

Degree programme	Type	Course
Biochemistry	OB	3

Contact lecturer

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Teaching staff

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Group languages

You can consult this information at the [end](#) of the document.

Prerequisites

There are no official prerequisites. However, it is assumed that the student has acquired the basic knowledge of Molecular Biology explained in previous subjects of the degree of Biochemistry.

Objectives

Recombinant DNA technology includes diferents methodologies developed from 1970-1980. These methodologies are now a basic tool in many biochemistry laboratories and have allowed in recent years a very important advance in the knowledge of the structure and function of biomolecules. In this subject the fundamentals of this technology will be presented. The general objective of the subject is to provide the knowledge that allows the student working with these methodologies during his professional future.

Specific objectives of the course:

- Know and apply the basic techniques of recombinant DNA: nucleic acid labeling, Southern and Northern blots, in situ hybridization, arrays, sequencing, restriction enzyme use, PCR reaction, CRISPR based technology.
- Describe the main cloning vectors in Escherichia coli, know their characteristics and know how to apply them in the different strategies for the cloning of DNA fragments.
- Understand strategies for the construction of libraries and their use for the study of genes and genomes.
- know the methodology for the expression of recombinant proteins and for the directed mutagenesis.

Learning outcomes

- CM16 (Assess new methodologies and approaches in molecular biology research applied to the study of cancer.) Assess new methodologies and approaches in molecular biology research applied to the study of cancer.
- CM17 (Design experiments using molecular biology techniques to address complex problems in the field of biochemistry.) Design experiments using molecular biology techniques to address complex problems in the field of biochemistry.
- KM21 (Describe the molecular mechanisms involved in the maintenance, variability and transmission of genetic information, as well as in the regulation of gene expression.) Describe the molecular mechanisms involved in the maintenance, variability and transmission of genetic information, as well as in the regulation of gene expression.
- SM18 (Apply computing resources to visualize and understand the three-dimensional structure of proteins, search for information in databases, and use molecular tools.) Apply computing resources to visualize and understand the three-dimensional structure of proteins, search for information in databases, and use molecular tools.
- SM20 (Apply the basic techniques of recombinant DNA technology to molecular biology and protein engineering.) Apply the basic techniques of recombinant DNA technology to molecular biology and protein engineering.

Contents

Topic 1. Introduction. What is genetic engineering? First steps in DNA cloning (recombinant DNA technology). Introduction to the main concepts of molecular biology as the basis of genetic engineering. The flow of genetic information. Organization of genes. Gene expression and its regulation. The genomes, the transcriptome and the proteome.

Topic 2: Isolation and quantification of nucleic acids. Purification of plasmid DNA or genomic DNA. Purification of total RNA and messenger RNA. Quantification by spectroscopy or fluorescence.

Topic 3. Basic tools (enzymes) used in genetic engineering: Restriction enzymes (specific endonucleases). DNA Ligase (binding of DNA molecules). Non-sequence-specific nucleases (endo and exonucleases). Polymerases. Reverse transcriptase. Enzymes that modify the ends of DNA molecules. Nucleases for gene editing.

Topic 4: Labeling and Hybridization of DNA. Tag type. Labelling techniques. Concept of hybridization of a probe, concept of T_m and severity of hybridization. Transfer techniques based on the hybridization of a probe labeled: Southern, Northern, Dot-Blot. Hybridization techniques with probes labeled on microscopic preparations: Microarrays (mass hybridization techniques), in situ hybridization and hybridization on chromosomes (Fish).

Topic 5. Polymerase chain reaction (PCR) Introduction. Characteristics of the PCR reaction. Optimization of the reaction. Design of barley. Applications and special types of PCR (RT-PCR, quantitative PCR, etc.).

Topic 6. Analysis of gene expression and its regulation. Comparison of the different techniques to determine gene expression (RNA) levels. Techniques for the study of the interaction of proteins with the promoter region of the gene (DNA-foot-printing, delay gel, etc.). Identification of some epigenetic signals that regulate gene expression (ChIP, bisulfite sequencing, etc.).

Topic 7. Cloning I. General scheme of cloning. Cloning in the pre-genomic era versus cloning, or not, in the post-genomic era. Cloning vectors: plasmids, bacteriophages, hybrids (plasmid-bacteriophage), artificial chromosomes (others).

