



Universitat de Lleida

# DEGREE CURRICULUM **IMMUNOLOGY**

Coordination: MORA GIRAL, CONCEPCION

Academic year 2022-23

Subject's general information

<b>Subject name</b>	IMMUNOLOGY			
<b>Code</b>	101651			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Bachelor's Degree in Biomedical Sciences	2	COMPULSORY	Attendance-based
	Master's Degree in Biomedical Research		COMPLEMENTARY TRAINING	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRALAB	PRAULA	TEORIA
	<b>Number of credits</b>	0.3	1.8	3.9
	<b>Number of groups</b>	3	2	1
<b>Coordination</b>	MORA GIRAL, CONCEPCION			
<b>Department</b>	EXPERIMENTAL MEDICINE			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	Catalan/Spanish/English			
<b>Distribution of credits</b>	<p>Theoretical classes: 3,9 ECTS (depending on the health situation classes will be turned into the virtual mode)</p> <p>Seminars: 1,8 ECTS (depending on the health situation classes will be turned into the virtual mode)</p> <p>Laboratory Practical classes: 0,3 ECTS (attendance required unless the sanitary condition forbids it)</p>			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MORA GIRAL, CONCEPCION	conchi.mora@udl.cat	5,9	
ROSELL MASES, ESTELA	estela.rosell@udl.cat	1,1	
VERDAGUER AUTONELL, JOAN	joan.verdaguer@udl.cat	1,4	

## Learning objectives

It is a subject of the second year of the Degree in Biomedical Sciences that is taught during the second academic semester. In this subject we want to provide students with the basic and necessary knowledge that allows them to understand the processes of the functioning of the immune system in both health and disease, and interpret the bases of both the physiological and pathophysiological immune response. This knowledge must be known to be used to solve questions related to health and biomedical processes using a basic scientific language related to Immunology and Immunopathology.

The purpose of the course is to provide the student with basic knowledge of the mechanisms that drive the immune system, as a basis for the homeostatic maintenance of the organism and its defense against the different external agents or adverse phenomena.

The immune response can be divided into three major phases: one of antigen recognition, one of immune system activation and finally one of effector immune response. In order to understand these mechanisms, the teaching program is divided into blocks: the first serves as an introduction to the general characteristics of the immune system. The second is dedicated to the organs and cells of the immune system, and the third details the molecules and factors involved in the immune response. The regulation bases of the immune response are described in the fourth block. Finally, a final block of topics is intended to give a very general view of Immunopathology. In the seminars, clinical cases of different immunopathology will be analyzed and discussed.

To pass this course, the student must achieve the following specific objectives:

1. Know the fundamental characteristics of the immune system (organs, cells, and molecules).
2. Know and understand the characteristics of the performance of the innate immune system (or primary immune response).
3. Know and understand the characteristics of the performance of the acquired immune system (or secondary immune response).
4. Understand the characteristics of Immunopathology.
5. Learn the clinical applications of immunology.

In addition to knowing and knowing how to apply the concepts specified in the theoretical program that are established in theory topics and seminars, students must:

- Know the terminology and the basic scientific language related to Immunology and Immunopathology.

- Know how to use the concepts related to these thematic contents to interpret physiological and human pathology aspects.

## Competences

CB1 That students have demonstrated that they have and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study

CB2 That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the development and defense of arguments and problem solving within their area of study

CE29. Describe the molecular, cellular and physiological bases of the immune system and the immune response.

CE35. Define the molecular, cellular and genetic bases of the immune mechanisms involved in autoimmunity and hypersensitivity. As well as the immunopathological mechanisms and pathogenetic bases of autoimmune diseases.

CE36. Describe the fundamentals of innate immunity and inflammation, and the involvement of low-grade chronic inflammation in the pathogenesis of prevalent diseases: type 2 diabetes, obesity and metabolic syndrome.

CE37. Recognize the basics of immunotherapy and immunomodulation in autoimmune diseases and inflammatory diseases.

CE38. Define the mechanisms for generating the target organ injury of the main systemic and organ-specific autoimmune diseases.

## Subject contents

The structure and contents of the teaching program have been designed according to the needs of the degree, taking into account that it is mainly oriented to the biomedical research. Therefore, in the lectures and seminars equal importance is given to both, the basic and the clinical part of the subject. Within the teaching of this subject, the distinction is made between Basic Immunology, and Clinical Immunology or Immunopathology. The first one deals with the study of the elements of the normal immune system and their function (ex: study of organs, cells and molecules, embryology, physiology and genetics). Immunopathology, on the other hand, deals with the study of the pathological processes of the immune system in humans, both in those pathological situations that involve the response of the immune system (eg: infections, cancer, organ transplants) and in those pathological processes that they originate, by excess or by defect, in the own immune system (ej: autoimmunity, allergy, Immunodeficiencies).

