Universitat Autònoma de Barcelona

2021/2022

Immunology

Code: 100918
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OB	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

There are no official prerequisites, but it is understood that the student of the immunology course has achieved the learning skills in the subjects scheduled for the first and second year of the Degree and therefore has acquired solid knowledge on subjects such as cell biology, physiology and biochemistry in the first and second year of the degree.

On the other hand, in a scientific discipline such as Immunology the most up-to-date sources of information are in English. Therefore, it is recommended that students have some basic knowledge of this language.

Objectives and Contextualisation

Contextualization:

Immunology is the branch of Biotechnology that studies the physiological and pathological mechanisms of specific response of organisms to the presence of foreign agents that can potentially cause damage, such as microorganisms and toxins. This is a compulsory subject of the degree of Biotechnology. Immunology is an integrative subject allowing the students to understand the interrelation established between the pathogen and the host using the previously acquired knowledge on cell biology, biochemistry, microbiology, virology, genetics and molecular genetics, physiology and animal biology.

Objectives of the subject:

The Immunology subject, worth 6 ECTS, will be divided into four thematic blocks for which specific learning competences have been defined and that the student will achieve at the completion of the Immunology course.

Block I. Basic Immunology. Elements of the Immune System

- To know the concepts of innate and adaptive immunity as well as to understand their role on the immune response

- To identify the elements that intervene in both innate and adaptive responses

- To enumerate and explain the structural and functional characteristics of the molecular and cellular components of the innate and adaptive immunity

- To understand the connection between the immune system components through the blood and the lymphatic system circulation, as well as the anatomical location of the immune response

Block II. Organization of the Immunological Response

- To integrate the molecular and cellular elements described in Block I to the three phases of the immunological response: 1) activation; 2) effector phase; and 3) regulation and homeostasis

Block III. Response to pathogens.

- To determine the characteristics of the immune response depending on the type of infectious agent: bacteria, virus, fungus or parasites

- To identify the evasion mechanisms used by different pathogens to avoid the immune response

- Describe possible pathological consequences of the immune response

Block IV. Immunopathology and immunotherapy

- To identify the dysfunctions of the immune system causing immunopathologies: hypersensitivity, autoimmunity and immunodeficiency

- To know immunotherapeutic strategies for the manipulation of the immune response both to potentiate or to suppress it

Competences

- Apply the principal techniques for the use of biological systems: recombinant DNA and cloning, cell cultures, manipulation of viruses, bacteria and animal and plant cells, immunological techniques, microscopy techniques, recombinant proteins and methods of separation and characterisation of biomolecules.
- Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of living organisms in the framework of their application to biotechnological processes.
- Design continuation experiments for problem solving.
- Identify the structural and functional elements of viruses and other useful microorganisms for the design of new strategies for molecular diagnosis of infectious diseases.
- Interpret experimental results and identify consistent and inconsistent elements.
- Learn new knowledge and techniques autonomously.
- Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
- Make decisions.
- Obtain information from databases and use the software necessary to establish correlations between the structure, function and evolution of macromolecules.
- Read specialised texts both in English and ones own language.
- Reason in a critical manner
- Search for and manage information from various sources.
- Search for, obtain and interpret information from the principal databases on biology, bibliography and patents and use basic bioinformatic tools.
- Think in an integrated manner and approach problems from different perspectives.
- Use ICT for communication, information searching, data processing and calculations.
- Work individually and in teams

