

Academic Year/course: 2021/22

## 66018 - Advances in Molecular Pathology

### Syllabus Information

---

**Academic Year:** 2021/22

**Subject:** 66018 - Avances en Patología Molecular

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 537 - Master's in Molecular and Cellular Biology

**ECTS:** 6.0

**Year:** 1

**Semester:** Second semester

**Subject Type:** Optional

**Module:**

## 1. General information

### 1.1. Aims of the course

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

Advances in Molecular Pathology is an optional subject that the Master in Molecular and Cellular Biology offers to its students, especially those who want to do a thesis related to biomedical aspects of Biochemistry and Molecular and Cellular Biology. Its general purpose is to provide the most recent updates of the knowledge related to some hot topics selected in molecular biopathology.

Its general objective is to acquire the knowledge of molecular and cellular biology necessary to address an accurate molecular diagnosis as well as new therapeutic strategies in selected pathologies (cancer, mitochondrial diseases, dyslipemias, lysosomal diseases) that are caused by failures in gene expression or in epigenetic regulation.

### 1.2. Context and importance of this course in the degree

The subject serves to provide advanced and updated knowledge in a series of hot topics of molecular and cellular pathology. It serves to provide basic information to adequately address the doctoral thesis and to know the main research problems raised in this area.

### 1.3. Recommendations to take this course

The program and content of this subject is designed to improve knowledge about the molecular basis of various relevant pathologies caused by defects in the expression of genes important for proper cell function. The basic knowledge obtained in the bachelor's degrees in the field of Life Sciences will be updated with the latest advances in each field. It is especially recommended for students who hold a degree in Biochemistry, Biotechnology or similar.

## 2. Learning goals

### 2.1. Competences

Upon passing the subject, the student will be more competent to ...

To approach with the necessary theoretical preparation the experimental work directed to the realization of his PhD thesis.

Search relevant information in the scientific literature to start an investigation or solve a methodological problem.

Prepare and present succinct and rigorous reports on various hot topics in molecular pathology

### 2.2. Learning goals

The student, to pass this subject, must demonstrate the following results ...

- Student will be able to understand the molecular basis of the main lysosomal diseases
- Student will be able to understand the current state of knowledge of the molecular basis of the main hereditary dyslipemias

- Student will possess advanced knowledge of the molecular mechanisms that regulate programmed cell death or apoptosis
- Student will understand the current state of research on the molecular basis of mitochondrial diseases
- Student will understand the importance of genetic and environmental factors in the genesis of obesity
- Student will understand the relationship between the inflammation process and acute phase proteins

### 2.3. Importance of learning goals

This course is an effective system for permanent updating the knowledge of graduates in Biochemistry and other Bachelor's degrees in Life Sciences who want to make a doctoral thesis in biomedicine.

## 3. Assessment (1st and 2nd call)

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

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

- Active participation in the master classes and in the discussions raised in them. Workshops will be held in which a current research topic will be discussed, in English, and in which the students will have to formulate at least 1 or 2 questions each to the moderator or the speaker and will debate the previously presented information. All the activities of the workshops will be developed in English.
- Conducting a short public presentation (15 min) of one or several research articles related to any of the topics covered in the course (see program under "Activities and resources"). Next, the student will answer the questions raised by 2-3 teachers of the course for another 15 min.
- Attendance of at least 80% of the classes will be mandatory

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

The learning process designed for this course is based on the following teaching and learning tasks: Lectures on the latest developments in different research topics related to molecular pathobiology, and seminars presented by the students.

### 4.2. Learning tasks

The course includes the following learning tasks:

Lectures and workshops: 45 hours. The work and the latest advances in leading areas of research in molecular pathobiology will be presented to the students, as detailed in the syllabus. Besides, discussion workshops, focusing on hot and controversial topics, will take place. The teacher will do a brief presentation, based on some key articles and then, a discussion in which each student will make 1 or 2 questions related to the topic.

Elaboration and presentation of an assignment. In-class work: 8 hours; autonomous work: 60 hours. In this activity the students collect information on a particular topic, helped by the teacher. The analysis of information should lead to the elaboration of a public presentation of the chosen topic. The teacher will monitor the individual work of students in tutoring sessions. After the presentation, it will be discussed by the student and 2-3 teachers.

"The teaching and assessment activities will be carried out in person unless, due to the health situation, the provisions issued by the competent authorities and by the University of Zaragoza compel them to be carried out electronically. ?

### 4.3. Syllabus

The course will cover the following topics:

- 1- Course introduction. Dr. Javier Naval.
- 2- Advances in the mechanisms involved in intestinal absorption of sterols, plasma cholesterol levels and sterol removal: implications for cardiovascular risk and other pathologies. Dr. Miguel Pocovi
- 3- Obesity: predisposition or incorrect nutrition? Genetic predisposition. Genes and obesity relationships: interplay with food intake and satiety; interplay with inflammatory state. Factors associated to adipose tissue differentiation and metabolic control. Epigenetics. Obesity and the thrifty phenotype. Adipogenesis. Obesity and chronobiology. Dra. Maria Iturralde
- 4- Gaucher Syndrome: clinical, genetic and epidemiological characteristics. Dra. Pilar Giraldo.
- 5- 1)Importance of programmed cell death. Apoptosis, Necroptosis, Autophagy. Discovery of apoptosis in the worm *Caenorhabditis elegans*. Apoptosis in *Drosophila melanogaster*.

