COURSE DATA

Data Subject	
Code	33048
Name	Molecular methods in biology
Cycle	Grade
ECTS Credits	6.0
Academic year	2017 - 2018

Study (s)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Faculty of Biological Sciences	2	Second term

Subject-matter

Degree	Subject-matter	Character
1100 - Degree in Biology	7 - Molecular and genetic basis of living beings	Obligatory

Coordination

Name	Department
RAUSELL SEGARRA, CAROLINA	194 - Genetics
REAL GARCIA, MARIA DOLORES	194 - Genetics

SUMMARY

The subject Molecular Methods in Biology is taught in the second year of the Degree in Biology (2009 Plan) in the second quarter and it is compulsory. It is a primarily methodological subject and it is part of the core subject "Molecular Basis of Living Beings", which also includes the subjects Biochemistry and Genetics that are studied in parallel throughout the year, also in second grade.

The main objective of Molecular Methods in Biology is to provide students with the basic knowledge and methodological tools required for DNA manipulation. Thus, protocols and experimental designs discussed in this course constitute the basis for the molecular analysis of genes and genomes and gene transfer between species that are primary in Biotechnology.

An additional objective of the course is to convey to students that the methodology introduced in this course can be applied to fields such as Biomedicine, Agriculture and Farming and several aspects of the professional activity of biologists.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

OUTCOMES

1100 - Degree in Biology

- Skills in analysis and synthesis.
- Capacidad de resolución de problemas.
- Capacidad de razonamiento crítico.
- Capacidad de aprendizaje autónomo.
- Capacidad de comunicación oral y escrita.
- Capacidad de manejar el inglés como vehículo de expresión científica.
- Capacidad de utilizar las nuevas tecnologías de información y comunicación.
- Comprender el método científico.
- Capacidad de trabajar en equipo.
- Saber hacer análisis de datos científicos.
- Capacidad de búsqueda de información y análisis crítico de textos científicos.
- Conocer los mecanismos de la herencia biológica.
- Conocer los mecanismos de replicación, transcripción, traducción y modificación del material genético.
- Conocer las bases biológicas del desarrollo.
- Conocer las metodologías de análisis global estructural y funcional de genomas y procesos celulares.
- Conocer la estructura y función de las biomoléculas.
- Conocer los conceptos básicos y las aplicaciones de la tecnología del DNA recombinante y de la Ingeniería Genética.
- Capacidad para trabajar correctamente en los laboratorios de Bioquímica, Genética y Biología Molecular, incluyendo seguridad, manipulación, eliminación de residuos y registro anotado de actividades.
- Capacidad para utilizar la instrumentación básica en los laboratorios de Bioquímica, Genética, Biología Molecular y Celular.

- Tener una visión integrada de las técnicas y métodos utilizados por la Bioquímica, Genética y Biología Molecular.
- Capacidad para diseñar experimentos y aproximaciones multidisciplinares para la resolución de problemas concretos.
- Capacidad para presentar, discutir y extraer conclusiones de los resultados de los experimentos científicos.

LEARNING OUTCOMES

1. To solve questions and problems
2. To carry out practical activities in the laboratory and analyze the results obtained
3. To perform practical exercises in the computer lab and interpret the results obtained
4. To work in group to prepare a written manuscript and an oral presentation with audiovisual support
5. To design experiments to solve specific problems
6. To analyze and compare nucleic acid sequences and proteins
7. To integrate molecular and genetic aspects of cellular organization and function
8. To acquire the basic conceptual and methodological knowledge concerning:

1. The basic tools for the analysis of nucleic acids and proteins

2. The characterization and modification of DNA sequences and large scale DNA manipulation

3. Structural and functional genomics and proteomics

4. The application of molecular techniques in the fields of biomedicine, agriculture, farming and industry.

DESCRIPTION OF CONTENTS

1. Introduction

Objectives and scope of molecular biology methods.
Development of recombinant DNA technology.
Areas of application of recombinant DNA technology.

2. Cloning

General scheme.
Basic elements in this technology.
Enzymes commonly used: restriction enzymes.
Cloning Methods.

3. Cloning in bacteria

Plasmid and phage vectors.
Vectors for cloning large fragments.
Expression vectors.
Transformation methods.

4. PCR amplification of DNA

General scheme of the method.
Parameters to be considered.
Types and applications.
Quantitative PCR.
Cloning vector for PCR products.

5. Cloning in animals

Methods of transfection in mammalian cells.
Methods of selection and marker genes.
Most common vectors.
Obtaining transgenic animals.
Obtaining cloned animals.

6. Cloning in plants

Methods of gene transfer in plants.
Transformation with Agrobacterium.
Cloning vectors.

7. Obtaining and identification of clones of specific genes.

Molecular hybridization. Probes: types, methods of obtaining and labeling. Factors affecting hybridization. Most common methodologies.

Libraries. Genomic and cDNA libraries. Construction, titering and screening.

DNA sequencing. Sequencing methods. Basis of the Sanger sequencing method. Basic methodology in automatic sequencing. New methodologies. Sequencing strategies.