Learning Outcomes

1. Analyse the relationship between the nature of the immune response and the molecular and physical characteristics of the antigens that induce it.
2. Apply the principal techniques for studying and manipulating biological systems in the immune system.
3. Describe the mechanisms of activation and regulation of cellular and humoral immune response.
4. Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of the immune system.
5. Describe the theoretical principles of immunological techniques.
6. Design continuation experiments for problem solving.
7. Explain the clonal distribution of lymphocyte antigen receptors and justify the theory of clonal selection: one lymphocyte, one receptor.
8. Identify structural and functional elements of pathogens that can be recognised by the immune system, and induce an innate or specific response enabling the design of strategies for the molecular monitoring of the immune response to infections, and also for the prevention of these diseases.
9. Interpret experimental results and identify consistent and inconsistent elements.
10. Learn new knowledge and techniques autonomously.
11. Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
12. Make decisions.
13. Obtain information from databases on the immune system to study protein structure, analyse MHC polymorphisms, identify antigen epitopes for B and T lymphocytes, and analyse the diversity of antigen receptors and the various molecular interactions between immune system cells.
14. Read specialised texts both in English and ones own language.
15. Reason in a critical manner
16. Search for and manage information from various sources.
17. Search for, obtain and interpret information from the principal databases on immunology and bibliography and use basic bioinformatic tools to study the immune system and immunotechnologies.
18. Think in an integrated manner and approach problems from different perspectives.
19. Use ICT for communication, information searching, data processing and calculations.
20. Use the basic techniques of immunodetection.
21. Work individually and in teams

Content

Each block is divided into teaching units (TU) that define the specific learning descriptors associated to the specific competencies.

Block I. BASIC IMMUNOLOGY: ELEMENTS OF THE IMMUNE SYSTEM

Overview. Immunology for biotechnologists.

TU-1: Introduction.
What is Immunology? Elements of the immune system (organs, cells and molecules). Definition of innate and adaptive immunity. Basis of the adaptive immune response: humoral and cellular response. Concept of antigenic clonality.

TU-2: Innate Immunity
Molecular elements of the innate immunity. Inflammation. The Complement System. Innate immunity cells.

TU-3: Adaptive immunity. Antigen recognition by B lymphocytes.
B cell antigen receptor (BCR). Immunoglobulins, structure and gene organization. Ontogeny and maturation of B lymphocytes in the bone marrow. Subpopulations of B lymphocytes.

TU-4: Adaptive immunity. Antigen recognition by T lymphocytes.
Antigen receptor of T cells (TCR). T lymphocytes development. Thymic selection. Generation of T lymphocytes repertoire. T lymphocyte subpopulations.

TU-5: Adaptive immunity. Antigen processing and presentation

Molecules of the Major Histocompatibility Complex. Structure and genetics. Antigen processing and presentation. Antigen presenting cells APC).

TU-6: Immune System Organs and recirculation of lymphocytes
Cytokines and Chemokines. Lymphatic system. Organization ofthe primary and secondary lymphoid organs. Leukocyte circulation.

Block II. ORGANIZATION OF THE IMMUNE RESPONSE

TU-7: Cellular immune response. Activation and T effector cell differentiation. Intracellular transduction of activation signals. Effector mechanisms of the different T cell subpopulations. Generation of memory T lymphocytes.

TU-8: Humoral response
B lymphocytes activation and differentiation to effector cells. Plasma cells. Intracellular transduction of activation signals. Germinal center formation. Effector mechanisms of the different B lymphocytes subpopulations. Antibody production.

TU-9: Regulation of the immune response
Immune Tolerance: central and peripheral tolerance. Regulatory elements and mechanisms during and after an immune response.

Block III. IMMUNE RESPONSE TO PATHOGENS

UD-10: Immune response against bacteria
Effector mechanisms of the innate and adaptive immune response to extracellular and intracellular bacteria. Immune response evasion mechanisms. Pathological consequences of the bacterial response.

UD-11: Immune response against viruses.
Effector mechanisms of the innate and adaptive immune response to viruses. Evasion mechanisms. Pathological consequences of the immune response to viruses.

UD-12: Immune response to fungi and parasites.

Mechanisms of the innate and adaptive immune response to fungi and parasites. Evasion mechanisms. Pathological consequences of the response.

Block IV. IMMUNOPATHOLOGY AND IMMUNOTHERAPY

TU-13: Hypersensitivity reactions. Hypersensitivity and Type of hypersensitivity reactions. Examples.

TU-14: Autoimmunity. Tolerance and autoimmunity. Predisposition factors. Effector mechanisms of autoimmunity. Autoimmune diseases.

TU-15: Immunodeficiencies. Congenital or acquired immunodeficiencies. Innate immunity and adaptive immunity immunodeficiencies.

