Teaching guide

IDENTIFICATION DETAILS

Degree:	Biotechnology
Scope	Biology and Genetics
Faculty/School:	Experimental Sciences
Course:	RECOMBINANT DNA TECHNOLOGY
Type:	Compulsory
ECTS credits:	6
Year:	3
Code:	2037
Teaching period:	Sixth semester
Subject:	Advanced Biotechnology Training Technologies
Module:	Biotechnology Tools
Teaching type:	Classroom-based
Language:	Spanish
Total number of student study hours:	150

SUBJECT DESCRIPTION

Recombinant DNA technology houses a set of methodologies aimed at manipulating DNA, amplifying it, sequencing it, transferring it between genetically different organisms and making new combinations between DNA molecules that normally come from different species and whose expression in a host organism will result in a product with value in medicine, agriculture, basic science and industry. This course will explain the molecular basis of the different DNA manipulation techniques and their application, with special emphasis on cloning methodologies for the expression of recombinant proteins in both bacteria and eukaryotic organisms, as well as for obtaining genomic libraries. Techniques for obtaining transgenic and clonic organisms and their applications in basic and biotechnological research will also be explained.

By means of DNA manipulation techniques, an isolated gene can be modified and returned to a bacterial cell or to

a germ cell of an animal or plant in such a way that it becomes a functional and inheritable part of the organism's genome (genetic engineering). DNA manipulation techniques have represented an exponential development in different areas, giving rise to modern biotechnology for the production of recombinant proteins and other compounds useful at the industrial level, as well as for the generation of transgenic animals and plants. At the clinical level, genetic engineering allows the production of recombinant drugs, advances in clinical diagnosis, the development of advanced and gene therapies, and is an essential tool in current forensic sciences.
The subject corresponds to the Biotechnological Tools module, integrated into the subject Advanced Biotechnology Training Technologies. This course will allow students to obtain knowledge and mastery of the main genetic engineering techniques and will provide them with the necessary basis for understanding other subjects of the degree, such as Genomics and Proteomics, Genetically Modified Organisms, Agrobiotechnology and Industrial Microbiology.

GOAL

The fundamental objective of the course is for the student to learn about recombinant DNA technology and its most frequent applications in basic, biotechnological and biosanitary research.

The specific aims of the subject are:

FAITH1. To know the fundamental theoretical bases of recombinant DNA technology.

FE2. Decide experimental DNA manipulation strategies to be carried out according to the specific objective.

FE3. Understand the fundamental requirements for the expression of heterologous proteins of biotechnological interest.

FE4. Distinguish possible routes of DNA transfer to prokaryotic or eukaryotic cells.

FE5. Propose experimental models of gene modification (prokaryotic or eukaryotic) to generate research tools or biotechnological products.

PRIOR KNOWLEDGE

For the correct development of the subject, the student must have a solid background in Molecular Genetics, more specifically with regard to the structure and properties of nucleic acids, as well as to the mechanisms of replication, transcription and translation in prokaryotic and eukaryotic organisms. In the same way, it requires basic knowledge of Microbiology.

COURSE SYLLABUS

THEORETICAL PROGRAM:

Topic 1: Introduction.
Topic 2: Basic techniques for the analysis of nucleic acids.

Topic 3: Amplification of DNA and RNA sequences.
Topic 4: Cloning processes in bacteria.
Topic 5: Cloning in yeasts.
Topic 6: Plant transgenesis.
Topic 7: Gene transfer in eukaryotic cells.
Topic 8: Homologous recombination and CRISPR/Cas9.
Topic 9: Gene manipulation of animals.
Topic 10: Gene therapy.

PRACTICAL PROGRAM: Cloning of DNA sequences in bacterial plasmids: construction of the recombinant plasmid, transformation, selection, identification and verification of clones.