Unit 8: Cloning II: Generation of the DNA fragment to be cloned and strategies to introduce it into the vector. Host cells and mechanisms for introducing recombinant DNA into them (transformation, transfection, etc.). Recombinant clone selection systems.

Topic 9: Genomic libraries. Classical library construction scheme (by lambda cloning) versus current massive sequencing systems (genome projects, ESTs). Concept of representativeness.

Topic 10: DNA-copy libraries. Schematic construction of classical libraries (by cloning with lambda) versus current massive sequencing systems (ESTs or RNA-seq projects). Concept of abundance and complexity of messenger RNAs in RNA libraries. Special cases of RNA libraries with selection by protein-protein interaction by antibodies, by double hybrid (yeast) or by functional complementation.

Item 11. Obtaining recombinant proteins in E. coli or yeast. Factors that affect the expression of recombinant proteins. Optimization of the expression of recombinant proteins in E Coli and Yeast (*Pichia pastoris*). Specific vectors for each of the guests. Engineering proteins to improve their efficiency through two systems: i) targeted mutagenesis (concepts and methods) ii) molecular evolution (concept and its combination with phage-display)

Topic 12: Genomic engineering (genome editing) using modified nucleases. Definition and characteristics of the technique. Method using Zinc-Finger Nucleases. Method using TALEN nucleases. Methods using the CRISPR-Cas9 system.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Preparation of a delivery linked to the theoretical content of the subject to solve practical cases	16	0.64	CM16, CM17, SM18, SM20
Problem class	9	0.36	CM16, CM17, KM21, SM20
Preparation of the delivery linked to the problem and computer sessions	10	0.4	CM16, CM17, SM18, SM20
Tutorials	7	0.28	CM16, CM17, KM21, SM18, SM20
Magisterial class	30	1.2	CM16, CM17, KM21, SM20
Computer lab sessions	6	0.24	CM17, SM18, SM20
Independent study of the content of theory sessions, problem sessions, computer lab sessions	65	2.6	CM16, CM17, KM21, SM18, SM20

The learning activities consist of theoretical classes and problem-solving sessions. Each of these has its own specific methodology.

Theoretical Classes and Related Assignment

The theoretical content of the course will be delivered primarily by the instructor through lecture-based sessions supported by audiovisual materials. The presentations used in class will be made available to students on the course's Virtual Campus prior to the start of each topic. These lecture sessions will constitute the core component of the theoretical part of the course.

Some sessions will be interspersed to introduce and discuss practical cases on which students will be required to submit an assignment (e.g., experimental designs or data interpretation). This assignment may be completed individually or in groups of up to three students. Students are expected to work independently to analyze and resolve the proposed cases, thereby enhancing their understanding and study of this part of the subject matter.

Students are strongly encouraged to regularly consult the recommended bibliography listed in this syllabus, as well as the review articles referenced in the class materials, which are accessible online through the UAB network, in order to consolidate and clarify, if necessary, the content covered in lectures.

Problem-Solving Sessions, Computer Lab Practicals, and Related Assignment

There will be nine problem-solving sessions per group. For these sessions, the theory group will be divided into two subgroups (A and B), with the lists published at the beginning of the course. Students must attend the sessions scheduled for their assigned group. At the start of the semester, a dossier containing the problem statements will be distributed via the Virtual Campus. These problems will be solved by the teaching staff with detailed explanations and, where appropriate, will complement the material covered in the theoretical classes.

Regarding the computer lab practicals, these will take place in the Faculty's computer rooms and will be conducted in groups of approximately 20 students. The practicals will consist of three sessions, each lasting two hours. They will be based on problems proposed by the instructors, which students will solve using various bioinformatics tools and analyses.

In connection with the content and resolution of the problems and computer lab practicals, an assignment will be scheduled via the Virtual Campus. Students must complete this assignment independently to facilitate their understanding and study of this part of the course. The assignment may be submitted individually or in groups of up to three students.

Tutorials

Individual or small-group tutorials will be available upon student request. The purpose of these tutorials is to address questions, provide guidance on consulted sources of information, and assist with the preparation of assignments. If the number of requests becomes particularly high-especially in the lead-up to midterm exams-a classroom tutorial session may be organized before each exam. These sessions, which will be announced in advance via the Virtual Campus, will focus on resolving doubts and reviewing key concepts. They will not involve the presentation of new material from the official syllabus but will instead serve as discussion and debate forums.

