

1. DESCRIPTION OF THE SUBJECT

Degree:	Biotechnology
Subject:	Genetics
Module:	Biology, Microbiology and Genetics fundamentals
Department:	Molecular Biology
Academic year:	2015-16
Semester:	Second
Number of total credits:	6
Course:	1º
Subject type:	Obligatory
Language:	English

Teaching model:	B1	
a. Basic teaching (BT):		60%
b. Practice and developmental teaching (PDT):		40%

3. Teaching team

2.1. Teacher engaged	
Name:	Juan Jiménez
Faculty:	Faculty of experimental sciences
Department:	Molecular biology
Area:	Genetics
Level:	Full Professor
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4. Teaching plan

3.1. Objectives of the course

"Genetics" is conceived as a comprehensive introduction to lay basic concepts in this field. It aims to understand the origin of the genetic diversity and its inheritance both in the context of the basic scientific research as well as in the view of its biotechnological applications.

Lectures are the main activity in the course as a guide to highlight the most important concepts. However, from a methodological point of view, this course integrates learning and reasoning by solving genetics problems and drawing conclusions. In addition, a number of experimental practices drives the student to the routine in a laboratory of genetics analysis. Aside, being the subject of introductory character, the students necessarily have to work on their own to deepen the studied concepts in advanced reports and articles. Thus, by searching scientific literature related to genetics, the student also become familiar with its reading in its various common formats (descriptive articles, method, research and review).

3.2. Contributions to the training plan

"Genetics" belongs to the basic matters in the biotechnology degree (Biology, Microbiology and Genetics fundamentals module). This course provides basic acknowledgments in molecular, cellular, and population genetics to allow the in deep analysis of these matters addressed in later courses.

Genetics tools are involved in most biotechnological approaches both, in public research institutions and private companies, making of this subject an essential matter for the training of the students in Biotechnology.

Advances in the genetic fields conducted to a social and scientific revolution since its first applications using classical breeding tools until today. At present, it applies not only in genetic engineering, but also in aspects as relevant to society as diagnosis and treatment of diseases, forensic analysis, improved crop and animal production, conservation of species etc. The basic knowledge of genetics is essential to understand all these applied aspects is, at the time that provided the basic acknowledgment to progress in basic scientific research, which in turn generates new knowledge in the field of genetics itself. Also, advanced knowledge in genetics is highly appreciated in research laboratories and biotechnology companies abroad, widely opening the professional range of our graduates.

With regard to the Degree in Biotechnology, "Genetics" closely interacts with issues addressed in subjects such as "Cell Biology" (cell cycle, life cycles, differentiation, etc.) and "Biomolecules" (Structure of DNA and Proteins, translation, biochemical pathways etc.), also the first year.

Issues further developed in subjects such as "Genetic Engineering" and "Molecular Genetics" (second year), "Bioinformatics" or "Animal Biotechnology" (third and fourth year) are also addressed.

3.3. Recommendations and Previous Acknowledgments

The use of biological and scientific data bases is highly recommended. Literature in Pubmed (<http://www.ncbi.nlm.nih.gov/pubmed>) should be routinely visited.

5. COMPETENCES

4.1 Main competences developed in this subject at the level of degree

- To find query data in scientific literature and specialized databases.
- To be familiar with reading and understanding scientific articles.
- To distinguishing between descriptive scientific publications, method, experimental and review articles.
- To be familiar with the scientific reasoning.
- To interpret results presented in experimental researches

4.2 Main competences developed in this subject at the level of Module

- To solve out basic genetic problems, being able to address answers and conclusions from experimental results
- To design experimental approaches in order to address biological problems using genetic tools and model organisms.

4.3. Specific competences of the subject

- Understanding the origin of genetic diversity.
- To understand the laws of inheritance of that diversity.
- Being able to analyze results of genetic breeding in real and model organisms.
- To handle the basic techniques of genetic analysis at the molecular, cellular and organisms.

6. CONTENT OF THE SUBJECT (TOPICS)

General descriptors

Nature, structure, function and transmission of the hereditary material.

Gene and Chromosomal Alterations. Mutation and Repair. Phenotypic effect of the mutations. Genetic analysis in individuals and populations.

Basic Teachings

The course is divided into five thematic blocks. The first three deal with Molecular Genetics and the other two apply this knowledge to the genetic analysis of individuals and populations. In addition to conventional lectures, the course includes lectures dedicated to solve out genetic problems.

PROGRAM

INTRODUCTION

Topic 0.- From Mendel to Genomic

I. THE GENOME

Topic 1. Genetic information.

- a) Structure of the Nucleic Acids.
- b) Genome structure and organization

Topic 2. The duplication of the genetic material

- a) DNA Replication
- b) Replication as a scientific and biotechnological tool

II CHANGES IN THE GENETIC INFORMATION

Unit 3. Alterations of DNA

- a) Spontaneous and induced mutations
- b) Mechanisms of DNA repair

III ROLES OF THE GENETIC MATERIAL.