In addition to facilitating the acquisition of basic transversal competences, students are expected to acquire terminological competences and the basic concepts of Immunology and Immunopathology. At the instrumental level, we will collaborate in the acquisition of competences related to communication skills, teamwork and the use of ICT (Information and Communication Technologies) to obtain and manage information.

## Methodology

To achieve the objectives and acquire the attributed competences, the following activities will be programmed:

- Master classes. (CM)

These will be done with all students. Class attendance is not mandatory..

They are intended to give a general overview of the thematic content highlighting those aspects that will be useful in their training as doctors.

- Seminars. (Sem)

These will be done with 1/5 of the students and have to be done with the corresponding group. Each group will be subdivided into 5 working groups that will always be integrated by the same students.

The seminars have purpose so that the students apply the theoretical concepts and deepen in these more relevant and more complex aspects of the topics. In the Basic part of the subject, students must present a paper, this part is mandatory.

-Practical classes (PRALAB)

These classes will be performed with 1/3 of the students, they are not compulsory and have to be carried out with the corresponding group. Each group will be subdivided in 3 work teams, where the alumni will be acquainted with an analytical technique widely used in Immunology.

## Development plan

The subject will be taught through the development of the following theoretical and seminar topics:

THEORETICAL THEMATIC (SINGLE GROUP)

### **BASIC IMMUNOLOGY (50% of the subject)**

THEORY (30% of the subject)

UNIT 1.- Introduction to Immunology. The immune system as a response device against aggression. Elements of the immune system: organs (primary and secondary), cells, and molecules. Definition of natural (or primary) immunity and acquired immune (or adaptive) immunity. Anatomy of the Immune System.

UNIT 2.- Anatomy of the Immune System. Different organs and tissues responsible for the formation of immunological agents (primary lymphoid organs for adults: thymus and bone marrow); and of its organization to mount the immune response (spleen, lymph nodes, mucosa-associated lymphoid tissue).

UNIT 3. Immunity Innata. Definition. Mechanisms of natural resistance. External defense system, physical and chemical barriers. Phagocytes: polymorphonuclear phagocytes: neutrophils. Macrophages Pattern Recognition Receptors (PRR), PAMPS and DAMPS. Inflammatory response Antimicrobial chemical components: lysozyme, defensins, ... Acute phase proteins: inflammation and fever. Mastocytes.

UNIT 4.- The complement. . Introduction. Serum proteins, enzymatic activation system in cascade. Principal effector and amplifier of humoral immunity. Nomenclature. Classical, Alternate, and Lectin ways of activation. Regulation of the complement system. Receptors of the complement system.

UNIT 5.- Immunogens and Antigens. Definition of acquired immunity and main characteristics. Definition of immunogen, antigen, haptene, and epitope.

UNIT 6.- Antigen Presenting Cells (APCs). Professional antigen presenting cells: Macrophages, dendritic cells, and lymphocytes B. Functions and varieties according to their anatomical location. Bookmarks Initiation of the response received.

UNIT 7.- Major Histocompatibility Complex (MHC). Definition and function of the MHC. Proteins encoded in the MHC. Structure of MHC molecules of class I. Structure of MHC molecules of class II. Differential characteristics of MHC molecules of class I and II. Processing paths.

UNIT 8.- Immunoglobulins, B cell receptor (BCR), T cell receptor (TCR). Immunoglobulins. Molecular structure Light (VL-CL) and heavy chains (VH-CH). Nomenclature. Properties and biological activities of immunoglobulins. BCR as a membrane antigen receptor: molecules that participate in the complex. Antigen-antibody interaction. T cell lymphocyte receptor (TCR). TCR $\alpha$  and TCR $\beta$ . Biochemical structure of the receptor. Properties, restriction for the MHC. Complex CD3. Restriction of the response T by the MHC. Somatic recombination, receptor editing and

receptor review.

UNIT 9.- Lymphocytes B and T. Generalities. Lymphocytes, types of lymphocytes, phenotypic and functional study of lymphocytes. Lymphocytes B: Ontogeny and maturation of the lymphocytes B. Function of the B cells during the immune response. Plasma cells and antibody production. Somatic hypermutation and affinity maturation. Subpopulations of lymphocytes B. Lymphocytes T: Definition. Properties. Ontogeny and maturation of the lymphocytes T. Thymic selection. TCR $\alpha$  and TCR $\beta$  lymphocytes. TCR interaction, MHC and accessory molecules. T CD4 + and CD8 + lymphocytes. Functional subpopulations of T CD4 + and CD8 + lymphocytes.

