Universitat Autònoma de Barcelona

2023/2024

# Immunology

Code: 100757
ECTS Credits: 9

| Degree | Type | Year | Semester |
|---|---|---|---|
| 2500250 Biology | OB | 3 | 2 |

## Contact

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## Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

## Teachers

Angel Raul Castaño Garcia

## Prerequisites

The student who has to study Immunology must have obtained the competences of learning in the subjects programmed by the first two courses of the Degree. It is advisable for the student to have knowledge about the structure and organization of animal organisms and their cellular systems. As well as knowledge of the structural and functional characteristics of biomolecules, the basic foundations of biochemistry, molecular biology and protein structure.

## Objectives and Contextualisation

Objectives of the subject:

At the end of the course, students must:

- Know the components of the immune system: molecules, cells and lymphoid organs.

- Understand the innate and adaptive immune response, humoral and cellular; the phases of the immune response and the regulation and homeostasis of the immune system.

- Know the communication between components of the immune system through blood and lymphatic traffic; and the anatomical location of the immune response.

- Apply the knowledge of the immune response in infections for viruses, bacteria, protozoa, helminths and fungi.

- Know the cellular and molecular immunological techniques applicable to the different biological systems.

- To know how to apply the reactions of the immune system and its specificity to the study of biomolecules, diagnosis, vaccines and immunotherapy.

- Know the basics of immunopathology.

The 9 ECTS of the subject of Immunology will be divided into three thematic blocks with specific learning competences, in addition to the laboratory practices that make up them all:

Block I. Basic immunology *(3 ECTS) 33 hours*

- Know the components of the immune system: molecules, cells and lymphoid organs.

- Know the communication between components of the immune system through blood and lymphatic traffic.

- Know the concepts of innate immunity and specific immunity.

- Identify the elements that intervene in both responses.

- List and explain the structural and functional characteristics of each molecular and cellular component of innate and adaptive immunity.

Block II. Organization of the Immune Response *(2 ECTS) 12 hours*

- Integrate the elements of the immune system in the three phases of the immune response: 1) activation phase; 2) effector phase; and 3) phase regulation and homeostasis of the immune response.

- Integrate the different phases of the immune response and its cellular components with the anatomical location of the same.

- To know the mechanisms that participate in the immune response against infections for viruses, bacteria, protozoa, helminths, fungi and tumor processes.

- Identify the evasion mechanisms used by pathogens against the immune system.

Block III. Applications of Immunology *(1 ECTS) 9 hours*

- Know the cellular and molecular immunological techniques applicable to the different biological systems.

- To know how to apply the reactions of the immune system and its specificity to the biomolecular student, the diagnosis, the vaccines and the immunotherapy.

- Know the basics of dysfunctions of the immune system that originate immunopathologies and immunodeficiencies.

- To know the mechanisms of immunopathology for excess response (hypersensitivity), by default (immunodeficiencies) or by mistake (autoimmunity).

Laboratory practices (3ECTS) 20 hours.

## Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Be able to analyse and synthesise
- Carry out functional tests and determine, assess and interpret vital parameters.
- Describe and identify the levels of organisation of living beings.
- Design and carry out biodiagnoses and identify and use bioindicators.
- Isolate, culture and modify microorganisms and cells and tissues of multicellular organisms.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Obtain information, design experiments and interpret biological results.
- Perform genetic analyses.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Understand heredity mechanisms and the fundamentals of genetic improvement.
- Understand the processes that determine the functioning of living beings in each of their levels of organisation.
- Work in teams.

## Learning Outcomes

1. Analyse a situation and identify its points for improvement.
2. Analyse the reordering of specific receptors in lymphocytes.
3. Analyse the sex- or gender-based inequalities and the gender biases present in one's own area of knowledge.
4. Be able to analyse and synthesise.
5. Critically analyse the principles, values and procedures that govern the exercise of the profession.
6. Design and perform immune-system molecular and cellular experiments, both on basic aspects and on applications to infectious or immune-system diseases, and interpret the findings.
7. Explain the genetic mechanisms of the generation of diversity of the specific antigen receptors and the fundamental principles behind selection and improvement in the immune response.
8. Extract, isolate, analyse and culture organs and cell components of the immune system.
9. Identify and use cell markers in the identification and functional analysis of immune-system cells.
10. Identify the levels of organisation of the immune system of living beings.
11. Interpret the functioning of the immune system and the interrelations between the different levels of organisation.
12. Perform cell trials and basic studies of the immune response.
13. Propose new methods or well-founded alternative solutions.