Unit 4. From genes to proteins

- a) Transcription
- b) Translation. Structure and function of proteins

Topic 5. Control of gene activity

- a) Genetic control elements
- b) Epigenetics

Unit 6. Phenotypic effect of mutations

- a) Functional consequences of the mutation
- b) Reversion of mutations

IV GENETIC ANALYSIS

Unit 7. The inheritance of diversity

- a) Life Cycles: Mitosis-Meiosis
- b) Errors in meiosis: numerical alterations in the karyotype

Unit 8. Genetic analysis in haploid

- a) Analysis of complementation
- b) Linkage analysis and recombination

Unit 9. Genetic analysis in diploid

- a) Mendelian segregation
- b) Interdependence between genes
- c) Exceptions to Mendelian segregation

V. POPULATION GENETICS AND DEVELOPMENT

Unit 10. The genes in evolution

- a) - Population genetics
- b) - Molecular Evolution

EXPERIMENTAL CLASSES (PRACTICES).

The practices program has two series, the first one with 2 main sessions (3 hours / session) and the second practice series with 4 sessions.

Practice 1. Replication as a tool in Biotechnology

1. Objectives of the Practice.

In this practice we see the replication machinery as a tool in biotechnology. We deal with two techniques that revolutionized molecular sciences, techniques that become today's essential tools in any laboratory of Molecular Biology: the Polymerase Chain Reaction (PCR) and DNA sequencing. In both cases we see the theoretical basis and the necessary equipment, and carry out the experimental analysis of two major variants in a human gene as an application of the PCR technique.

2. Topics of the Practice.

- 2.1. Two techniques, two Nobel laureates
- 2.2 PCR and DNA sequencing. Molecular basis.
- 2.3. Types and Applications
- 2.4 Separation and visualization of nucleic acids

Practice 2. Genetic Analysis haploid. Linkage

1. Objectives of the Practice.

Historically, genetics began using whole organisms without any knowledge of the molecular basis of genes. In fact, Mendel formulated his laws without knowing the nature of the gene. Haploid organisms constitute a fabulous model for genetic analysis. In this practice we will see the power of Genetics analysis in understanding biological

processes, and how this analysis drive to the construction of genetic maps and biochemical routes.

2. Topics of the Practice.

2.1. Haploid sexual cycle

2.2. Reverse genetics. Analysis of mutants.

2.3. Complementation analysis. Complementation groups.

2.4. Chromosome theory.

2.5. Linkage. Coupling and Repulsion

2.6. Positional cloning. Genetic maps

2.7. Gene conversion.

7. RESOURCES AND METHODOLOGY

From a methodological point of view, this course is based on learning and reasoning by solving problems and drawing conclusions. Lectures are the primary source of information and practices in the labs implement this learning at the time that you are introduced to the routine work in the laboratory. Since this subject is of introductory character, you have to work also on your own to deepen knowledge and concepts presented in class.

Types of activities:

BASIC ACTIVITIES

Theory

Audiovisual materials and demonstrations uses in classes are provided in the website of the subject. Since classes are based in a “deductions strategy” rather than in simple talks, your active participation is also welcome.

Practices

In the laboratory practices, learning and assimilation of concepts are aimed by using genetics tools with "your own hands". It also introduce you to the routine use of a laboratory (security protocols, material handling, analysis results etc.). Practices should not be understood as an accessory, but rather as a structural part of the course where acquired knowledge and skills can be examined.

Students with special interest in genetics may be involved in the preparation of practices (Up to 3 students/group practice, chosen by the teacher of practice according to the student's interest in genetics, time availability and previous calcifications of the candidates). These students will have the opportunity to contact more closely with the laboratory.

Series of problems

In order to promote continuous evaluation and encourage personal work, two series of evaluable problems need to be presented. You have to solve out these problems individually, but we encourage you to discuss them in groups. Problems are finally

resolved and discussed in class by students selected at random.

COMPLEMENTARY ACTIVITIES

Biotech Ideas

The possibility of a written work based on scientific articles that you think could lead to a new biotechnology product or service will also be evaluated, on a voluntary basis. The maximum length for works is 20,000 characters (with spaces)

Practical problems

During the course, genetic analysis problems are proposed (maximum of one per student) will. This problem are related to real case of genetic segregation in corn, an activity that complements the theoretical aspects of the Mendelian segregation.

Given the additional and voluntary nature of biotech ideas and practical problems, punctuations in these activities will only be considered when a minimum score is obtained in the basic activities.

Preparation of practical classes

Students with special interest in genetics may participate with the teacher (up to three/group practice) to help in media preparation and laboratory settings previous to the practice.

RESOURCES

Besides classes and group tutorials, the virtual platform facilitates the student-teacher interaction.

Virtual Platform

During the course, the student will have access to the virtual platform which will serve as the principal channel for the student-teacher communication and the main source of teaching materials seen in class, updated review articles, links to relevant pages related to genetics etc.

Online support

This assistance will be available to students through the web platform and by via email.

