Universitat Autònoma de Barcelona

2023/2024

Immunology

Code: 100869
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OB	3	1

Contact

Name: Maria Merce Marti Ripoll

Email: merce.marti@uab.cat

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.

Prerequisites

The student who must take the studies of Immunology must have achieved the learning competences in the subjects of Biochemistry I and II, Molecular Biology, Cell Biology, programmed for the first and second years of the Degree.

Objectives and Contextualisation

OBJEBTIVES

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

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

- To 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.

- To know the communication between components of the immune system through blood and lymphatic traffic, and the anatomical location of the immune response.

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

- To 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.

- To know the basics of immunopathology.

The 6 ECTS of the subject of Immunology will be divided into two thematic blocks with specific learning competences.

Block I. Basic immunology (3 ECTS)

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

- To know the concepts of innate immunity and specific immunity.

- To identify the elements that intervene in both responses.

- To enumerate 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 and its application (3 ECTS)

- To 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.

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

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

- To 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.

- To know the basics of dysfunctions of the immune system that originate immunopathologies.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Collaborate with other work colleagues.
- Combine research and and the generation of knowledge with problem-solving in one's own field, showing sensibility to ethical and social questions.
- Define the structure and function of proteins and describe the biochemical and molecular bases of their folding, intracellular traffic, post-translational modification and replacement.
- Demonstrate understanding of the components of the immune system, their structure and function and their mechanisms of action.
- Design experiments and understand the limitations of experimental approaches.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Make an oral, written and visual presentation of one's work to a professional or non-professional audience in English and understand the language and proposals of other specialists.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and one's own language.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take responsibility for one's own learning after receiving general instructions.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

- Think in an integrated manner and approach problems from different perspectives.
- Understand the language and proposals of other specialists.

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. Collaborate with other work colleagues.
4. Combine research and and the generation of knowledge with problem-solving in one's own field, showing sensibility to ethical and social questions.
5. Define the properties of adaptive immune response and how it differs from innate response.
6. Describe the activation pathways of the receptors of the immune system and the intracellular and extracellular intermediaries involved in these pathways.
7. Describe the clonal distribution of lymphocyte antigen receptors and justify the theory of clonal selection: one lymphocyte, one receptor.
8. Describe the theoretical principles of immunological techniques.
9. Design experiments and understand the limitations of experimental approaches.
10. Explain the mechanisms of activation and regulation of cellular and humoral immune response.
11. Explain the processes of diversity generation in the clone receptors of the immune system.
12. Identify and analyse the proteins involved in the principal functions of the immune system: innate response, antigen presentation, antigen elimination, response regulation.
13. Interpret experimental results and identify consistent and inconsistent elements.
14. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
15. Make an oral, written and visual presentation of one's work to a professional or non-professional audience in English and understand the language and proposals of other specialists.
16. Manage information and the organisation and planning of work.
17. Read specialised texts both in English and one's own language.
18. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
19. Take responsibility for one's own learning after receiving general instructions.
20. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
21. Think in an integrated manner and approach problems from different perspectives.
22. Understand the language and proposals of other specialists.

Content

Course contents

Block I. Basic immunology (3 ECTS)

Block II. Organization of the Immune Response and its application (3 ECTS)

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

Introduction

UNIT 1: Introduction I. Organization of the subject. Overview of the immune system. Basic concepts

UNIT 2: Introduction II. Overview of the immune system. Innate and specific response: cellular and molecular components

UNIT 3: Anatomy. Description of the structure of the primary lymphoid organs. Secondary lymphoid organ class (OLS): lymph nodes, spleen, MALT. Anatomical and functional characteristics of the different morphological areas of the OLS.

Innate immunity

UNIT 4: Innate immunity. Definition. Natural resistance mechanisms. External defense system, physical and chemical barriers. Danger signs. Pathogen-associated molecular patterns (PAMPS). Pattern recognition receptors (PRR). Innate immunity cells: phagocytes.