2) Apoptosis in mammals. Extrinsic pathway. Caspases. Caspase inhibitors. Intrinsic pathway. Inhibitors of apoptosis. Dr. Javier Naval

6- Role of mitochondria in apoptosis. Cytochrome c, AIF, Smac/Diablo. Apoptosis regulation by Bcl-2 family proteins. Dra. Isabel Marzo

7- Apoptosis in the Immune System I. Central tolerance. Mechanisms of control of peripheral tolerance. Dr. Alberto Anel

8- Apoptosis in the Immune System II. Cell-mediated cytotoxicity. Natural Killer (NK) cells, cytotoxic T-lymphocytes (CTL) and their weapons of mass destruction. Dr. Julián Pardo

9- Immunological features of a novel tuberculosis vaccine. Dr. Juan Ignacio Aguiló

10- Workshop on Granzymes Dr. Julián Pardo.

11- Redox activity of Apoptosis-Inducing Factor (AIF): molecular basis and biological function implications. Dr. Patricia Ferreira

12- Unravelling causes of multifactorial diseases: OXPHOS differences among mitochondrial haplogroups. Dr. Eduardo Ruiz Pesini

13- Identification of nuclear factors involved in mitochondrial diseases. Dr. Patricio Fernández

14- 1) Innate immune response: mechanisms of inflammation.

2) Acute-phase proteins. Dr. María Angeles Alava

15- 1) Acute-phase proteins as pathological markers and of animal welfare.

2) Protein glycosylation: principles, study methods and clinical applications. Dr. Fermín Lampreave

16- Introduction to the study of Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (NOS). Antioxidant defences and oxidative stress. Dr. Pedro Iñarrea

17- Final week: Student evaluation seminars: Presentation and discussion of papers related to syllabus topics. Dr. Alberto Anel, Isabel Marzo and Javier Naval

#### 4.4. Course planning and calendar

Further information concerning the timetable, classroom, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the Faculty of Science website, the virtual platform Moodle, and the Department information boards.

Provisional calendar (it may vary depending on the availability of guest lecturers)

session 1

Gaucher Disease. clinical, genetic and epidemiological characteristics  
Dr. Pilar Giraldo.

session 2

1) Inborn errors of metabolism of chylomicrons, remnant lipoproteins and high density.  
2) regional Hypercholesterolemia dominant.  
Dr. Miguel Pocoví.

session 3

1) Importance of programmed cell death or apoptosis. Apoptosis in *C. elegans*.  
2) Apoptosis in *Drosophila melanogaster*.  
Dr. Javier Naval

session 4

1) Via extrinsic apoptosis. MORTALS RECEPTORS.  
2) Caspases. Caspase inhibitors.  
Dr. Javier Naval

session 5

1) Role of mitochondria in apoptosis. Cytochrome c, AIF, Smac / Diablo.  
2) Regulation of apoptosis by proteins of Bcl-2 superfamily  
Dr. Isabel Marzo

session 6

Apoptosis in the immune system I. Central Tolerance. Maintenance mechanisms of peripheral tolerance.  
Dr. Alberto Anel

session 7

Apoptosis in the immune system II. Cell mediated cytotoxicity. Cytotoxic lymphocytes and their deadly weapons  
Dr. Julian Pardo

session 8

Lessons from vector-borne infectious disease "Lyme borreliosis"  
Novel vaccination strategy outwits pathogens' versatility.

Dr. Markus Simon, Max-Planck Institut

session 9

Workshop on granzymes

Dr. Markus Simon, Max-Planck Institut

session 10

1) Introduction to reactive oxygen species. The chemistry of free radicals.

2) The antioxidant defenses and oxidative stress.

Dr. Pedro Iñarraia

session 11

1) Physiological basis of intake. Orexigens and anorectic neuropeptides and other regulatory molecules. related genetic alterations

2) accumulation of fat in the adipose tissue. Physiological basis and genetic alterations.

Dr. Maria Iturralde

session 12

1) Unraveling the causes of multifactorial diseases: OXPHOS differences between mitochondrial haplogroups.

Dr. Eduardo Ruiz Pesini

session 13

1) Identification of nuclear factors involved in mitochondrial diseases

Dr. Patricio Fernández

session 14

1) innate immune response: mechanisms of inflammation

Dr. Fermin Lampreave

2) Acute Phase Proteins.

Dr. M. Angeles Alava

session 15

1) acute phase proteins as pathological markers and animal welfare.

2) Changes in protein glycosylation: principles, methods of study and possible clinical applications.

Dr. Fermin Lampreave

session 16

Seminars student assessment: presentation and discussion of related agenda items.

Drs. Alberto Anel, Isabel Marzo and Javier Naval

#### **4.5. Bibliography and recommended resources**

Each of the corresponding teachers will indicate the specific bibliography for each topic, updated every year.