EDUCATION ACTIVITIES

AF1. Participatory expository classes: In the theoretical classes, the topics will be presented, using different teaching resources. Positive participation will be encouraged, jointly resolving any doubts that arise, with the active search for information. The teacher will provide the students with the presentations in electronic format to facilitate their study, before or after class. The publication by the student of the material provided by them in the virtual classroom, or by any other means, is NOT authorized.
AF2. Practical classes I: Experimental work carried out in the laboratory supported by an in silico simulation tool of cloning strategies. Carrying out real experiments in the experimentation laboratory where techniques and knowledge related to the contents of the subject are applied.
AF3. Practical classes II: Exercises and practical cases in the classroom. Problem solving at the end of each block of the syllabus. Practical exercises related to the given block will be proposed and solved, in person or not in person. We will rely on in silico simulation tools for part of the exercises to be performed.

DISTRIBUTION OF WORK TIME

TEACHER-LED TRAINING ACTIVITIES	INDIVIDUAL WORK
66 Horas	84 Horas

SKILLS

Basic Skills

Students must have demonstrated knowledge and understanding in an area of study that is founded on general secondary education. Moreover, the area of study is typically at a level that includes certain aspects implying knowledge at the forefront of its field of study, albeit supported by advanced textbooks

Students must be able to apply their knowledge to their work or vocation in a professional manner and possess skills that can typically be demonstrated by coming up with and sustaining arguments and solving problems within

their field of study.

Students must have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflections on pertinent social, scientific or ethical issues

Students must be able to convey information, ideas, problems and solutions to both an expert and non-expert audience

Students must have developed the learning skills needed to undertake further study with a high degree of independence

To be familiar with the applications of biotechnology in the healthcare, food, agrobiotechnological, environmental and chemical fields.

To have acquired the ability for analytical, synthetic, reflective, critical, theoretical and practical thought.

Capacity for problem-solving and decision-making.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

To acquire the molecular biology and biochemistry knowledge needed to develop biotechnological processes and products.

General Skills

To be familiar with the applications of biotechnology in the healthcare, food, agrobiotechnological, environmental and chemical fields.

To have acquired the ability for analytical, synthetic, reflective, critical, theoretical and practical thought.

Capacity for problem-solving and decision-making.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

To acquire the molecular biology and biochemistry knowledge needed to develop biotechnological processes and products.

Specific skills

Define and know how to apply genetic engineering techniques to the study of gene expression and function in different systems, as well as the manipulation and modulation of gene expression.

Know how to describe, quantify, analyze and critically evaluate the results obtained from experimental work carried out in the laboratory.

Develop habits of rigorous thinking.

Ability to communicate the knowledge acquired orally and in writing.

Know how to apply the theoretical knowledge acquired to solving problems and practical cases related to different subjects.

LEARNING RESULTS

Know and properly apply the fundamental theoretical bases of recombinant DNA technology.

Decide the appropriate strategy to carry out basic DNA manipulations.

Resolve characteristic problems derived from the subject in a reasoned manner by proposing experimental strategies.

Designs cloning protocols aimed at heterologous protein expression and the creation of genomic libraries.

Design vectors for therapeutic purposes using nucleic acids as the basis of this therapy.

Plan experimental strategies for obtaining transgenic animals and plants.

He applies DNA manipulation techniques in the laboratory that allow him to obtain and amplify recombinant DNA molecules.

LEARNING APPRAISAL SYSTEM

Plagiarism, as well as the use of illegitimate means in evaluation tests, will be sanctioned in accordance with those established in the Evaluation Regulations and the University's Coexistence Regulations.
ORDINARY SYSTEM: The final grade of the course will be obtained from the grades obtained in the evaluation of the following modules, and it will be necessary to obtain at least 50% of the total grade to consider the subject approved.

IF 1. Evaluation of the theoretical content of the subject: It represents 65% of the final grade. The main objective of the exam will be to verify that the basic concepts presented in the theoretical classes have been assimilated and understood, as well as the students' reasoning ability to solve problems about recombinant DNA technology. It is mandatory to pass this exam with at least 45% of the grade to apply the rest of the percentages.
IF 2. Evaluation of the experimental work carried out in university laboratories: It represents 25% of the total grade of the subject. Internship attendance will be mandatory and essential to be able to take the theory exam and the practice exam.