UNIT 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. Focus of inflammation.

UNIT 6: The Complement System. Definition. Cascade activation enzymatic system. Nomenclature. Hydrolysis products. Complement activation pathways: classical pathway, alternative pathway, and lectin pathway. Regulation of the complement system. biological activity.

Acquired Immunity - Cells and Antigen-Specific Receptors and Antigen Recognition

UNIT 7: Structure of immunoglobulins and B-cell antigen receptor (BCR). 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 membrane antigen receptor.

UNIT 8: Organization and rearrangement of immunoglobulin genes. Nada encoding the light (L) and heavy (H) chains. Recombination of variable region gene segments: V-D-J in the heavy (H) chain; V-J in the light chain (L). Somatic recombination mechanism. Generation of diversity of the immunoglobulin repertoire.

UNIT 9: Antigen-antibody interaction. Generation of monoclonal antibodies. What is an immunogen. Generation of monoclonal antibodies.

UNIT 10: B lymphocytes: Selection in the bone spring and subpopulations of B lymphocytes. Ontogeny and maturation of B lymphocytes. Type of lymphocytes. Phenotypic and functional differences of lymphocytes.

UNIT 11: Main Histocompatibility Complex (MHC): synthesis, structure and function of the MHC. Definition of the Major Histocompatibility Complex (MHC): class I and class II. Structural features. MHC function. Proteins encoded in the MHC. Characteristics of antigenic peptides that bind to MHC class I and class II molecules. Antigen processing and biosynthesis of MHC class I and class II molecules.

UNIT 12: Genetics of the Main Histocompatibility Complex. Genetic organization of the MHC (HLA in humans). Location in the genome. Description of the class I region. "Classic" 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. MHC properties: polymorphism, polygenicity and codominance. HLA and disease.

UNIT 13: T cell antigen receptor (TCR): structure and genetics. T lymphocyte receptor (TCR): structural characteristics, gene organization. CD3 complex: TCR signaling complex. Trimolecular TCR/MHC/antigen interaction. Epitopes recognized by the TCR.

UNIT 14: T lymphocytes: thymic selection and subpopulations of T lymphocytes. Ontogeny and maturation of T lymphocytes. Thymic selection: positive selection and negative selection. Essential properties: MHC restriction and tolerance to self antigens. T lymphocyte populations: TCR. Functional subpopulations: helper T cells (Th), cytotoxic T cells (Tc), regulatory T lymphocytes, and T cells.

Block II. Organization of the Immune Response. Immunopathology (3 ECTS)

Organization of the Adaptive Immune Response

UNIT 15: Cytokines and chemokines. Cytokines: definition, general characteristics and function. Families of cytokine receptors: structure and function. Chemokines: structure and function. Type of receivers.

UNIT 16: Chemokines and Adhesion Molecules. The recirculation of lymphocytes through the lymphatic and blood circulation.

UNIT 17: Lymphocyte traffic and recirculation of lymphocytes: homing. Leukocyte traffic: rolling, activation, adhesion. and transfer. Molecular families involved: Selectins, molecules of the immunoglobulin superfamily and integrins. Definition of the concept of homing of lymphocytes in lymphoid organs.

UNIT 18: Cellular immune response. Activation of T cells: first, second and third signal. Role of CD4 and CD8 coreceptors. Description of the signaling pathway and activation of the transcription factors NFkB, NFAT and AP-1. Definition of the immunological synapse. Type of effector T cells and cell lineage transcription factors. Effector mechanisms of Thelper cells and cytotoxic T cells.

UNIT 19: Humoral immune response. T dependent and T independent antigens. Activation of B lymphocytes: first and second signal. Collaboration T-B. Generation of the germinal center. Follicular helper T lymphocytes. B response maturation: somatic hypermutation, affinity maturation, and isotypeswitching. Effector role of immunoglobulins. Memory B lymphocytes.