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.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes

Virtual campus delivery linked to theory content	10%	0.25	0.01	CM16, CM17, KM21, SM18, SM20
Virtual campus delivery of problems and computer sessions	5%	0.25	0.01	CM16, CM17, SM18, SM20
Individual written test of problems (P1+P2)	20 %	2.5	0.1	CM16, CM17, SM18, SM20
Theory module evaluation: multiple choice questions (P1+P2)	30%	2	0.08	CM16, CM17, KM21, SM20
Written theory test of short questions (P1+P2)	30%	2	0.08	CM16, CM17, KM21, SM20

The evaluation of this subject foresees the following:

Continuous evaluation

Theory evaluation through individual written exam (60%).

Two partial tests, P1+P2, will be held; each of them will weigh 30% of the final grade of the subject, and the date of the test will be marked in the semester calendar.

Each of these partial tests will include:

1) Multiple-choice questions (multiple answers), which will have a final weight in the evaluation of the subject of 15% per partial

2) Short open-ended questions relating to various sections of the program, on the use of knowledge to interpret experimental results or to propose the most appropriate techniques to achieve the objectives set out in the question, which will have a final weight in the evaluation of the subject of 15% per partial.

The grade for each midterm will be obtained by the average obtained in each of the types of questions (tests and short questions).

If the grade obtained in any of the partial exams is less than 4 out of a maximum of 10, it will be necessary to take the retake test on the date set in the semester program. Each partial can be recovered individually.

Evaluation of the delivery linked to the content of theory.

Submissions must be made on the date set by the professor, which can be consulted on the Virtual Campus. The weight of the grade of this activity will be 10%. Participation in this activity is not a requirement to pass the subject. In the event that you do NOT participate, the grade obtained in this activity will be a 0. The evaluation of this activity is NOT susceptible to recovery

Problem assessment using individual written exam (20%).

There will be two partial tests, P1+P2, which will be written and individual. It will consist of the resolution of 1-2 problems posed by the teacher of the same type as those worked on during the problem training activity. The weight of each of the partials will be 10% and the date of the test will be marked in the semester calendar.

If the grade obtained in any of the partial exams is less than 4 out of a maximum of 10, it will be necessary to take the retake test on the date set in the semester program. Each partial can be recovered individually.

Evaluation of the delivery of virtual campus experimental design linked to the content of Problem and Computer Lab Sessions

Submissions must be made on the date set by the professor, which can be consulted on the Virtual Campus. The weight of the grade of this activity will be 10%. Participation in this activity is not a requirement to pass the subject. In the event that you do NOT participate, the grade obtained in this activity will be a 0. The evaluation of this activity is NOT susceptible to recovery

Single Assessment

Theory evaluation through individual written tests (60%):

On the day marked by the second partial in the calendar of the subject, the students who have taken advantage of the single evaluation system will take a single written test with questions from the set of all the theoretical content of the subject. In this test, the following will be recorded as in the continuous assessment:

- 1) Multiple-choice questions (multiple answers), which will have a final weight in the evaluation of the subject of 30%.
- 2) Short open-ended questions relating various sections of the program, on the use of knowledge to interpret experimental results or to propose the most appropriate techniques to achieve the objectives set out in the question, which will have a final weight in the evaluation of the subject of 30%.

The same recovery system will be applied as for continuous evaluation.

Problem assessment using individual written tests (20%).

On the day marked by the second partial in the calendar of the subject, the students who have taken advantage of the single evaluation system will take a single written test, on the total of the problems of the subject. This test will have a weight of 20% of the final grade, and the same recovery system will be applied as for continuous assessment.

Evaluation of submissions linked to both theory and problem content

In this type of teaching, the same system described in the continuous assessment will be applied. The teaching staff will set the deadline for making the delivery, and it will be the same as for continuous assessment. It will have the same weight as in continuous evaluation. Like continuous assessment, participation in this activity is not a requirement to pass the subject and cannot be retaken.