14. Propose projects and actions that incorporate the gender perspective.
15. Relate the different components of the immune system to the rest of the organism.
16. Relate the functioning of the immune system to the other components of the organism, and explain its bidirectional influence.
17. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
18. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
19. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
20. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
21. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
22. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
23. Work in teams.

## Content

Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents

Block I. Basic immunology: elements of the Immune System (3 ECTS)

Introduction

ISSUE 1 and 2: Introduction: general view of the immune system. Basic concepts.

ISSUE 3 and 4: Introduction: general organization of the immune response.

Innate immunity

ISSUE 5: Anatomy: organs and tissues.

ISSUE 6: Innate Immunity: Molecules.

ISSUE 7: Innate cells: macrophages, neutrophils, mast cells.

ISSUE 8: Antigen Presenting Cells and others cells of the innate response.

ISSUE 9: The Complement System.

Acquired immunity - Antigen-specific cells and receptors and antigen recognition

ISSUE 10: Structure of immunoglobulins and antigen receptor of B cells (BCR).

ISSUE 11: Organization and rearrangement of immunoglobulin genes.

ISSUE 12: Antigen-antibody interaction.

ISSUE 13: B lymphocytes: Selection in the bone marrow and subpopulations of B cells.

ISSUE 14: Main Histocompatibility Complex (MHC): structure and function.

ISSUE 15: Main Histocompatibility Complex (MHC): genetic organization.

ISSUE 16: Antigenic processing and presentation.

ISSUE 17: T cell antigen receptor (TCR): structure and genetics.

ISSUE 18: T lymphocytes: Thymic selection.

ISSUE 19: T lymphocytes II: subpopulations of T lymphocytes and functions.

ISSUE 20: Citocines.

ISSUE 21: Chemokines and adhesion molecules.

Block II. Organization of the Immune Response (2 ECTS)

Organization of the immune response

ISSUE 22: Lymphocyte traffic and recirculation of lymphocytes: concept of homing.

ISSUE 23: Humoral immune response.

ISSUE 24: Cellular immune response.

ISSUE 25: Regulation of the immune response.

ISSUE 26: Immune Tolerance.

Immune response in front of pathogens and evasion mechanisms

ISSUE 27: Immune response against bacteria.

ISSUE 28: Immune response against fungi and parasites.

ISSUE 29: Immune response against viruses.

ISSUE 30: Antitumour immunity.

ISSUE 31: Transplant.

Block III. Applications of Immunology (1 ECTS)

ISSUE 32: Primary immunodeficiencies.

ISSUE 33: Secondary immunodeficiencies.

ISSUE 34: Immunopathology associated with the immune response: hypersensitivity I.

ISSUE 35: Immunopathology associated with the immune response: hypersensitivity II-IV.

ISSUE 36: Autoimmunity.

ISSUE 37: Immunotherapy. Vaccines

## Methodology

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities

The group for the lectures (theory) will be the total number of students enrolled.

For the classroom practices (seminars), there will be two groups, each with half of the students enrolled.

Classroom practices will be taught in 10 hours (10 hours for each of the two groups) in which various topics, cases or articles will be presented and discussed.

Expositive Classes:

The different subjects of the program will be taught in 36 hours. During the course, and within the exhibit classes, up to 3 seminars will be included that will be taught by experts in each subject.

