

Approval date: 21/06/2022

COURSE GUIDE

**Immunology (20011A4)**

<b>Grado (Bachelor's Degree)</b>	Grado en Biología	<b>Branch</b>	Sciences
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<b>Module</b>	Biología Sanitaria	<b>Subject</b>	Inmunología
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<b>Year of study</b>	4 <sup>o</sup>	<b>Semester</b>	2 <sup>o</sup>	<b>ECTS Credits</b>	6	<b>Course type</b>	Elective course
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**PREREQUISITES AND RECOMMENDATIONS**

To have taken the subjects of Cell Biology, Genetics, Biochemistry and Animal Physiology.  
 To have adequate knowledge of English to follow the classes and understand scientific texts.

**BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)**

- General characteristics of the Immune System.
- Antigen receptors
- Nonspecific response.
- Inflammation
- Specific response.
- Immunopathology.
- Identification and collection of lymphoid organs.
- Identification of leukocyte subpopulations.
- Functional study of phagocytosis in peritoneal macrophages.
- Immuno-detection of proteins: Dot-Blotting.

**SKILLS**

**GENERAL SKILLS**

- CG01 - Organisational and planning skills
- CG02 - Teamwork
- CG03 - Applying knowledge to problem solving
- CG04 - Capacity for analysis and synthesis
- CG05 - Knowledge of a foreign language
- CG06 - Critical reasoning
- CG07 - Informatic knowledge regarding the field scope
- CG08 - Self-directed learning for continuous professional development
- CG18 - Interdisciplinary teamwork



- CG19 - Ethical commitment
- CG22 - Recognition of diversity and multiculturalism

### SUBJECT-SPECIFIC SKILLS

- CE01 - Recognise different levels of organisation in the living system.
- CE06 - Analizar y caracterizar muestras de origen humano
- CE15 - Identificar y analizar material de origen biológico y sus anomalías
- CE17 - Realizar cultivos celulares y de tejidos
- CE21 - Realizar pruebas funcionales, determinar parámetros vitales e interpretarlos
- CE23 - Realizar bioensayos
- CE24 - Analizar e interpretar el comportamiento de los seres vivos
- CE25 - Design models of biological processes
- CE56 - Entender los mecanismos de la señalización celular
- CE67 - Entender las bases de la inmunidad

### LEARNING OUTCOMES

#### Specifics of the subject

- To know the elements, cells and organs of the immune system.
- To know and understand the types of immune response and the effector and regulatory mechanisms involved in each one. mechanisms involved in each one of them.
- To know the mechanisms involved in the main diseases of the immune system.
- Immune System.
- To know the main drugs that modulate the immune response, and the role of Immunology in the research and Immunology in pharmaceutical research and development.
- To learn the basic immunological techniques used in research and diagnostic laboratories.
- research and diagnostic laboratories.
- To know the elements, cells and organs of the Immune System.
- To know and understand the types of immune response and the effector and regulatory mechanisms involved in each one. mechanisms involved in each one of them.
- To know the mechanisms involved in the main diseases of the immune system. Immune System.
- To know the main drugs that modulate the immune response and the role of Immunology in research. Immunology in research.
- To learn the basic immunological techniques used in research and diagnostic laboratories. research and diagnostic laboratories.

### PLANNED LEARNING ACTIVITIES

#### THEORY SYLLABUS

1. Introduction. General characteristics of the Immune System. Nonspecific response and specific response. Main cells and molecules. Families of molecules. Cytokines. Lymphoid organs. Hematopoiesis.
2. Innate response: Phagocytes. Macrophages and Neutrophils. Phagocyte receptors.