SE2.1 Final practice exam that will evaluate the understanding of the practices (65%). It is mandatory to pass this exam with at least 45% of the grade to apply the rest of the percentages.

SE2.2 Conducting a questionnaire to demonstrate your knowledge of the practice (15%).
SE2.3 Performing a task using software commonly used in laboratories within the scope of the subject (15%).
SE2.4 Exploitation and interest shown during the internship (5%).

IF 3. Seminar evaluation and class participation: It represents 10% of the final grade. Carrying out and presenting exercises, case studies, debates, tutoring, etc.

If one of the parties is suspended from the ordinary call, the note of the approved party for the extraordinary call for the same academic year will be saved.
ALTERNATIVE SYSTEM (I): Only in the case of students in the second call and later, who have completed 100% of the practical sessions in the laboratory in person, and students with academic exemption, can choose to take advantage of the previously specified Primary System (in which case they must meet all the requirements, including class attendance) or take advantage of the alternative system in which the following percentages will be applied:

SEA1: Evaluation of the theoretical content of the subject (75%).
SEA2: Evaluation of the practical content of the subject (25%).

In order to average the different parts, it is essential to obtain a score equal to or greater than 4.5 in each of the SEA1 and SEA2 parts and obtain a final score of at least 50% of the grade.
If they wish to take advantage of the primary system, students must communicate this decision to the responsible teacher through the Virtual Classroom during the first two weeks of class. If you do not report, the evaluation will be taken over by the alternative system.

ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE

1.- The use of any Artificial Intelligence (AI) system or service shall be determined by the lecturer, and may only be used in the manner and under the conditions indicated by them. In all cases, its use must comply with the following principles:
a) The use of AI systems or services must be accompanied by critical reflection on the part of the student regarding their impact and/or limitations in the development of the assigned task or project.
b) The selection of AI systems or services must be justified, explaining their advantages over other tools or methods of obtaining information. The chosen model and the version of AI used must be described in as much detail as possible.
c) The student must appropriately cite the use of AI systems or services, specifying the parts of the work where they were used and describing the creative process followed. The use of citation formats and usage examples may be consulted on the Library website(https://www.ufv.es/gestion-de-la-informacion_biblioteca/).
d) The results obtained through AI systems or services must always be verified. As the author, the student is responsible for their work and for the legitimacy of the sources used.
2.- In all cases, the use of AI systems or services must always respect the principles of responsible and ethical use upheld by the university, as outlined in the Guide for the Responsible Use of Artificial Intelligence in Studies at UFV. Additionally, the lecturer may request other types of individual commitments from the student when deemed necessary.
3.- Without prejudice to the above, in cases of doubt regarding the ethical and responsible use of any AI system or service, the lecturer may require an oral presentation of any assignment or partial submission. This oral evaluation shall take precedence over any other form of assessment outlined in the Teaching Guide. In this oral defense, the student must demonstrate knowledge of the subject, justify their decisions, and explain the development of their work.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

Brown, T.A. Genomes 4 4th Garland Sciences, 2017

Desmond S. T. Nicholl An Introduction to Genetic Engineering Fourth Edition. Cambridge University Press. 2023

Glick, B.R. and Pasternak, J.J. Molecular biotechnology. Principles and applications of recombinant DNA. 5th Edition, ASM Press, 2017.
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Strachan, T. and Read, A.P. Human Molecular Genetics. 5th Edition, Garland Science, 2019.

Additional

Brown, T.A. Gene cloning and DNA analysis. An introduction. 7th Edition, Wiley-Blackwell, 2015.

Perera, J., Tormo, A., Garca, J.L. Genetic Engineer. Synthesis Publisher. Madrid, 2002.

Rastogi, S. and Pathak, N. Genetic engineering. Oxford University Press, 2009.