Universitat Autònoma de Barcelona

2018/2019

Integrated Laboratory Class 1

Code: 100928
ECTS Credits: 3

Degree	Type	Year	Semester
2500253 Biotechnology	OB	1	1

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

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 and security tests available in Moodle 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 course 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 courses 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 areas:

- Informatics

- Cell Biology

- Instrumental Techniques

- Biochemistry

The knowledge of Informatics from an applied point of view are key to being able to use 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.

Skills

- 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 hours 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 hours that are done 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). 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 cells exposed to different concentrations of NaCl. Study of simple diffusion of alcohols accross the membrane ofElodea 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 to 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. Preparation of the gel (which will be run the following day). Amplification of a gene by PCR, effect of magnesium concentration. Prepare the reaction to be analyzed the following day.

Practice 3 (4h). Determination of the Mr of some proteins by means of 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 obtention. Hydrophobic chromatography: Separation of GFP from a bacterial extract, observing the fluorescence of the different fractions.

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. Analyze the data obtained in practice 1 for the determination of pKa of p-nitrophenol. Analyze the data obtained in practice 4 to determine the kinetic parameters of the reaction, the effect of the inhibitor and the type of inhibition.

Methodology

Class attendance is mandatory, since they imply an acquisition of skills based on the practical work.

Informatics

Classes in the computer rooms that include the delivery of the practice protocol, the presentation by the professor and the realization of the practice. All the materials will be available in Moodle.

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 professor.

Practical protocols and, if applicable, the questionnaires for response, will be available in Moodle.

Before each practice session students must have read the protocol and, thus, know the objectives of the practice, the fundamentals and the procedures that must 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:

- Protocol and, if applicable, the questionnaire.

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

- Laboratory coat.

- Safety glasses.

- Permanent marker

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

Evaluation

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 makeup test for students who fail the first test.

Students with two or more non-justified absences will not be allowed to take the tests.

Cell Biology

The practices will be evaluated through questionnaires that students will have to answer at the end of each of the practical sessions.

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.

Final grading

The final grade of the course will be the weighted average of the grades of the different modules, as follows: 19% Informatics, 23% Cell Biology, 23% Instrumental Techniques and 35% Biochemistry.

Attendance to the practical sessions is mandatory. To pass the course, students must attend at least 80% of the sessions, obtain a final grade of 5 or more points, and obtain a minimum grade of 4 points in each module. Students who fail the minimum grade of 4 in one or more of the moudles will receive a maximum final grade of 4 points, and willnot be able to pass the course.

Students will receive the "Non-Evaluable" qualification when attending less than 20% of the programmed sessions of the course.

Repeating students

Repeating students will have to repeat the practices and the corresponding evaluation only of those parts of the course that they failed (<4) in the first enrollment. For the parts already passed, the grades will be kept for a maximum period of three additional enrollments.

Evaluation 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

Recommended bibliography and web links are indicated in the practice protocols or, where appropriate, in the Study Guide of the corresponding theory course.