UNIT 20: Regulation of the immune response: tolerance. Definition of the concept of peripheral tolerance and comparison with the mechanisms of central tolerance. Main regulatory mechanisms of the immune response: according to signals, apoptosis induction mechanisms, regulatory cytokines, inhibitory receptors (ITIMs motifs). Tregs and Bregs regulatory lymphocytes.

UNIT 21: Immune response against bacteria. Routes of entry of bacteria. Role of conventional dendritic cells. Effector immune response against extracellular and intracellular bacteria. Evasion mechanisms.

UNIT 22: Immune response against viruses. Characteristics of viral infections: cell tropism. plasmacytoid dendritic cells. Immune response against viruses. Evasion mechanisms.

UNIT 23: Immune response against fungi and parasites. Features of fungal infections Elements that direct the effector immune response against fungi, helminths, and protozoa. Evasion mechanisms.

Immunopathology

UNIT 24: Introduction to Immunopathology associated with the immune response. Definition and examples of the three types of pathologies associated with the immune system: hypersensitivity reactions, autoimmunityand immunodeficiencies.

UNIT 25: Immunotherapy. Vaccines. Forms of intervention on the immune response. passive immunization. Non-specific active immunization. Vaccines definition and importance in public health. Type of vaccines: attenuated and inactivated germs. Vaccines generated by biotechnological techniques. Methodology.

UNIT 26: Experimental techniques related to Immunology and its application. Antigen antibody reaction. Labeling design with primary and secondary antibodies. Staining of tissue sections by immunohistochemistry (IHC), immunofluorescence (IF). Staining of cell suspensions and analysis by flow cytometry. Description of the experimental techniques to define the functionality of T cells. Determination of cytokines: ELISA plate, ELISpot, intracytoplasmic staining. Proliferation and cytotoxicity assays. Determination of monoclonal expansions: CDR3 sequencing.

Methodology

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

The class group will be divided into two to carry out the classroom practices that will be taught in 8 hours in which cases and scientific articles will be discussed.

Expositive Classes (lectures):

The 25 topics in the program will be taught in 37 lectures.

Classroom practices:

Classroom practices (PAUL) will be group activities to reinforce the theoretical content and give tools to understand the scientific articles related to the subject. Transversal skills such as searching will also be worked on bibliography, oral communitaction, dinamization of the class group.

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	8	0.32	3, 9, 16, 13, 17, 21, 4, 15, 19
Lectures	37	1.48	2, 3, 5, 7, 8, 6, 10, 11, 12, 15, 19
Type: Supervised			
Data interpretation	8	0.32	3, 16, 13, 17, 21, 4
Type: Autonomous			
Seminar preparation	32	1.28	3, 9, 16, 13, 17, 21, 15, 19
Study	58	2.32	3, 16, 13, 17, 21, 4, 19

Assessment

ASSESSMENT

Partial exams: two partial exams, at the end of Blocks I and II. Each test will be worth 40% of the final grade. They will be multiple choice exams with 5 options. In the correction, 1/5 of the value of each question will be substracted for an incorrect answer. The student must answer 70% of the exam questions to be evaluated. The duration of each test will be a maximum of 2 hours.

Classroom practices: Seminars and classroom practices help the development of students' self-learning, synthesis and written and oral communication skills. The assessment will represent 20% of the final mark of the subject and will assess the demonstrated knowledge, the written summary, the answer to and the ability to solve the questions posed and the relevance of the questions proposed in the class. Attendance is mandatory. As the objective of this activity is to encourage group work among students, so that they all actively participate in the proposed activity, the final grade of the activity will be distributed by the same group.

Final Exam: A final exam will be scheduled for students who have not reached the minimum required (that is, they do not have a minimum of 4 in any of the two partials or do not reach a 5 in the total of the course) or who want to raise the grade . The final exam will be by partials and will have a value of 40% each of them. Likewise, to pass the subject a minimum grade of 4 is required in this exam as a whole, provided that the final result of the 3 evaluable activities is ≥ 5.

