutions to the assignment

Referral evaluation:

Since the evaluation of the module is based on continuous work, much of it in the classroom, there is no referral evaluation option.

Non-assessable:

A student who hands in pieces of evidence that account for less than 2/3 of the total mark will be qualified as "Non-assessable".

Misconduct:

Written works and presentation documents will be scanned with plagiarism detection software. Detection of a single plagiarism event will lead to failing the module with no option for referral evaluation.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Presentation and defence of assignments	85%	8	0.32	17, 2, 3, 5, 4, 8, 19, 10, 16, 11, 12, 14, 13, 15, 20, 7, 9, 1, 18, 21, 26, 24, 23, 22, 25, 6
Presentation and discussion of Journal Clubs	15%	10	0.4	17, 3, 5, 4, 10, 11, 12, 13, 15, 20, 7, 9, 1, 18, 21, 26, 22, 25, 6

Bibliography

The recommended textbooks are available at the UAB libraries.

- At the Bench. A laboratory Navigator. Kathy Barker. Cold Spring Harbor Laboratory Press, 2005.
- Experimental Design for Biologists. David J. Glass. Cold Spring Harbor Laboratory Press, 2007.
- Statistics at the Bench. A Step-by-Step Handbook for Biologists. Martina Bremer. Cold Spring Harbor Laboratory Press, 2009.
- How to Present at Meetings. George M. Hall, Neville Robinson. BMJ Books, London, 2011.
- University of Manchester Academic Phrasebank <http://www.phrasebank.manchester.ac.uk/>

Software

Software will be provided by the Computer Lab Practices instructors.