Immunology

Code: 101932
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biomedical Sciences	OB	2

Contact

Name: Maria Merce Marti Ripoll

Email: merce.marti@uab.cat

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

To enroll in this subject, students must have obtained the basic knowledge of Biochemistry, Molecular Biology and Cell Biology of the subjects that have completed the first year of the Degree

Objectives and Contextualisation

Objectives of the subject:

At the end of the course, students will have to:

- Identify the components of the immune system: molecules, cells, and lymphoid organs.
- Explain the innate and adaptive immune response, both humoral and cellular; the phases of the immune response, and the regulation and homeostasis of the immune system.
- Describe the communication between components of the immune system through blood and lymphatic traffic; and the anatomical location of the immune response.
- Apply knowledge of the immune response in infections caused by viruses, bacteria, protozoa, helminths, and fungi.
- Demonstrate proficiency in cellular and molecular immunological techniques applicable to different biological systems.
- Evaluate how to utilize immune system reactions and specificity in the study of biomolecules, diagnosis, vaccines, and immunotherapy.
- Summarize the basics of immunopathology.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Display knowledge of the bases and elements applicable to the development and validation of diagnostic and therapeutic techniques.
- Display knowledge of the basic life processes on several levels of organisation: molecular, cellular, tissues, organs, individual and populations.

- Display knowledge of the concepts and language of biomedical sciences in order to follow biomedical literature correctly.
- Display theoretical and practical knowledge of the major molecular and cellular bases of human and animal pathologies.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- 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.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Analyse the relationship between the nature of the immune response and the molecular and physical characteristics of the antigens that induce it.
3. Define the properties of the adaptive immune response that distinguish it from the innate response. Understand the clonal distribution of the antigen receptors of lymphocytes and the theory of clonal selection.
4. Describe the most important groups of pathogenic microorganisms .
5. Describe the principal mechanisms by which the immune system participates in pathology: immunodeficiencies, hypersensitivity, autoimmunity.
6. Describe the theoretical principles of immunological techniques.
7. Display practical skills in performing a diagnostic analysis in immunopathology.
8. Display practical skills in using the technologies applicable to experimentation in immunology.
9. Explain the mechanisms of activation and regulation of the cellular and humoral immune response and their link to immunopathology.
10. Explain the relationships between a possible pathogen and its host.
11. Identify the principal elements intervening in the immune response to infections and tumours, and in the situation of allogeneic transplant.
12. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
13. Recognise the role of microorganisms as agents of disease or toxicological problems in human beings, animals and plants.
14. Reproduce a general vision of the modes of intervention in the immune response, that is, the principles of immunotherapy.
15. 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.
16. 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.
17. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.

18. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
19. 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.
20. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
21. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
22. Understand scientific texts and write review papers on immunology and biology.
23. Understand the scientific literature and the databases specialising in problems of immunology and immunopathology, and interpret the results of a scientific project.
24. Understand the structure and function of the immune system on the scale of molecules, cells, tissues and organs.
25. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

Course Contents

Block I. Basic Immunology (2 ECTS)

Block II. Organization of the Immune Response (2.5 ECTS)

Block III. Introduction to Immunopathology (0.5 ECTS)

Block IV. Applications of Immunology (1 ECTS)

Block I. Basic Immunology: Elements of the Immune System

Introduction: Overview of the Immune System

TOPIC 1. Basic Concepts of the Immune System. Brief introduction to the course: description of the syllabus, recommended bibliography, study tips, evaluation. What is Immunology?

TOPIC 2. Components and Actions of the Immune Response. Elements of the immune system: organs, cells, and molecules. Definition of innate or natural immunity and acquired or adaptive immunity. Concept of immune response: humoral and cellular responses. Concept of antigenic clonality.

Innate Immunity

TOPIC 3. Innate Immunity: Immediate and Induced. Definition. Natural resistance mechanisms. External defense system, physical and chemical barriers. Danger signals. Pathogen-associated molecular patterns (PAMPs). Pattern recognition receptors (PRRs). Cells of innate immunity: phagocytes.

TOPIC 4. The Complement System. Definition. Enzymatic cascade activation system. Nomenclature. Hydrolysis products. Pathways of complement activation: classical pathway, alternative pathway, and lectin pathway. Regulation of the complement system. Biological activity.

