Universidad Zaragoza

Academic Year/course: 2021/22

27105 - Genetics

Syllabus Information

Academic Year: 2021/22
Subject: 27105 - Genética
Faculty / School: 100 - Facultad de Ciencias
Degree: 446 - Degree in Biotechnology
ECTS: 6.0
Year: 1
Semester: Second semester
Subject Type: Basic Education
Module:

1. General information

1.1. Aims of the course

The subject and its expected results respond to the following approaches and objectives:

This is a basic training subject in the first year of the Degree in Biotechnology that aims to provide students with basic knowledge related to the characteristics of hereditary material and inheritance. Through the different activities, the aim is to achieve the following general objectives:

- Knowledge of the nature and transmission of hereditary material
- Knowledge of genetic variability
- Knowledge of the basis of population genetics

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), so that the acquisition of the learning outcomes of the subject provides training and competence to contribute to some extent to their achievement. In particular, the study of this subject will enable the student to know, understand, become aware of or contribute directly to the achievement of Goal 3 of the SDGs, related to Health and well-being. Knowledge of the genetic basis of a wide range of diseases and inheritance patterns, as studied in this subject, will enable the student to address a significant number of health-related problems, both ongoing and emerging.

1.2. Context and importance of this course in the degree

The subject of Genetics is integrated in the second term of the first course of the Degree in Biotechnology. It is a subject that provides specific skills not provided by any other subject. Some of the aspects covered in the subject of Genetics can also serve as a basis for some very specific aspects of other subjects such as Microbiology, Clinical Biotechnology, Molecular Biology, Animal Biotechnology, Plant Biotechnology or Environment Biotechnology.

1.3. Recommendations to take this course

For the good progress and understanding of the subject it is recommended to attend and participate in all the proposed activities.

2. Learning goals

2.1. Competences

Upon successful completion of the course, the student will be more competent to...

1. To understand the nature and organization of the hereditary material.
2. To understand the basis of transmission of hereditary material.

3. To understand the fundamentals and consequences of ligation and recombination.
4. To understand the basis of Population Genetics.

In addition to these specific skills, the student will be more competent:

- To solve specific problems from different perspectives.
- To analyze information critically.
- To present and discuss the issues in public.

2.2. Learning goals

In order to pass this course, the student must demonstrate the following results:

1. The student knows the nature and organization of the hereditary material,
2. The student is able to apply to specific cases the basis of transmission of hereditary material through generations,
3. The student understands the concepts of genetic linkage and recombination and their application to genetic maps,
4. The student gets to know the basics of Population Genetics.

2.3. Importance of learning goals

This subject provides an insight into fundamental aspects of the functioning of living organisms. It introduces the student to the most important aspects and characteristics of hereditary material from a functional point of view in prokaryotes and eukaryotes, as well as to the different forms of distribution of this material and the repercussions on the resulting cells. It also allows an approach to the consequences of inadequate partitioning, i.e. the clinical repercussions of variation or inadequate partitioning of hereditary material. The study is carried out at both the individual and population level, offering an insight into the genetic constitution of individuals or populations depending on their progenitors or previous generations.

Many molecular aspects of genetics are not covered and they will be dealt with by other subjects, mainly in the third year.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that he/she has achieved the learning outcomes through the following assessment activities:

1. The specific competences shall be assessed by means of a written test consisting of tests of short questions and problem solving and case studies. The oral test option is also open to students who find this type of assessment more appropriate. The result of the assessment, by means of the written test, of the theoretical knowledge acquired will account for 60% of the mark.
2. The assessment of the individual resolution of problems or cases will contribute 15% of the final mark.
3. The active participation and the qualification of the test proposed at the end of each laboratory practice will contribute 10% of the final mark.
4. The active participation in an innovative activity carried out by groups and which allows the acquisition of key terms and definitions of the subject to be assessed with 15% of the mark. The activity may vary depending on the academic year: seminar discussion, trivia game, debates, crossword puzzle solving or any other activity proposed by the subject teachers.

In order to be taken into account the assessments of points 2, 3 and 4, the student must obtain a minimum score of 5 in the written test.

In addition to the assessment modality indicated in the previous points, the student will have the possibility of being assessed in a global test, which will judge the achievement of the learning outcomes indicated above.

The syllabus that students should use to prepare for the different tests can be found in the "Activities and resources" section of this teaching guide.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. Students are expected to participate actively in class throughout the semester. Further information regarding the course will be provided on the first day of class. A wide range of teaching and learning tasks are implemented, such as:

1) **Participatory lectures:** taught in a full group. The material will be available on the website of the ADD of the University of Zaragoza (https://moodle2.unizar.es/add/).

2) **Classroom problem classes**. Different classroom sessions will be devoted to solving genetics problems that will have been previously given to the students so that they can work on them individually and facilitate that the session will be participative and will be used to resolve doubts. Theoretical and problem classes will be interspersed, with no special timetable for either.

3) **Laboratory practice sessions:** These sessions will be of compulsory attendance except in exceptional cases. They will be carried out in small groups in two sessions of 3 hours each.

4) **Computer practice sessions:** These sessions will be of compulsory attendance except in exceptional cases. They will be carried out in small groups in one session of 4 hours each.