8. Modification of DNA sequences

Mutagenesis by PCR and using oligos.
Mutagenesis by homologous and site-specific recombination.
Generation of knock-out.
Other approaches to modify DNA sequences.

9. Analysis methods of gene expression

mRNA detection and quantification.
Use of reporter genes in prokaryotes and eukaryotes.
Analysis of differentially expressed genes.
Analysis of DNA-Protein Interactions.
Identification of Protein-protein interactions.
Silencing and over expression.

10. Structural genomics. Functional genomics. Proteomics

Structural genomics. Gene mapping using molecular markers. Genetic and physical maps. Genome projects. Human Genome Project: shotgun sequencing versus hierarchical sequencing.

Functional genomics. Microarrays and DNA chips. Types, construction and use. General and experimental scheme of the process. Applications: analysis of expression profiles.

Proteomics. Objectives of proteomics. Methods for comparative and quantitative analysis of proteomes.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	26,00	100
Laboratory practices	18,00	100
Classroom practices	8,00	100
Computer classroom practice	5,00	100
Tutorials	3,00	100
Development of group work	6,00	0
Development of individual work	6,00	0
Study and independent work	30,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	16,00	0
Preparation of practical classes and problem	12,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

For the development of theoretical activities expository method or lecture is used, but with active participation of students.

For practical work the methodology of solving questions and problems developed in the classroom, bioinformatics class or lab is used, always trying to put into practice previous knowledge. Teamwork is encouraged, since in the activities carried out in the laboratory, as well as in the bioinformatics class and in the sessions dedicated to questions and problems resolution, students work in groups.

The activities of the course are completed and complemented with the interdisciplinary activity "Interdisciplinary Work" directly focused to the development of competencies.

The course is developed with the following structure:

Class work:

A. Two lectures per week of one hour duration. **A total of 26 hours** will be necessary to cover this teaching resource.

B. One-hour session per week (8 weeks) to work on different kinds of **problems and questions** related to the lectures.

C. Nine sessions of two hours (during 9 weeks) to perform **laboratory practices**.

D. Two sessions of two hours and another of one hour to perform **bioinformatics practices.**

E. Three group tutorial sessions of one hour on applications of recombinant DNA technology.

Work out of class:

F. Interdisciplinary work: preparation of a seminar and presentation in front of an audience.
In this activity participate all subjects in the second degree course in Biology (Cell and Tissue Biology, Developmental Biology, Biochemistry, Botany, Genetics, Methods in Molecular Biology, Evolutionary Processes and Mechanisms and Zoology). The activity is mandatory for all students enrolled in second grade, except for those that have already taken it before (and have already obtained a grade). Each working group, consisting of three students, will prepare a seminar (which consists of a written manuscript and an oral presentation) on a topic assigned at random from among those proposed by the teachers of the subjects participating in this activity. Each interdisciplinary work is considered linked (see impact assessment of the activity) to the subject that assigned the topic. A tutor will be assigned to each working team whose task will be to supervise the work to be done. To do so, there will be scheduled a series of regular meetings with the tutor throughout the course. At the beginning of the course the dates on which such meetings to follow-up the work should take place will be published, as well as the date on which the final work should be submitted and the documents handed in. A co-tutor will also be assigned who will review the final version of the work presented. Each work will be presented orally by all members of the group for 30 minutes. The presentation will be attended by all students of the course since attendance is compulsory, and also two teachers: the tutor's work and a second teacher will be attending. Both students and teachers will participate in selecting the seminars that due to their quality and originality will be presented at the Congress of Biology, in which the first and second degree courses in Biology will participate.

EVALUATION

The evaluation of knowledge and skills acquired by students will consider all aspects of the teaching of this subject: theoretical, practical (laboratory and bioinformatics classroom), resolution of problems and questions, and presentation of the interdisciplinary work.
The numerical rating of the degree of knowledge and skills acquired by students will be obtained from different tests related to the different teaching activities carried out.

A. Assessment of theoretical knowledge. At the end of the course there will be a test to evaluate the knowledge acquired in lectures. The value of this test will account for 55% of the final course grade.

B. Assessment of practical skills.

B.1. Evaluation of experimental work in the laboratory. The student's ability to design, implement and critically analyze experiments will be evaluated.

Assistance to laboratory practices is an absolute requirement to pass the course.

Once the laboratory practices have been carried out, the student should write a report in which the degree of knowledge acquired by the student should be demonstrated, including a description of the main objective of the practice, the experimental procedure, the results obtained and specially, a discussion of the results obtained. **To hand in the laboratory report at the end of the laboratory practices will be mandatory**.

The laboratory practices final grade will be the result of adding the grade obtained in the laboratory report (50% of the final grade) plus the grade obtained in an exam at the end of the course (50% of the final grade).

The value of the experimental work in the laboratory will be **15% of the final grade of the subject**.