TOPIC 5. Cells of the Innate Immune Response. Phagocytes: neutrophils and macrophages. Effector mechanisms: respiratory burst and phagocytosis. Other effector cells: basophils and eosinophils, mast cells. Inflammatory focus. Introduction to the knowledge of NK cells and innate lymphoid cells.

Adaptive Immunity - Specific Antigen Receptors and Antigen Recognition

TOPIC 6. B Cell Antigen Receptor (BCR): Structure of Immunoglobulins. Light chains (VL-CL) and heavy chains (VH-CH). Antigen binding site, hinge region, biological activity of the Fc region. Variable (V) and constant (C) domains. Variable domains: hypervariable region (CDRs). Isotypes: classes and subclasses of Igs. BCR as a membrane antigen receptor.

TOPIC 7. Reorganization of Immunoglobulin Genes. Genes encoding light (L) and heavy (H) chains. Recombination of variable region gene segments: V-D-J in the heavy chain (H); V-J in the light chain (L). Mechanism of somatic recombination. Generation of immunoglobulin repertoire diversity.

TOPIC 8. T Cell Antigen Receptor (TCR): Structure and Genetics. T Cell Receptor (TCR): structural characteristics, gene organization. CD3 complex: TCR signaling complex. Trimolecular interaction TCR/MHC/antigen. Epitopes recognized by TCR.

TOPIC 9. Major Histocompatibility Complex (MHC): Synthesis, Structure, and Function of MHC. Definition of the Major Histocompatibility Complex (MHC): class I and class II. Structural characteristics. Function of MHC. Proteins encoded in the MHC. Characteristics of antigenic peptides that bind to class I and class II MHC molecules. Polymorphism and peptide binding. Antigen processing and biosynthesis of class I and class II MHC molecules.

TOPIC 10. Genetics of the Major Histocompatibility Complex. Genetic organization of the MHC (HLA in humans). Location in the genome. Description of the class I region. "Classical" class I loci: HLA-A, B, C. Characteristics of class I genes. Description of the class II region: HLA-DP, HLA-DQ, and HLA-DR. HLA-DM. Description of the class III region. Properties of the MHC: polymorphism, polygeny, and codominance. HLA and disease.

Cells of the Adaptive Immune System

TOPIC 11. Antigen-Presenting Cells: Dendritic Cells. Hematopoiesis and generation of cellular subtypes. Macrophages as APCs. Activation pathways. Macrophage subtypes. Dendritic Cells: professional APCs. Types of dendritic cells: conventional and plasmacytoid.

TOPIC 12. T Lymphocytes: Thymic Selection and T Lymphocyte Subpopulations. Ontogeny and maturation of T lymphocytes. Thymic selection: positive selection and negative selection. Essential properties: MHC restriction and self-tolerance. T lymphocyte populations: TCR. Functional subpopulations: helper T cells (Th), cytotoxic T cells (Tc), regulatory T lymphocytes, and NKT cells. Memory T lymphocytes.

TOPIC 13. B Lymphocytes: Bone Marrow Selection and B Lymphocyte Subpopulations. Ontogeny and maturation of B lymphocytes. Types of lymphocytes. Phenotypic and functional differences of lymphocytes. Effector function of B lymphocytes: antibody production and antigen presentation (APC). B lymphocyte subpopulations: B-1 and B-2 lymphocytes.

TOPIC 14. Cytokines and Chemokines. Cytokines: definition, general characteristics, and function. Families of cytokine receptors: structure and function. Chemokines: structure and function. Types of cytokine and chemokine receptors.

TOPIC 15. Lymphocyte Recirculation. Homing Concept. Costimulatory molecules. Adhesion molecules. Lymphocyte recirculation through the lymphatic and blood circulation. Leukocyte trafficking: rolling, activation, adhesion, and transvasation. Involved molecular families: selectins, molecules of the immunoglobulin superfamily, and integrins. Definition of the lymphocyte homing concept in lymphoid organs.

Block II. Organization of the Immune Response

Organization of the Immune Response

TOPIC 16. Organization of Immune System Organs. Description of the structure of primary lymphoid organs. Classification of secondary lymphoid organs (SLOs): lymph nodes, spleen, MALT. Anatomical and functional characteristics of the different morphological areas of SLOs.

TOPIC 17. Cellular Immune Response. Activation of T cells: first, second, and third signals. Role of CD4 and CD8 coreceptors. Description of the signaling pathway and activation of transcription factors NFkB, NFAT, and AP-1. Definition of the immunological synapse. Types of effector T cells and lineage transcription factors. Effector mechanisms of helper T cells and cytotoxic T cells.

