Universitat Autònoma de Barcelona

2021/2022

Integrated Laboratory Class 1

Code: 100928
ECTS Credits: 3

Degree	Type	Year	Semester
2500253 Biotechnology	OB	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: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Ramon Antoine Riolobos

Prerequisites

Students must be simultaneously taking or have already taken the theory courses corresponding to the contents of the laboratory practices of Integrated Laboratory 1.

It is necessary for the student to have passed the biosafety test for teaching laboratories available in *Campus Virtual* (Moodle class of the Faculty of Biosciences) and to know and to accept the rules of operation of the laboratories of the Faculty of Biosciences.

Objectives and Contextualisation

The Integrated Laboratory 1 is the first subject of a group of 6 that are distributed over the 6 semesters corresponding to the first three years of the Degree in Biotechnology.

The learning objectives of these subjects focus on the acquisition of skills related to the practical training of the students.

The contents are organized in a growing order of complexity and are associated to the needs and progress of the theory contents of the Degree.

The learning objectives of Integrated Laboratory 1 focus on the acquisition of practical skills in 4 specific content modules:

- Informatics
- Cell Biology
- Instrumental Techniques
- Biochemistry

The knowledge of Informatics from an applied point of view is key for the use of specific computer applications in the different areas of the Degree, especially in those of Mathematics and Engineering. The rest of laboratory practices focus on the learning of basic techniques specific to each field and on the characteristics of the laboratory work.

Competences

- Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
- Apply the principal techniques for the use of biological systems: recombinant DNA and cloning, cell cultures, manipulation of viruses, bacteria and animal and plant cells, immunological techniques, microscopy techniques, recombinant proteins and methods of separation and characterisation of biomolecules.
- Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of living organisms in the framework of their application to biotechnological processes.
- Interpret experimental results and identify consistent and inconsistent elements.
- Lead and manage teams, and develop capacities for organisation and planning
- Make decisions.
- Search for, obtain and interpret information from the principal databases on biology, bibliography and patents and use basic bioinformatic tools.
- Think in an integrated manner and approach problems from different perspectives.
- Use ICT for communication, information searching, data processing and calculations.
- Use analytical methodologies for assaying the biological activity of cellular components, especially enzymes, both in vitro and in vivo.
- Work individually and in teams

Learning Outcomes

1. Apply the different waste disposal processes correctly.
2. Apply the fundamental techniques used in the analysis, purification, and characterisation of biomolecules.
3. Apply the general safety rules in place in a a biotechnology laboratory.
4. Assign mutants to chromosomes.
5. Extract complementary information from databases to support the analysis of results and the writing of reports on experiments.
6. Identify the principal microscopic characteristics that distinguish prokaryote cells from eukaryote cells, and animal cells from plant cells.
7. Interpret experimental results and identify consistent and inconsistent elements.
8. Lead and manage teams, and develop capacities for organisation and planning
9. Make decisions.
10. Think in an integrated manner and approach problems from different perspectives.
11. Use ICT for communication, information searching, data processing and calculations.
12. Use the basic computer tools for calculating kinetic parameters.
13. Use the basic techniques for analysing enzyme activity.
14. Use the basic techniques for handling, separating, detecting and analysing proteins and nucleic acids.
15. Use the basic techniques for preparing and observing samples with an optical microscope and an electron microscope.
16. Work individually and in teams

Content

The course includes 4 types of contents or modules.

Informatics

The practices are organized in 5 sessions of 2 h that take place in the computer rooms.

Practice 1 (2h). Introduction to Bash: First instructions: ls, cd, pwd, ... File manipulation: directory system/folders, redirects, visualization and file sorting, ...

Practice 2 (2h). File manipulation: sort, grep and AWK.

Practice 3 (2h). Introduction to spreadsheets: LibreOffice Calc (I).

Practice 4 (2h). Introduction to spreadsheets: LibreOffice Calc (II).

Practice 5 (2h). Practical application.

Cell Biology

The practices are organized in 6 sessions of 2 h that take place in the laboratory.

Practice 1 (2h). Introduction to the optical microscope and observation of plant cells. Description of the optical microscope elements and instructions for using the microscope. Obtaining temporary preparations from different plant tissue samples (potatoes, peppers, *Elodea*) and observing the morphology of plant cells and their main components: cell wall, nucleus, chloroplasts, amyloplasts, chromoplasts, plasmodesmata.

Practice 2 (2h). Observation of animal cells under the optical microscope. Observation of the morphology of different types of animal cells: oral mucosa cells, fibroblasts and spermatozoa.

Practice 3 (2h). Introduction to electron microscopy. Fundamentals of electron microscopy. Recognition and measurement of different structures and cell organelles in SEM and TEM micrographs.