- Phagocytosis. Mechanisms of intracellular death of germs.
- 3. Specific receptors. Immunoglobulins. Basic structure of immunoglobulins. Classes and subclasses. Domains. Molecular basis of specificity. The B cell receptor. Functions of immunoglobulins. Fc receptors. Antibodies.
  - 4. Immunoglobulin genes. Rearrangement of genes. Isotypic and allotypic exclusion. Mechanisms of generation of antibody diversity. Secreted immunoglobulin and membrane immunoglobulin. Class switching. Regulation of transcription. Differentiation of B lymphocytes. Mechanisms of self-tolerance. Immunoglobulin synthesis and secretion.
  - 5. Major histocompatibility complex (MHC). HLA system and H-2 system. Class I and class II molecules. Peptide binding site. MHC genes. Alleles. Variability. MHC functions.
  - 6. Antigen processing and presentation. Antigen presentation associated with MHC class I molecules. Presentation of antigen associated with MHC class II molecules. II MHC Molecules . Antigen presenting cells. Other membrane molecules involved in antigen presentation. antigen presentation.
  - 7. The T-cell receptor (TCR). Classes of T lymphocytes according to their TCR. Structure of the TCR. Structure of CD3. TCR genes. Gene rearrangement. Mechanisms of diversity generation. Thymic differentiation of T cells. Development of self-tolerance.
  - 8. T cell activation and differentiation: T cell activation. Activation through CD3/TCR complex. Role of CD45 in T cell activation. Stimulation pathway through CD28. Interleukin 2. Regulatory mechanisms.
  - 9. Differentiation of Th1, Th2, Th17 and regulatory T lymphocytes, virgin T lymphocytes, effectors and memory T lymphocytes.
  - 10. Leukocyte movements. Leukocyte circulation. Adhesion molecules. Chemokines. Lymphocyte homing and recirculation. Leukocyte-endothelial cell endothelial cells. Secondary lymphoid organs: lymph nodes Stages of leukocyte-endothelial cell interaction. Arrival of leukocytes to the inflammatory focus.
  - 11. The Complement System. Alternative pathway, classical pathway and lytic pathway. Complement functions. Complement regulation mechanisms.
  - 12. Inflammation. Mediators of inflammation. Phases. Initiation of inflammation. Mast cells and Basophils. Arrival of molecules to the inflammatory focus. Cytokines: IL-1, IL-6 and Tumor necrosis factor (TNF). Regulation and repair mechanisms in inflammation.
  - 13. Specific Response I. Defense against extracellular germs. Types of B cells. Activation of B lymphocytes. Primary and secondary response. Thymus-dependent antigens. Thymus-independent antigens. Follicular dendritic cells. Defense against extracellular parasites.
  - 14. Specific response II. Defense against intracellular germs. Cytotoxic lymphocytes. Cytotoxic T cells TCR $\alpha\beta$  and TCR $\gamma\delta$ . NK cells. Stages of cytotoxicity mediated by lymphocytes. Mechanisms of lymphocyte-mediated cytotoxicity. Exocytosis of granules. Fas. TNF and Lymphotoxin. Apoptosis and necrosis. NK cell receptors. Interferons.
  - 15. Immunological tolerance. Central and peripheral tolerance. Regulatory T cells. Cytokines with regulatory function. Immunologically privileged organs.
  - 16. Regional Immunology. Mucosal immunity. Characteristics of the mucosal-associated immune system (MALT). Defenses in the digestive tract. Humoral components of the innate mucosal response. Antimicrobial proteins and peptides. Components of the specific mucosal response. Secretory IgA. Maintenance of homeostasis in mucous membranes. Skin immunity and maternal-fetal interface.
  - 17. Introduction to the pathologies of the immune system. Autoimmunity. Hypersensitivity, primary and secondary immunodeficiencies. Transplants. Tumor Immunology.

## PRACTICAL SYLLABUS

### Seminars/Workshops



1. Antibody production: monoclonal antibodies. Adaptation of monoclonal antibodies for use in humans. Monoclonal antibodies for therapeutic use. Treatment of Tumors.
2. Hypersensitivity reactions. Types of hypersensitivity. Immediate hypersensitivity mediated by IgE (Type I). Antibody-mediated hypersensitivity (Type II). Immune-complex-mediated hypersensitivity (Type III). Cellular or delayed hypersensitivity (Type IV). delayed hypersensitivity (Type IV).
3. Primary immunodeficiencies. Types. Characteristics. X-linked immunodeficiencies and X chromosome and autosomal immunodeficiencies.