B.2. Evaluation of problems and questions. The student's ability to solve problems and questions will be evaluated continuously. At the end of the course, there will be a final exam to evaluate this issue, which will represent **10% of the final grade of the subject**.

B.3. Evaluation of knowledge acquired in the bioinformatics class. The value of this part will represent **5% of the final grade of the subject**. Fifty percent of this final grade will correspond to the assistance to the bioinformatics sessions and the remaining 50% will correspond to the grade obtained in the assignments handed in after each session.

C. Evaluation of the tutorial groups. The tutorial groups activities will represent 5% of the final grade of the subject. Assistance to the sessions will be evaluated as well as participation in the activities prepared for each session, and if it applies, the resolution of exercises related with them.

D. Evaluation of the interdisciplinary work. The grade obtained in the interdisciplinary work will represent 10% of the subject´s final grade. The tutor´s work and the assistant teacher will evaluate this activity (60% and 40% of the grade, respectively). Evaluation will consider the scientific contents as well as the way they were presented, especially regarding communication skills and the students' ability to transmit ideas and concepts. The works selected to be presented in the Biology Congress will obtained an extra 10% or the initial grade.

In the case the student failed to pass the subject, the grade obtained in the interdisciplinary work would be maintained until the following academic course.

If the interdisciplinary work (that is mandatory) were not carried out, the student will fail the subject linked to the interdisciplinary work, regardless of the grade obtained in the other parts of the subject. In this case, the grade obtained would be maintained until the following academic course (if is equal or higher than 5 over 9 and the students meets the requirements specified in the present Teaching Guide). This grade will be added to the interdisciplinary work grade as soon as this activity is carried out.

If this subject were not linked to the interdisciplinary work, in the case that the interdisciplinary work were not carried out, the student will pass if obtains a grade equal or higher than 5 over 9, and meets all the requirements specified in the present Teaching Guide.

E. Student´s portfolio. The student will be able to obtain an extra 10% in the subject´s final grade by taking into account the student´s interest on the subject as well as his/her maturity in this field of Biology, by means of evaluating his/her assistance to individual tutorials and individual assignments arranged with the teachers.

	Score
A. Theory	Up to 55 points
B. Practical skills (laboratory, problems and bioinformatics)	Up to 30 points
C. Group Tutorials	Up to 5 points

C. Interdisciplinary Work	Up to 10 points
E. Student Portfolio (voluntary)	Up to 10 points (extra)

Other considerations:

The subject´s final grade will be the result of adding all the points obtained by the student, taking into account that it is required to obtain 5 points or more (out of 10) in the laboratory practices. In order to pass, it will be necessary to obtain a final grade of at least 5 points out of 10.

Those students that do not hand in any of the parts of the final exam (theory, laboratory, problems and questions) will be graded as NOT PRESENTED.

The students that fail in the first examination call of the course will be able to be examined in the second call, of any of the exam parts (theory, laboratory, problems and questions) that the student decides to obtain a final grade of at least 5 points out of 10.

Grades obtained in the corresponding parts of the subject in sections A, B2, B3, C and E will not be saved for the following academic course. Only the grades obtained in the corresponding parts of the subject in sections B1 and D, concerning laboratory practices and interdisciplinary work. In the case of the grade obtained in the laboratory practices will be saved for three academic courses.

It will not be possible to resign the grade obtained in any part of the subject, either related to teaching activities in class, exams or assignments handed in.

The note of the portfolio activity will only be taken into account once approved the subject.

REFERENCES

Basic

- Perera, J.; Tormo, A. y J.L. García. (2001). Ingenieria genetica. Vol.I. Preparacion, analisis, manipulacion y clonaje de DNA. Ed. Sintesis.
  Perera, J.; Tormo, A. y J.L. García. (2001). Ingenieria genetica. Vol.II. Expresión de DNA en sistemas heterólogos. Ed. Sintesis. ISBN: 0-19-513294-7

- Watson, JD; Caudy AA; Myers, RM y Witkowski JA. (2007) Recombinant DNA: Genes and Genomes, a short course. W.H. Freeman and Company. Cold Spring Harbor Laboratory Press.
- Pierce B. (2009) Genética. Un enfoque conceptual. 3ª edición. Ed. Médica Panamericana. ISBN: 978-84-9835-216-0
- Brown, T.A. (2008). Genomas. 3ª ed. Ed. Médica Panamericana. ISBN: 978-950-06-1448-1
- Sambrook, J. and Russell DW. (2001). Molecular cloning. A laboratory manual. Cold Spring Harbor Laboratory Press. (3 Volúmenes)

Additional

- Biology-Biotechnology http://science.uniserve.edu.au/school/curric/stage6/biol/bioltech.html#dna
- www.dnai.org/b/index.html
- http://www.nature.com/scitable/ebooks/intro-to-biotechnology-techniques-and-applications-16570330
- DNA learning center. Cold Spring Harbor Laboratory: http://www.dnalc.org/resources/animations/
- ActionBioscience.org http://www.actionbioscience.org/genomic/index.html
- Departamento de Genética (http://www.uv.es/genetica)