Practice 4 (2h). Osmosis and simple diffusion. Study of osmosis in *Elodea* leaf cellsexposed to different concentrations of NaCl. Study of simple diffusion of alcohols across the membrane of *Elodea* leaf cells.

Practice 5 (2h). The mitotic cell division. Preparation of slides of plant tissues to observe and recognize the different mitotic phases and estimate their duration.

Practice 6 (2h). The meiotic cell division. Observation of the different phases of the meiotic cycle of spermatogenesis in insects.

Instrumental Techniques

Basic techniques of laboratory work. Application of spectrometry.

Practice 1 (4h). Preparation of a pH buffer system. Determination of glucose concentration using a colorimetric method. Analysis of an absorption spectrum.

Use of the basic techniques of separation, detection and analysis of proteins and nucleic acids.

Practice 2 (4h). Determination of protein concentration using a colorimetric method (Bradford). Separation of proteins by SDS electrophoresis (Part 1). Amplification of a gene by PCR, effect of Mg^{2+} concentration (Part 1).

Practice 3 (4h). Determination of the Mr of some proteins by SDS electrophoresis (example: milk proteins). Separation of DNA fragments by agarose electrophoresis (identification of amplified PCR fragments obtained in practice 2).

Biochemistry

Application of the basic techniques for the analysis, purification and characterization of biomolecules.

Practice 1 (4h). Gel filtration chromatography: separation of hemoglobin from vitamin B12 and blue dextran. Process of expression and purification of a heterologous protein: GFP (green fluorescence protein).

Practice 2 (4h). Continuation of the process of GFP purification. Hydrophobic chromatography: partial purification of GFP from a bacterial extract.

Practice 3 (4h). Identification of lipids by thin layer chromatography. Determination of the pKa of p-nitrophenol and its usefulness to follow the enzymatic activity of phosphatase.

Basic techniques of analysis of enzymatic activity. Study of the activity of acid phosphatase.

Practice 4 (4h). Application of spectrometry to the analysis of enzymatic activity. Determination of the optimal pH for the activity of an enzyme. Determination of the time in which the linearity of the reaction is maintained. Obtention of initial rate data to determine the kinetic parameters KM and Vm of the reaction. Analysis of the effect of an inhibitor on enzymatic activity.

Practice 5 (2h). Use of computer tools to determine the value of pKa and the kinetic parameters. Use of the GRAFIT program. Determination of pKa of p-nitrophenol from the data obtained in practice 3. Determination of kinetic parameters, KM and Vm, from the data obtained in practice 4. Determination of the type of inhibition and the corresponding inhibition constants from the data obtained in practice 4.

Methodology

Classes will take place in the computer rooms and teaching laboratories, in small groups of students.

Class attendance is mandatory, since it implies the acquisition of skills based on practical work. Absences must be properly justified to the coordinator of the corresponding module (indicated in the document "*Equip docent*" available in *Campus Virtual*). At the discretion of the coordinator, and only if possible according to the calendar and the organization of the laboratory sessions, the student will be offered an alternative date to take the practical session missed. This possibility will not be offered in case of unjustified absences.

Informatics

Classes in the computer rooms that include the delivery of the practice protocol, the presentation by the teacher and the realization of the practice. All the materials will be available in *Campus Virtual*.

Cell Biology, Instrumental Techniques and Biochemistry

Practical classes of laboratory and data analysis. The students will perform the experimental work in pairs and under the supervision of the teacher.

Practical protocols and, if applicable, the questionnaires for response, will be available in *Campus Virtual*.

Before each practice session students must have read the protocol and know the objectives of the practice, the fundamentals, and the procedures that will be carried out. If applicable, they should also be familiar with the specific safety and waste treatment measures.

In the practical sessions, students must bring:

- The protocol and, if applicable, the questionnaire.

- A notebook to collect the information from the experimental work.

- Laboratory coat.

- Safety glasses.

- Permanent marker.

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			
Practical classes in laboratories and computer rooms	52	2.08	1, 11, 3, 2, 5, 4, 7, 8, 10, 9, 6, 16, 12, 13, 14, 15
Type: Supervised			
Tutorials	3	0.12	1, 11, 3, 2, 5, 4, 7, 8, 10, 6, 12, 13, 14, 15
Type: Autonomous			
Resolution of questionnaries	10	0.4	1, 11, 3, 2, 5, 4, 7, 8, 10, 9, 6, 16, 12, 13, 14, 15
Study	8	0.32	1, 11, 3, 2, 5, 4, 7, 8, 10, 9, 6, 16, 12, 13, 14, 15

Assessment

Informatics

Final test in computer rooms. It is a test of 1 h 30 min where the student will be asked about the contents of the 5 practices. There will be a reassessment test for students who fail the first test.

Students with two or more non-justified absences will not be allowed to take the tests, which means that they will not be able to pass the subject of *Laboratori Integrat* 1.