Personal Tutoring

Available for all students to solve any doubt, requires previous appointment by e-mail.

8. EVALUATION

The evaluation of the course is continuous and modular. It consists of several scoring activities: basic activities, which are obligatory and define the minimum to pass the course, and complementary activities, which are essentially voluntary and can serve to

raise the final score. To pass the course, you must obtain a score equal to or greater than 1.2 points (out of 3) in each of the exams and at least 5 points in the sum of the basic activities. Only when these criteria are met, the complementary activities will be added.

BASIC ACTIVITIES:

Exams

To facilitate the continuous evaluation, two partial tests (over 3 points each) will be made, one at mid-semester and another at the end of the course. You must obtain a minimum score of 1.2 points in each part to pass the subject and to add points from other basic activities (series of problems up to 2 points, and practices up to 2 point). Those students who have not passed the minimum of 1.2 points in any of the partial exams needs to repeat it (or both if applicable) in the final call of June, and eventually, of July.

Series of Problems

Two sets of problems are normally made during the semester, each evaluated on a maximum of 1 point. Problems-solving classes are considered as an evaluation activity. The corresponding series will be available in the web site. The student will have a few days to resolve the problems of the serie. The sheet with the resolution of problems are provided by each student at the resolution class. Attendance is required to compute problems score in the corresponding serie. The answers and arguments of each problem will be explained in a randomly chosen student among those provided the solutions sheet. If the chosen student has submitted a correct answer but is not present or is unable to solve it out, automatically lose points for all the series of problems.

Practices

The practices are designed for the students to complement their basic acknowledgments and to acquire relevant experimental skills. Two Practical series, each evaluated on a maximum of 1 point will be made. Attendance at practices is mandatory to pass the course. After each session, a test on laboratory procedures and / or assimilated skills in the practical sessions will be held. One component of that score may depend on the individual results of each practice.

COMPLEMENTARY ACTIVITIES

These activities are voluntary, and your score will be added to the final punctuation only when a minimum score is obtained on basic activities.

Biotech Ideas

Most biotech companies emerge from the scientific knowledge. Each student will present along the course a brief original idea that could lead to a biotechnology-based company. The ideas must be protected, so that these works are treated confidentially.

New products or services in the biotechnology sector stem from the investigation, so that the idea should be based on one or several research papers published in prestigious scientific journals. The project brief must be submitted as a paper of up to 20,000 characters (including spaces), including: a summary of the idea, the scientific result in which it is based, an introduction of the current state of the idea, the scientific

observations or results that led to your business idea, some final conclusions about the new product or service that would be generated, the sector of the society to which it is addressed, and where appropriate, the competitive with equivalent products / services that already exist, and its market advantage. You should also include reference to the articles that you have used for your job and are mentioned therein.

In the library are recent issues of these scientific journals, and in many cases, there are also "on line" access through the website of the University (only from computers in the University server or through the library after identification of student UPO), located in the section of electronic journals (<http://www.upo.es/serv/bib/revelec.htm>). You can also search in many magazines at once using the database known as "Medline" (<http://www.ncbi.nlm.nih.gov/PubMed>). For some items, this browser allows full access to all text.

The ideas's work will be delivered electronically to the teacher through the virtual plataform. The submission deadline normally coincides with the day of the final exam in June. This work may receive a maximum of 0.5 point.

Practical problems.

The last part of the semester, once seen item 10, each student may pick a corn cob that can analysed for a day. Cob contains grains with different genetic characteristics (color and / or roughness). The student must count the number of different types of grain and deduct the genes that are involved in the character, the kind of inheritance that best explains this segregation, and the genotype of the maize and its parent. Results are presented by filling a sheet available in laboratory classroom. This voluntary activity is evaluated on 0.5 points.

Assists in the preparation of practices

Whenever the timing and availability of laboratories permits, students with special interest in genetics may be involved in the preparation of the practical sessions. These students will have the opportunity to contact more closely with the lab working and the organization activities of the practice itself. No further punctuation is obtained with this activity, but the one point corresponding to the practice will be directly obtained without making the questionnaire by this activity.

FINAL COURSE RATING

Summary of scoring activities:

Basic activities	Exams (2 partial tests)	Practices (2 series)	Problems (2 series)	Total
Maximal score	6 (3 x 2)	2 (1 x 2)	2 (1 x 2)	10.0

Complementary activities	Help in practices	Biotechnological ideas	Practice problems	Total
Maximal score.	The practice punctuation	0.5	0.5	1.0

To pass the subject, the student needs to get at least 1.2 points (out of 3) in each of the partial tests and 5 points (out of 10) in the sum of all the basic activities.

For students who meet these conditions, the final score is obtained by adding complementary activities to basic activities, which can thereby add up to 1.0 additional point.

9. BIBLIOGRAPHY

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- Jocelyn E. Krebs y cols. Genes X. Jones & Bartlett. 10ª Ed. 2009. ISBN: 9780763779924
- Russell P.J. "Fundamentals of Genetics" Addison Wesley Longman (2ª Edición). 2000.
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