#### Laboratory practicals

1. Identification of antigens in suspension cells by flow cytometry.
2. Identification of lymphoid organs and lymphocyte extraction. Phagocytosis assay of peritoneal macrophages.
3. Protein immuno-detection: dot-blotting.

### RECOMMENDED READING

#### ESSENTIAL READING

A.K. Abbas, A.H. Lichtman and S. Pillai. Cellular and Molecular Immunology, Updated Edition, 9th ed. Elsevier 2018.

Abul K. Abbas, Andrew H. Lichtman J, Shiv Pillai. Basic Immunology, 6th Edition, Elsevier 2019.

Peter Parham, The Immune system International Student Edition. 5th Edition. Norton 2021.

K. Murphy, C. Weaver, L. Berg, Janeway's Immunology 10th Edition, Norton 2022.

#### COMPLEMENTARY READING

Kenneth Murphy, & Casey T. Weaver. Janeway's Immunobiology. Garland Science. New York and London. 9th edition 2020.

Judith A. Owen, Jenni Punt, Sharon A. Stranford, Patricia P. Jones. Kuby Immunology. 8<sup>a</sup> edition. Macmillan Learning S.A. 14-2020.m

#### INTERNATIONAL JOURNAL (REVIEWS):

- Current Opinion in Immunology
- Immunology
- Immunological Reviews
- Nature Immunology
- The Journal of Immunology
- Trends in Immunology
- Immunology Today

### RECOMMENDED LEARNING RESOURCES/TOOLS



**BiteSized Immunology (English/ Spanish):** Immunology fact sheets from the British Society of Immunology.

<https://www.immunology.org/public-information/bitesized-immunology>

**Website of the Spanish Society of Immunology (SEI):** access to outreach, education and webinars:

<https://www.inmunologia.org>

**Pages with divulgation topics in Immunology:**

[http://www.cellsalive.com/toc\\_immun.htm](http://www.cellsalive.com/toc_immun.htm)

<http://www.bioinf.org.uk/abs/>

<https://www.rndsystems.com/research-area/immunology>

**National Library of Medicine, EEUU:** biomedical literature from MEDLINE, life science journals, and online books

<http://www.ncbi.nlm.nih.gov/pubmed>

**Immunology videos:**

<https://immunology.utoronto.ca/immunology-videos>

## TEACHING METHODS

- MD01 - Lección magistral/expositiva
- MD03 - Resolución de problemas y estudio de casos prácticos
- MD04 - Prácticas de laboratorio y/o clínicas y/o talleres de habilidades
- MD07 - Seminarios
- MD10 - Realización de trabajos en grupo
- MD11 - Realización de trabajos individuales

## ASSESSMENT METHODS (Instruments, criteria and percentages)

### ORDINARY EXAMINATION DIET

The final evaluation will be the weighting of the marks obtained in all activities as indicated below:

**Theory Essay, 70% of the final mark.** Multiple-choice, essay or short-question exams to assess the theoretical and practical knowledge acquired. They will account for 70% of the student's final mark. In the middle of the semester, a follow-up test will be carried out, which will allow to eliminate the evaluated topics if the mark is equal to or higher than 6.5 points (out of 10). A minimum mark of 5 (out of 10) in the final average exam mark is required for the rest of the marks to be added to this one. In the case of multiple-choice exams, each question will have 5 possible answers and for each incorrect answer a quarter of the mark corresponding to a correct answer will be subtracted.



**Practical part 30% of the final mark:**

**Practical work 10% of the final Mark.** Completion of the practical work will be compulsory in order to pass the course. The skills and competences acquired by the student will be evaluated by means of a practical work questionnaire. It will account for 10% of the final mark. The students who have passed the practical work are not obliged to repeat it in the following two years, but in this case the mark obtained is not kept. Therefore, they must retake the questionnaire to obtain the corresponding 10% of the final mark. A minimum mark of 4.5 (out of 10 points) is required to add this mark to the final one.