5) **Individual problem or case resolution:** To develop this activity, students will be provided with a collection of problems. Individually, the student will have to solve a practical case/problem of those included in the collection provided, applying the theoretical-practical contents of the subject and on a date that will be announced in advance (expected end of May).

6) **Complementary activities related to the subject matter of the course which may include:** seminars on current news, debates, games or any other activity designed to learn genetics in a different way.

7) **Small group tutorials** for seminar preparation and problem solving.

8) **Individualized tutorials** for resolution of doubts. Tutorial hours will be flexible and agreed in advance with the group depending on the most convenient time. In addition, teachers will be able to resolve doubts through different systems, including Moodle, Meet or email, always respecting the rules and schedules that will be established with the group.

4.2. Learning tasks

The program offered to the student to help him/her achieve the expected results comprises the following activities...

1) Participatory lectures taught in whole group.

2) Problems resolution classes taught in whole group.

3) Laboratory practicals.

4) Computer training.

5) Individual problem solving or case studies.

6) Complementary activities.

7) Individual or small group tutoring.

8) Support for training through the resources available at the University of Zaragoza's ADD https://moodle2.unizar.es/add/.

The teaching and evaluation activities will be carried out in face-to-face mode, unless, due to the health situation, the provisions issued by the competent authorities and by the University of Zaragoza require them to be carried out telematically.

4.3. Syllabus

Section I. Nature and organization of hereditary material.

Theme 1. DNA, genes and genomes.

Chemical nature and structure of DNA. DNA replication. Transcription. Genetic code and translation. Genes, introns and exons. Types of eukaryotic DNA. Genomes: size and number of genes.

Theme 2. Organization of the hereditary material in eukaryotes.

Nuclear hereditary material. Internal structure of eukaryotic chromosome. Levels of chromosome packing. Heterochromatin and euchromatin. Chromosomal bands. Types of DNA. External structure of the chromosome. Centromere position, size and number. Extranuclear genetic material.

Theme 3. Organization of the hereditary material in prokaryotes.

Introduction. Hereditary material in Viruses. RNA viruses. DNA viruses. Hereditary material in Bacteria. Bacterial chromosome. Plasmids.

Section II. Transmission of hereditary material.

Theme 4. Chromosomal theory of inheritance.

Introduction. Cell cycle. Mitosis and hereditary material. Variations in the process of cell division. Meiosis. Biological and genetic significance of meiosis. Atypical meiosis. Differences between mitosis and meiosis.

Theme 5. Mutations in hereditary material.

Basic concepts. Classification of mutations. Chromosome mutations. Chromosomal rearrangements. Aneuploidy. Euploidy. Human karyotype.

Theme 6. Mendelism as a genetic consequence of meiosis.

Mendelian principles. Monohybridism: law of uniformity and law of segregation. Dihybridism: law of independent combination. Polyhybridism. Knowledge of genotype from phenotype.

Theme 7. Extension of Mendelian analysis.

Variations in genetic dominance. Allelic series. Several genes affecting the same trait. Lethal genes. Penetrance and expressivity.

Theme 8. Microsatellites: genetic markers.

Definition of genetic marker and microsatellite. Polymerase chain reaction. Example of allelic series and codominance.

Theme 9. Heredity and sex chromosomes.

Chromosomal sex determination. Gene dosage compensation. X-linked inheritance. Y-linked inheritance. Influence of sex on the inheritance of certain traits: sex-influenced inheritance and sex-limitation of trait expression.

Section III. Ligation and recombination.

Theme 10. Linked genes.

Discovery of gene ligation. Types of crossovers to explain ligation process. Coupling and repulsion. Complete and incomplete ligation. Cross-linking and chiasm formation.

Theme 11. Genome mapping in eukaryotes. I. Genetic maps.

Fundamentals for the construction of a genetic map. Detection of linkage between two genes. Calculation of recombination frequencies. Three-point crossover. Interference and coincidence. Relationship between genetic distance and recombination frequency. Map unit and map function.

Theme 12. Genome mapping in eukaryotes. II. Physical maps.

Sequencing of genomes. History. Applications. Identification of genes of interest.

Section IV. Population genetics

Theme 13. Basic concepts of population genetics.

Gene and genotypic frequencies and their estimation. Hardy-Weinberg equilibrium in autosomal and sex-linked genes.

Theme 14. Disturbances of the Hardy-Weinberg equilibrium. I. Systematic processes.

Effect of migration. Effect of mutation. Effect of selection in cases of complete dominance, incomplete dominance and selection in favor of the heterozygote. Mutation - selection balance.

Theme 15. Disturbances of the Hardy-Weinberg equilibrium. II. Dispersive processes.

Small populations. Genetic drift. Effective population size. Inbreeding and its effects. Calculation of inbreeding coefficient.

4.4. Course planning and calendar

The period of theory and problem classes will coincide with the officially established timetable. Please check the Facultad de Ciencias website https://ciencias.unizar.es/grado-en-biotecnologia and https://moodle2.unizar.es/add/. The dates of exams can also be consulted on this website in the section Degree in Biotechnology.

The places where the sessions will be held, the calendar and the practice groups will be established in coordination with the rest of the subjects at the beginning of the academic year. The coordinator will draw up the groups of practicals at the beginning of the course in order to avoid overlapping with other subjects.

The dates for the rest of the course activities will be agreed with the students well in advance and once agreed, they will be communicated through Moodle.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27105