Classroom practices (seminars):

Work will be scheduled for groups of 4-5 students, who will prepare them cooperatively. Some of them will be tracking topics that have emerged from the news of the daily press or the scientific press related to Immunology. Others will be subjects or clinical cases that teachers will prepare so that the students can develop their work. The information about each work and the application guidelines will be stored on the Virtual Campus (CV). Each group will prepare the oral presentation of their work based on a power point presentation (or similar). There is no written presentation of the work. Each session of classroom practices (1h) will present 1 work (30-40 min of exposure + 10-15 min of questions / discussion). The teacher and the rest of students will ask questions about aspects of the subject presented. The final presentation (in PDF format) will have to be saved by the students in the CV before the day of the presentation.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Activities

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Classroom practices | 10 | 0.4 | 6, 7, 10, 9, 11, 16, 15, 4, 23 |
| Expositive classes (theory) | 36 | 1.44 | 6, 7, 10, 9, 11, 16, 15, 4 |
| Laboratory practices | 20 | 0.8 | 2, 6, 8, 12, 9, 23 |
| Type: Supervised | | | |
| Oral presentation of a subject (seminar) | 10 | 0.4 | 6, 7, 10, 11, 16, 15, 4 |
| Type: Autonomous | | | |
| Preparation, presentation and discussion of seminars and cases | 20 | 0.8 | 2, 6, 7, 10, 9, 11, 16, 15, 4, 23 |
| Problems resolution | 8 | 0.32 | 6, 9, 11, 16, 4, 23 |

| | | | |
|---|---|---|---|
| Reading of texts | 12 | 0.48 | 7, 10, 9, 11, 16, 15, 4 |
| Realization of the laboratory notebook | 8 | 0.32 | 6, 12, 9, 4 |
| Study | 94 | 3.76 | 2, 6, 7, 10, 9, 11, 16, 15, 4 |

## Assessment

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities

The evaluation of the subject will be individual and continued through the following tests:

Partial examinations: two partial exams, at the end of Blocs I and IV (approximately). Each test will be worth 35% of the final mark. They will be test type questions with 5 options to choose one. In the correction, 1/5 of the value of each question will be subtracted by incorrect answer. The duration of each test will be of a maximum of 2 hours. The subject may be approved by partial, provided that the average between the two tests is 5, taking into account that the average can only be done with a minimum grade of 4 in one of the partial ones.

Classroom and laboratory practices (seminars): The seminars and laboratory activities help the development of the self-learning, synthesis and written and oral communication skills of the students. The assessment will represent 30% of the final mark of the subject and the content of the work, the oral presentation, the answer to questions and the participation in the discussion will be valued. It is mandatory to attend to classroom seminars and practical lab activities. Students will obtain the "Non-Valuable" qualification when the absence exceeds 20% of the programmed sessions.

Final Exam: A final exam will be scheduled for students who have not achieved the minimum necessary or who want to raise the mark. The two partials can be recovered separately or one of the two. The final exam will have a value of 70% of the subject that will add the percentage of note of the work of the seminars.

To participate in the recovery, the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject or module.

Final evaluation:

1) Students who have obtained a minimum of 5 (out of 10) in each of the partial, will have 70% of the grade. The students must reach a minimum of 4 to each partial to be able to compensate the note with the other partial, provided that the final result is $\geq$5.

2) 30% of the mark corresponds to the evaluation of the presented works and laboratory practices.

3) Students who have not passed the two partial examinations can do the final exam. The assessment of this final exam will be by partial and will count 70% of the total mark (one or two partial tests can be done in the same exam). The note of the seminars (30%) will be added to this note.

4) The same calculation will be done by students who want to raise notes. If you choose to upload a note, the original note is not saved.

5) Non-submission to any of the tests must be justified.

UNIQUE ASSESSMENT

Those students who request it at the beginning of the year may take as a single assessment an examination of the total theoretical content of the subject at the time the second part is assessed. The grade of this single exam will count for 70% of the grade of the subject. This will be complemented with the marks from the laboratory practices and the classroom seminars that are mandatory for all students.

## Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Classroom and laboratory practices (presentation, content and discussion) | 30% | 0 | 0 | 22, 5, 2, 3, 1, 6, 7, 8, 12, 10, 9, 11, 13, 14, 21, 19, 17, 18, 16, 15, 4, 23 |
| Final exam (recuperation ) | 70% | 3 | 0.12 | 2, 6, 7, 10, 9, 11, 21, 20, 16, 15, 4 |
| Partial exam, part 1 | 35% | 2 | 0.08 | 7, 10, 11, 21, 20, 15 |
| Partial exam, part 2 | 35% | 2 | 0.08 | 2, 6, 7, 9, 21, 20, 16, 4 |

## Bibliography


English books:

Janeway's Immunobiology by K Murphy, C. Weaver. Ltd/Garland Science, NY & London, 9th ed., (2017).

Kuby Immunology by Judy Owen , Jenni Punt , Sharon Stranford. W.H. Freeman Co., 7 th ed, (2012).

Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders, 9 th ed, (2017).

Roitt's Essential Immunology, Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt 9 th Edition Elsevier Ed. (2017).

Spanish books:

Inmunobiología: El sistema inmunitario en condiciones de salud y enfermedad de C. Janeway Jr., P. Travers, L. Walport, M. J. Shlomchik. 4ª edición. Editorial Masson, S.A. Barcelona, (2003).

Inmunología Celular y Molecular de A.Abbas, W. Lichtman, R. Pober. W. B. Saunders Co., Philadelphia, 5ª edición, (2004).

Introducción a la Inmunología Humana de L. Faimboim, J. Geffner. Ed Medica Panamericana, 5ª edición (2005).

Kuby Immunology (en español) by T.J. Kindt, R.A. Goldsby, B.A. Osborne. W.H. Freeman Co., 6 th ed, (2007).

Fundamentos de Inmunología de Roitt, I. M. Panamericana, 10ª ed. (2003).

Inmunología de I. Roitt, J. Brostoff, D. Male. Hartcourt Brace, 5ª ed. (2003).

Introducción a la Inmunología humana L. Fainboim, J. Geffner. 5ª ed. Editorial Médica Panamericana. Buenos Aires 2005.

Inmunología de P. Parham. Ed. Panamericana, 2ª ed. (2006).

Relevant reviews:

Advances in Immunology: https://www.sciencedirect.com/bookseries/advances-in-immunology

Annual Review of Immunology: https://www.annualreviews.org/loi/immunol

Current Opinion in Immunology: https://www.sciencedirect.com/journal/current-opinion-in-immunology

Immunological Reviews: http://www3.interscience.wiley.com/journal/118503650/home

Nature Reviews in Immunology: http://www.nature.com/nri/index.html

Seminars in Immunology: https://www.journals.elsevier.com/seminars-in-immunology/

Trends in Immunology: http://www.cell.com/trends/immunology/

Internet resources:

Inmunología en un mordisco: http://inmunologia.eu/

Sociedad Española de Inmunología: http://www.inmunologia.org/

Revista Inmunología: http://www.inmunologia.org/revista/home.php

Immunobiology by C. A. Janeway, P. Travers, M. Walport and M. Shlomchik. Garland Science 2001: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=imm

Roitt's Essential Immunology, by Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt. Wiley-Blackwell Ed., 11 th ed., (2006): http://www.roitt.com/

Microbiology and Immunology On line. School of Medicine, University of South Carolina: http://pathmicro.med.sc.edu/book/welcome.htm

Faculty of Medicine, Dalhouse University (Halifax, Nova Scotia, Canada): http://immunology.medicine.dal.ca/bookcase/

The Infectious Diseases WebLink: http://webpages.charter.net/deziel/

Departament of Molecular and Cellular Biology, Harvard University: http://mcb.harvard.edu/BioLinks/Immunology.html

Biology Animations: http://biology-animations.blogspot.com/

Introduction Immune System: http://www.biology.arizona.edu/immunology/tutorials/immunology/main.html

Janeway's animations: http://www.blink.biz/immunoanimations/

Davison College (Immunology course, Molecular Movies): http://www.bio.davidson.edu/courses/Immunology/Bio307.html

## Software

Softwares used for data analysis include: excell and CytoExpert