**Academically supervised works ,7.5% of the final mark.** The student's original work will be evaluated, taking into account the adequacy to the proposed topic, its development, methodology, results, bibliography and conclusions; as well as the ability of comprehension and the written presentation. It will represent 7,5% of the final mark.

**Seminars, 7.5% of the final mark,** A minimum mark of 5 (out of 10 points) is required to add the seminar's mark to the rest of the marks . Seminars are compulsory to obtain the continuous evaluation. In the final exam, or midterm exams, if applicable, questions on the seminars will be included. Questions about the seminars to be added to the attendance and participation grade for this participation of this activity. Seminar attendance is required to pass the course.

**Attendance (5% of the final grade).** Attendance and participation in all activities, both theoretical and practical. The attendance grade will be added to the rest of the continuous evaluation grades if the score is equal or higher than 5 out of 10 points.

**EXTRAORDINARY EXAMINATION DIET**

Students who have completed the training activities during the course may choose to take the exam only of theory (70%) and seminar questions (7.5%). The mark will be weighted with the rest of the grades obtained during the course as indicated in the ordinary exam. Only marks of 5 out of 10 will be added to the final mark.

Students may opt for the complete evaluation of the course with (The teacher must be notified in advance):

**Theory essay, 75% of the mark, and Seminar essay and commentary of a clinical case on immune pathologies proposed in the guide, 7.5% of the final mark. And a Laboratory practices essay, 10% of the final mark. Students need to deliver a monograph proposed by the professor on the day of the exam, 7.5% of the final mark.**

To add the different parts together, the students must have a minimum mark of 5 out of 10 each. For the practical part of the exam, students will have up to 1 additional hour of exam time.

Students who opt for the complete final evaluation must notify the professor in advance.

**SINGLE FINAL ASSESSMENT (evaluación única final)**

Students who opt for a Single Final Assessment will take a theoretical and practical essay of the course, including theory, seminars and laboratory practices. The exam will be preferably face-to-face, at the same time and under the same conditions as the Ordinary examination diet students.

The final mark will consist of the evaluation of:



- Theory exam, 75% of the final mark.
- Seminar exam and commentary of a clinical case on immune pathologies proposed in the guide, 7.5% of the final mark.
- Laboratory practice exam, 10% of the final mark.
- Delivery of a monograph proposed by the professor on the day of the exam, 7.5% of the final mark

To add the different parts together, the students must have a minimum mark of 5 out of 10 each.

Students with single final assessment will have up to 1 additional hour of exam time.

Students who opt for a single final evaluation must communicate this in advance to the professor in charge of the subject.

Students of single evaluation will take the exam in the ordinary or extraordinary call indicated by the Faculty of Sciences, for the Degree of Biology. Otherwise, they will be summoned 10 days in advance.

For the realization of the practical part, the students of single evaluation will have up to 1h more for the practical part.

According to Article 6.2 of the Regulations for Evaluation and Grading of Students of the UGR, the evaluation will be preferably continuous, understanding as such, the diversified evaluation that is established in this Teaching Guide of the subject. However, it is contemplated the realization of a single final assessment to those students who cannot comply with the continuous evaluation method due to work reasons, health condition, disability or any other duly justified cause, that prevents them from following the continuous evaluation system.

To take advantage of the single final evaluation, the student must request it to the Director of the Department through the UGR registry, and duly justified, in the first two weeks of the course. This single final evaluation will consist of a theoretical essay (75% of the grade) and a practical essay (25% of the grade).

## ADDITIONAL INFORMATION

In case of special incidences, due to exceptional and justified causes, that prevent the student from attending the day of the final exam, partial exam or delivery of the rest of the activities, the student must contact the professor to arrange another date for the exam. The system, criteria and weighting of the grade will be the same as previously described in this point, depending on the exam conditions of each student or type of exam. The incidence must be officially and duly justified.

Following the recommendations of the CRUE and the Secretariat of Inclusion and Diversity of the UGR, the systems of acquisition and evaluation of competences included in this teaching guide will be applied according to the principle of design for all people, facilitating the learning and demonstration of knowledge according to the needs and functional diversity of the students.