TOPIC 18. Humoral Immune Response. T-dependent and T-independent antigens. Activation of B lymphocytes: first and second signals. T-B collaboration. Germinal center generation. Follicular helper T lymphocytes. B response maturation: somatic hypermutation, affinity maturation, and isotype switching. Effector role of immunoglobulins. Memory B lymphocytes.

TOPIC 19. Regulation of the Immune Response. Definition of peripheral tolerance and comparison with central tolerance mechanisms. Main regulatory mechanisms of the immune response: second signals, apoptosis induction mechanisms, regulatory cytokines, inhibitory receptors (ITIM motifs). Regulatory Tregs and Bregs lymphocytes. Immune response against pathogens and evasion mechanisms.

TOPIC 20. Immune Response Against Bacteria. Bacterial entry pathways. Role of conventional dendritic cells. Effector immune response against extracellular and intracellular bacteria. Evasion mechanisms.

TOPIC 21. Immune Response Against Fungi and Parasites. Characteristics of fungal infections. Elements directing the effector immune response against fungi, helminths, and protozoa. Evasion mechanisms.

TOPIC 22. Immune Response Against Viruses. Characteristics of viral infections: cellular tropism. Plasmacytoid dendritic cells. Immune response against viruses. Evasion mechanisms.

Block III. Introduction to Immunopathology

TOPIC 23. Hypersensitivity. Definition, mechanisms of hypersensitivity types I, II, III, and IV. Examples of diseases associated with hypersensitivity reactions.

TOPIC 24. Autoimmunity. Definition, mechanisms related to the breakdown of tolerance and the development of systemic and organ-specific autoimmune diseases. Examples.

TOPIC 25. Immunodeficiencies. Definition. Congenital and secondary immunodeficiencies. Classification and diseases according to different severity levels.

*TOPIC 26. Vaccines. Immunotherapy.*Methods of intervention on the immune response. Passive immunization. Non-specific active immunization. Vaccines: definition and importance in public health. Introduction to immunotherapy.

Block IV. Experimental Application of Immunology

Experimental Techniques Related to Immunology and Their Application

Antigen-antibody reaction. Design of primary and secondary antibody labeling. Tissue section staining by immunohistochemistry (IHC), immunofluorescence (IF). Staining of cell suspensions and analysis by flow cytometry. Description of experimental techniques to define T cell functionality. Cytokine determination: ELISA in plate, ELISpot, intracellular staining. Proliferation and cytotoxicity assays. Determination of monoclonal expansions: CDR3 sequencing.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	29	1.16	2, 23, 24, 3, 4, 5, 6, 9, 10, 11, 13, 14

Seminars and problem based learning	14	0.56	25
Type: Autonomous			
Autonomous study	57	2.28	23
Interpretation of experimental data	15	0.6	23, 8, 25
Preparation of work in cooperative learning format	25	1	8, 17, 25

The program topics will teach 29 theoretical teaching sessions.

Classroom practices (PAUL) two activities will be carried out to reinforce the theoretical contents and provide tools to understand the scientific articles related to the subject. Transversal skills such as searching for bibliography, presenting in public, and writing a document following the scientific method will also be worked on.

The contents of block IV "Experimental Application of Immunology" will be carried out in PAUL sessions in which the most used experimental techniques in immunology will be explained and experiments will be presented to discuss in class.

The cooperative learning work is scheduled throughout the course and will be carried out in groups of 3 or 4 students. Information about each activity and the application guidelines will be stored on the UAB Virtual Campus (Moodle). Students may raise their questions during tutoring sessions with the instructor. Specifically, the proposed activities will consist of:

- Answering a short-answer questionnaire on the immunology techniques covered in class.
- Problem-based learning: a theoretical presentation of a scientific article related to the topics covered in the lectures, with strong emphasis on the writing of the objectives, the materials and methods used by the article's authors, and the results obtained.
- Project-based learning: design of a research project.

In this course, the use of Artificial Intelligence (AI) technologies is allowed as part of the development of the work, provided that the final result reflects a significant contribution by the student in terms of personal analysis and reflection. The student must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these tools influenced the process and the final outcome of the activity. Lack of transparency in the use of AI will be considered academic dishonesty and may result in a grade penalty for the activity, or more serious sanctions in severe cases.