To be eligible for the retake process, students must have previously been assessed in a set of activities whose weight is equivalent to a minimum of two-thirds of the total grade of the subject or module. Therefore, the

student will obtain the qualification of "Not Assessable" when the assessment activities carried out have a weighting of less than 67% in the final qualification.

CONTINUED AVALUATION:

1) The subject can be approved by partials as long as the average between the 3 assessment activities is a 5, bearing in mind that an average can only be made with a minimum grade of 4 in both of the partials. The partial exams are retrievable.

2) To recover: Students who have not passed with the sum of the two partial exams, may take the suspended partial exam. In the case of not passing any part during the course, a final exam will have to be taken.

3) If the student has passed the PAUL but not the exams, the grade obtained will be the one obtained in the exams. The classroom practices grade will be kept until the student passes the subject.

4) Failure to appear at any of the tests must be justified. The reason must be important enough to consider taking the exam on another day. The justification must be submitted to the teacher as soon as possible, sending the document by email.

UNIQUE ASSESSMENT:

1) Students who take the single assessment will take a single summary test in which the contents of the entire theory program of the subject will be assessed. The exam will consist of test-type questions with 5 options to choose one. In the correction, 1/5 of the value of each question will be deducted for an incorrect answer. The student must answer 70% of the exam questions to be evaluated. The grade obtained in this synthesis test will account for 80% of the final grade of the subject.

The single assessment test will coincide with the same date fixed in the calendar for the last continuous assessment test and the same recovery system will be applied as for the continuous assessment.

2) The assessment of classroom practice activities will follow the same process as the continuous assessment. The grade obtained will account for 20% of the final grade of the subject.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First partial exam	40%	3	0.12	5, 7, 6, 11, 16, 12, 19
Group seminar	20%	1	0.04	1, 20, 18, 3, 8, 9, 22, 16, 13, 14, 17, 21, 4, 15, 19
Second partial exam	40%	3	0.12	2, 8, 9, 10, 16, 13, 17, 21, 19

Bibliography

Books in English:

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

Books in Spanish or Catalan:

Inmunología de Kuby. J Owen, J Punt, S Stranford, P. Jones. Mc Graw Hill, 8ª edición (2019). Serà el llibre de referència fonamental del curs.

Inmunobiología de Janeway: K Murphy, P. Travers, M. Walport. Mc Graw Hill, 9ª ed, (2016).

Inmunología Celular y Molecular de A.Abbas, A. H. Lichtman, S. Pillai. Elsevier, 9ª ed, (2018).

Inmunología Básica de A.Abbas, A. H. Lichtman, S. Pillai. Elsevier, 6ª ed, (2020).

Introducción a la Inmunología Humana de L. Faimboim, J. Geffner. Ed Medica Panamericana, 7ª ed (2011).

Inmunología, Biología y Patología del Sistema Inmunitario de JR Regueiro, C López Larrea,S González Rodríguez, E Martínez Naves. Ed Médica Panamericana, 4ª ed, 2011.

Diccionari d'immunologia de TERMCAT, Centre de Terminologia, Ed Masson, Barcelona, 2005

In addition, we have acces to the platform on digital books https://mirades.uab.cat/ebs/). In the following link, you will find an infographics to facilitate findind of electronic books (https://ddd.uab.cat/record/22492).

Among the digital resources we higlight the course books:

Kuby inmunología [Recurs electrònic] / Judith A. Owen, Jenni Punt, Sharon A. Stranford ; con la colaboración de Patricia P. Jones ; traducción:Bernardo Rivera Muñoz Owen, Judith A.

Inmunología celular y molecular [Recurs electrònic] / Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai ; ilustraciones de David L. Baker, Alexandra Baker Abbas, Abul K.

Roitt inmunología [Recurs electrònic] : fundamentos / Peter J. Delves ... [et al.]

Introducción a la inmunología humana [Recurs electrònic] / Leonardo Fainboim, Jorge Geffner Fainboim, Leonardo

Software

Not necessary