UNIT 10.- Cytokines and Chemokines. Families. Definition of cytokines and chemokines. Function in hematopoiesis. Role of cytokines in the inflammatory response. Autocrine action, paracrine and endocrine. Cytokine patterns: TH1, TH2, TH3, TH17, ... Chemokines: Introduction. Chemotactic action and homing of leukocytes. Cytokines with chemotactic function. Families and their receptors.

UNIT 11.- Adhesion Molecules. Adhesion molecules. Definition and function. Distribution of the different cell populations in the lymphatic organs.

UNIT 12.- Lymphocyte Activation. Description of the main signaling pathways of the TCR and BCR. Coreceptors, co-stimulants, effector pathways to the acquired response.

SEMINARS (10% OF THE SUBJECT)

PRACTICAL CLASSES (10% OF THE SUBJECT)

## **IMMUNOPATHOLOGY (50% of the subject)**

THEORY (30% of the subject)

UNIT 13.- Overview of the immune response. Mechanisms of hypersensitivity. Coordinated global vision of the response of the immune system. Mechanisms of hypersensitivity according to the classification of Gel and Coombs.

UNIT 14.- Immune response against pathogens. Mechanisms of evasion of the immune response by pathogens.

UNIT 15.- Tumor immunity. Immune response against tumors.

UNIT 16.- Organ transplant. Concept of alloreactivity. General concepts of immunology of the transplant.

UNIT 17.- Immune Tolerance and Autoimmunity. Immunopathology concept. Self-regulation as an essential property of the SI. Regulatory mechanisms: immunological tolerance. Tolerance in T and B lymphocytes: central tolerance and peripheral tolerance. Autoimmune diseases.

UNIT 18.- Allergy. Immunopathogenic mechanisms involved in allergy.

UNIT 19.- Immunodeficiency. Immunodeficiencies: concept and classification.

SEMINARS: STUDY OF CASES (REDUCED GROUPS) (20% of the subject)

Clinical Cases of Immunopathology will be analyzed in the seminars.

## Evaluation

The final score of this subject will be the sum of the different aspects evaluated:

The conceptual and theoretical knowledge, and the acquisition of competences by the Basic Immunology will be evaluated in the middle of the course through: A multiple choice test of the practical part of the subject, which will contribute in a 10% to the final mark; another multiple choice test of the theoretical part of the subject, which will contribute a 30% of the final score; the evaluation of the seminars will be assessed in a continuous way, in class, during the exposition by the students of scientific review papers suited to the topics addressed in the

syllabus. The result obtained in this exam will constitute 50% of the final grade. In order to pass this part of the subject, the student have to obtain at least 5 out of 10 in this exam. The student will have a second chance to pass on the September exam.

The conceptual and theoretical knowledge, and the acquisition of competences of the part of Immunopathology will be evaluated by means of a multiple choice test once the course is finished (in the June exam). This test will represent 30% of the final grade (approximately).

An evaluation of the seminars will be carried out through a single test that will represent 20% of the final grade (approximately). It will be done through a multiple choice test once the course is finished (in the June exam). The evaluation of the part of Immunopathology of theory and seminars is done in a single joint examination in June that passes with a minimum grade of 5 out of 10. The student will have a second chance to pass on the September exam.

In case of notreaching the minimum of 5 in any of the partial tests, the note that will appear in the academic record will be 4 or less, even in those cases in which the average of the two tests is greater than this score.

IMPORTANT NOTE: Depending on the health situation, the evaluation may be virtual or in person.

## Bibliography

### BASIC BIBLIOGRAPHY

- Abbas A., W. Lichtman, R. Pober. Cellular and Molecular Immunology. 9 edition. Editorial ELSEVIER, 2018.
- Roitt, I. M. Immunology Foundations. 12th edition Panamericana Médica, 2014.
- Peakman M, Vergani D. Basic and clinical immunology. 2 edition. Editorial ELSEVIER, 2011.

### FURTHER READING

- Stites, D. P., A. I. Terr, T. G. Parslow. Basic and Clinical Immunology. 10th edition 2003. McGraw-Hill Companies.
- Stites, D. P., A. I. Terr, T. G. Parslow. Medical Immunology 10th edition 2001.
- William E. Paul. Fundamental Immunology. 7 edition. 2013. Lippincott Williams and Wilkins.
- . Nature reviews in Immunology.