Note: 15 minutes of one class session will be reserved, according to the schedule established by the school/degree program, for students to complete the evaluations of the teaching staff and the subject/module

.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

Cooperative learning (group work)	30%	2	0.08	1, 21, 20, 2, 23, 24, 22, 3, 7, 8, 5, 6, 9, 10, 12, 19, 18, 17, 15, 16, 13, 25
Final exam	Test 1 35% / Test 2 35%	3	0.12	2, 23, 24, 22, 3, 7, 8, 4, 5, 6, 9, 10, 11, 13, 14
Test 1	35%	2.5	0.1	2, 23, 24, 22, 3, 7, 8, 6
Test 2	35%	2.5	0.1	23, 22, 7, 8, 4, 5, 9, 10, 11, 13, 14

Continuous Evaluation allows the student to assess their learning progress and provides time for improvement during the course.

TEACHING ACTIVITIES

Partial Exams: Partial 1 accounts for 35% and Partial 2 for 35% of the final grade. These will be multiple-choice exams with 5 options to choose from. For each incorrect answer, 1/5 of the value of the question will be deducted. The student must answer 70% of the exam questions to be evaluated. Each test will have a maximum duration of 2 hours.

Final Exam: A final exam will be scheduled for students who have not reached the minimum required grade or who wish to improve their grade. It is possible to retake the partial exam that was not passed, or both partials if neither was passed.

Cooperative Learning consists of three activities: group activities represent 30% of the course. Cooperative learning (CA) fosters peer collaboration, development of self-learning, synthesis, and written and oral communication skills among students.
1. Problems on Experimental Techniques (TE): This part of the course will be assessed with 10%. It involves a questionnaire with problems related to experimental techniques in immunology.
2. Problem-Based Learning (PBL): This evaluation will represent 10% of the final grade. The activity is based on the presentation of a research article.
3. Project-Based Learning (ABPrj): This evaluation will represent 10% of the final grade. The activity is based on designing a research project based on a given hypothesis.
Attendance at the PAULs must be at least 80%, and a sign-in sheet will be passed around during the session to ensure this.

CONTINUOUS EVALUATION

There are two components in the evaluation of the course: individual work and cooperative work. The final grade is based on achieving a minimum of 5/10 in each part.

1.Individual Work: Evaluated through two partial exams that can be averaged to reach 5/10, provided that the grade in one of them is above 4/10. If neither exam meets the required passing grade, students can retake the partial exams. If both partials are failed, the student must take the final exam.
2. Cooperative Work: Students must achieve a minimum of 5/10 across all grades from the cooperative learning activities.

To pass the subject, each of the two modules must be passed with a minimum grade of 5.0 in the same academic year. In this case, the final grade will be the average of the grades obtained in each of the two modules of the subject. In the event of not passing any of the modules, the maximum grade obtained will be 4.8.

UNIQUE ASSESSMENT

The unique assessment consists of a single synthesis test covering the entire theoretical program, weighted at 70%, and PAULs and transversal skills at 30%, such as writing objectives. The grade from this synthesis test will be 100% of the final grade for the course. The teacher must be notified of the intention to take the unique

assessment before the first partial exam.
The unique assessment test will be held on the same date set in the calendar for the last continuous assessment test, and the same make-up system will apply.

Failure to appear for any of the tests must be justified. The reason must be significant enough to reschedule the exam. Specific justification must be submitted to the teacher as soon as possible.

A student who does not appear for any exam will be classified as NON-ASSESSABLE.

Bibliography

TEXT BOOKS:

- Kuby Immunology by J Owen, J Punt, S Stranford, P. Jones. Mc Graw Hill, 8th Edition (2018). ISBN: 978-1319114701
- Janeway's Immunobiology by K. Murphy, C. Weaver, L.J. Berg. Norton & Company; 10th ed (2022). ISBN: 978-0393884913
- Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Elsevier 10th ed (2021). eBook ISBN: 9780323757508
- Basic Immunology de A.Abbas, A. H. Lichtman, S. Pillai. Elsevier, 6th ed, (2019) eBook ISBN: 9780323639095
- The immune systemby P. Parham. Ltd/Garland Science, NY & London, 5th ed (2021). ISBN-13: 978-0393533378
- Roitt's Essential Immunology by Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt, Wiley-Blackwell Ed., 13th ed (2017) ISBN: 978-1-118-41577-1

Software

No more software is needed than the Office 365 available from UAB.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	521	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	522	Catalan	second semester	morning-mixed
(TE) Theory	52	Catalan	second semester	afternoon