Cell Biology

The practices will be evaluated through questionnaires that students will have to answer at the end of each of the practical sessions. The final mark of this module will be the average mark of all of questionnaires.

Students with two or more unjustified absences will receive a maximum mark of 3,5 points and will not be eligible for any type of reassessment, which means that they will not able to pass the subject of *Laboratori Integrat* 1.

Instrumental Techniques and Biochemistry

The practices will be evaluated taking into account:

1) The resolution of the questionnaires, which will evaluate:

- The understanding of the fundamentals of the experimental methods.
- The ability to process and analyze experimental data.
- The ability to interpret experimental results.
- The use of the computer application for kinetic data analysis.

2) The monitoring of the experimental work in the laboratory, which will evaluate:

- The preliminary preparatory work, especially in those practices that require previous calculations.
- The application of the general rules of safety and operation of a laboratory.
- The application of waste disposal processes.
- The ability to work as a team.

Students with two or more unjustified absences will receive a maximum mark of 3,5 points and will not be eligible for any type of reassessment, which means that they will not able to pass the subject of *Laboratori Integrat* 1.

Final grading

The final grade of the subject will be the weighted average of the marks of the different modules, as follows: 19% Informatics, 23% Cell Biology, 23% Instrumental Techniques and 35% Biochemistry. To pass the subject, the final grade must be of at least 5 points.

The weighted average will only be applied when the individual mark of each of the four modules is of at least 4 points. Students with marks lower than 4 in one or more of the modules will not be able to pass the subject and will receive a maximum final grade of 4 points.

Students will receive the "*No Avaluable*" qualification when attending less than 20% of the programmed sessions of the subject.

Repeating students

Repeating students will have to retake the practices and the corresponding evaluation only of the module or modules that they failed (<4 points) in the first enrollment. For the modules already passed, the marks will be kept for a maximum period of three additional enrollments.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Biochemistry: Answer of questionnaires	35%	0	0	2, 5, 7, 8, 10, 9, 16, 12, 13, 14
Cell Biology: Answer of questionnaires	23%	0	0	4, 7, 10, 9, 6, 16, 15
Informatics: Practical exam	19%	2	0.08	11, 7, 9, 16
Instrumental Techniques: Answer of questionnaires	23%	0	0	2, 5, 7, 8, 10, 9, 16, 14
Monitoring of the laboratory work	0%	0	0	1, 3, 16

Bibliography

Informatics

Introduction to Gnu/Linux

Josep Maria Mondelo, Guia de supervivència informàtica, UAB, 2003.

Lluís Alsedà, Recordatori de comandes bàsiques de Linux, UAB, 2004.

Albert Ruiz, Manipulació de fitxers, UAB, 2008.

Albert Ruiz, Introducció a l'awk, UAB, 2008.

LibreOffice manuals

Official web page (https://documentation.libreoffice.org/)

"Getting Started Guide" (https://documentation.libreoffice.org/assets/Uploads/Documentation/en/GS5.2/GS52-GettingStartedLO.pdf)

Cell Biology

Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Biología Molecular de la Célula. 6ª Edición. Ediciones Omega S.A. 2016. ISBN: 978-84-282-1638-8.

Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Martin KC, Yaffe M, Amon A. Molecular Cell Biology. 9th Edition. Macmillan Learning. 2021. ISBN: 9781319365493.

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Biochemistry Laboratory: Modern Theory and Techniques, 2nd Edition, 2012. Rodney Boyer. Ed. Pearson. ISBN: 9780136043027.

Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, 2018. Andreas Hofmann and Samuel Clokie. Ed. Cambridge University Press. ISBN: 9781316614761.

Técnicas instrumentales de análisis en Bioquímica. Juan Manuel García Segura. 1999. Ed. Síntesis. ISBN: 8477384290.

Calculations for Molecular Biology and Biotechnology. Frank Stephenson. 3rd Edition. 2016. Ed. Elsevier. ISBN: 9780128022115.

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Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Edition, 1976. Irwin Segel. Ed. Wiley. ISBN: 978-0-471-77421-1

Fundamentals of Biochemical Calculations. Second Edition. 2008. Krish Moorthy. Ed. CRC Press. ISBN: 9780429142185

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Principles and Techniques of Biochemistry and Molecular Biology. Andreas Hofmann and Samuel Clokie. Cambridge University Press, 8th Edition (2018)

Principios de análisis instrumental. Douglas A. Skoog et al. Cengage Learning Editores S.A. de C.V., Sexta edición revisada (2008)

Técnicas de Bioquímica y Biología Molecular. David Freifelder. Editorial Reverté. (2010). ISBN: 84-291-1819-5

Software

GraFit

Linux: BASH and LibreOffice Calc