General Considerations for the two systems of continuous and single evaluation

- The final grade of the subject is obtained by the weighted average of each of the evaluations. To pass the subject, it is necessary to obtain a final grade equal to or greater than 5 out of 10.
- The evaluation of the written tests of theory and problems are inseparable, and in order to pass the subject, the students must participate and be evaluated in all the written tests.
- On the other hand, participating in the activity of the deliveries is not a requirement to pass the subject; in the event that you do NOT participate in the deliveries, the grade obtained in this activity will be a 0.
- The written tests of theory and problems will be done together on the scheduled dates and already set in the calendar.
- If the grade obtained in some of the partial exams, both theory and problems, is less than 4 out of 10, it will be necessary to take the recovery test on the date set in the semester program. Each partial can be recovered individually.
- In the same way, if the final grade obtained is less than 5 out of 10, it will be necessary to take the recovery test on the date set in the semester program. Each partial can be recovered individually.
- To participate in the retake, students must have previously been evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade of the subject.
- The student will obtain the grade of "Not Assessed" when the evaluation activities carried out have a weighting of less than 67% in the final grade.
- Students who want to improve their grade may take the grade improvement exam at the end of the

semester, which will take place on the date scheduled for the retake exam. Students who take the exam to improve their grade renounce the grade obtained in the written tests they took throughout the course.

- Students who cannot attend an individual assessment test for a justified reason and provide the official documentation corresponding to the degree coordination will have the right to take the test in question on another day. The coordination of the degree will ensure that it is carried out with the teaching staff of the subject concerned.
- The use of artificial intelligence (AI) technologies is allowed in the preparation of assignments, provided that such use is compatible with the learning objectives of the activity and that the final work reflects a significant and personal contribution by the student in the analysis, interpretation, and critical reflection of the content. Students must explicitly declare the use of AI, specify the tools employed, identify the parts of the work in which they were used, and include a brief reflection on their contribution to both the process and the final outcome. Any use of AI that is not properly disclosed or that substantially replaces the intellectual contribution required from the student will be considered improper use of this technology and will be treated as an academic irregularity, as set out below.
- Any irregularity committed during an assessment activity, such as academic fraud, plagiarism, or improper use of AI (including failure to comply with the conditions governing the use of this technology in assignments as defined in the preceding paragraph), which may lead to a significant alteration of the grade, will result in a mark of 0 for that assessment activity. If the course guide establishes that obtaining a minimum grade in that assessment activity is an essential requirement to pass the course, or if multiple irregularities occur in assessment activities within the same course, the final grade for the course will be 0. Without prejudice to the above, disciplinary proceedings may also be initiated against any student who commits any of these irregularities.
- Any aspect that is not contemplated in this guide will follow the evaluation regulations of the Faculty of Biosciences.

Bibliography

a) Books

1) Nicholl, Desmond S. T. An Introduction to genetic engineering eBook | 2023. 4a edición (2023).

| 2018 https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjib/alma991000909739706709

2) MOLECULAR BIOTECHNOLOGY, PRINCIPLES AND APPLICATIONS OF RECOMBINANT DNA Harris, Bernadette; Harris, Bernadette, 2022

| 2018.

https://bibcercador.uab.cat/permalink/34CSUC_UAB/15r2rl8/cdi_askewsholts_vlebooks_9781683673101

3) Gene Cloning and DNA Analysis : An Introduction T. A. Brown; T. A. Brown eBook | 2016

2016 https://bibcercador.uab.cat/permalink/34CSUC_UAB/15r2rl8/cdi_askewsholts_vlebooks_9781119072553

4) S. B. Primrose and R. M. Twyman Principles of gene manipulation and genomics /, SEVENTH EDITION, eBook | 2006.

https://bibcercador.uab.cat/permalink/34CSUC_UAB/15r2rl8/cdi_askewsholts_vlebooks_9781444309096

5) H. Freeman. Recombinant DNA : genes and genomes - a short course, 2007

6) J. Perera, Julián. Ingeniería genética 2002

b) Review articles published in scientific journals.

The bibliographic references of the various recommended review articles will be indicated in the graphic material of the classes. These review articles will correspond to journals that are accessible via the network from the UAB.

Software

Microsoft Word, PowerPoint, Excel

Primer Design: Serial Cloner 2.6, NetPrimer, Primer3Plus, Primer-BLAST, PrimerX.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	33	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	331	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	331	Catalan	first semester	afternoon
(PAUL) Classroom practices	332	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	332	Catalan	first semester	afternoon
(PLAB) Practical laboratories	333	Catalan	first semester	afternoon