TU-16: Vaccines and Immunomanipulation. Immunization systems. Immune response to the different types of vaccines. Adjuvants. Immunomodulators. Immunosuppressants.

Methodology

The subject of Immunology consists of theoretical classes, classroom practices and tutorials. The following describes the organization and the teaching methodology that will be followed in these training activities.

Lectures

The content of the theory program will be covered in 30 sessions in the form of master classes with audiovisual support. Lectures will be available online on the Virtual Campus (CV). A list of reference materials available at the library is provided in the bibliography section of this Teaching Syllabus, as well as internet links where relevant videos and animations will be available for students to reinforce or clarify contents offered in the lectures.

Classroom Practicals

For these sessions, the group will be divided into two subgroups, GBT1-IMM and GBT2-IMM, with an approximate number of 40 students per group. A total of 13 sessions per group are programmed that will include the following activities:

1.- Seminars of experimental techniques (TE) (2 sessions).

For these seminars the group will be divided into two subgroups of approximately 40 students each. Immunology is an experimental science and therefore one of the objectives of the subject is for the student to acquire the skills necessary to understand a research project. Therefore, lectures, discussions and problems solving related to the techniques presented will be carried out. Exams will include questions about these seminars. Further, knowing these techniques will be necessary for the development of the research project.

The scheduled sessions and the specific aims are:

- TE1 (1h), to deepen in the antigen-antibody interaction and its use as an antigen-specific detection system in different substrates. The immunohistochemistry, immunofluorescence, ELISAand ELISPOT techniques will be analyzed.

- TE2 (1h), aims to study the cellular immune response using techniques to determine the functionality of different subpopulations of T lymphocytes. Tests will be described to measure cell proliferation and cytotoxicity using flow cytometry, among others.

2.- Research project development seminars (DPR) (4 sessions).

For these seminars the group will be divided into 4 subgroups with approximately 20 students per group. This will be a cooperative learning activity, so students will organize into five-members Work Groups to be established at the beginning of the semester.

The aim of these seminars is to help consolidate the contents previously worked on in the theory classes and allow the integration of this knowledge in the development of a research project to solve a real problem. The current bibliography on the problem will be sought, a hypothesis and objectives and a methodology will be proposed to respond to the objectives set.

To achieve this goal, 4 seminars will be scheduled for each subgroup in the first of which the project to be developed will be proposed and the aspects that will be developed by each of the working groups (5 members) will be distributed. The development of the project proposal will involve the search for theoretical and experimental information in public databases. On the following sessions the students will share the information gathered, the doubts will be raised and solved and the strategies developed by each working group will be discussed. Therefore, participation in the discussion is one of the criteria used for the evaluation of this activity.

3.- Research project presentation seminars (PPR) (2 sessions).

The aim of these seminars is to present the research project developed by each of the 4 subgroups. The starting hypothesis, the experimental design and the expected results will be presented so that they can be discussed with the rest of the subgroups. Students will present the project with audiovisual support. The presentation will be evaluated by the teacher and the other Working Groups. The final score of the presentation will be the average of the assessment of each member of the group and therefore their presence on the seminars is required. The contribution of other students of the course to the discussion will also be valued and therefore their attendance at these sessions is required. A minimum attendance of 80% of these seminars is required to be evaluated.

4.- Self-assessment (2 sessions)
A self assessment session will be programmed at the end of blocks I and IV. Model exams will be uploaded onto the CV that will be solved during these session. Correct and incorrect options will be discussed.

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			
1. Master class	30	1.2	10, 1, 3, 4, 5, 7, 8, 9, 18
2. Experimental techniques seminars	2	0.08	10, 19, 16, 17, 6, 8, 9, 14, 13, 18, 12, 21, 20
3. Research project development (DPR)	8	0.32	16, 17, 6, 14, 18, 12, 15, 21, 20
4. Research project presentation (PPR)	2	0.08	10, 19, 16, 17, 11, 14, 15, 21
5. Self-assessment sessions	2	0.08	1, 2, 3, 4, 5, 7, 18, 15, 21, 20
Type: Autonomous			
1. Consolidation of the theoretical lessons	60	2.4	10, 1, 2, 16, 3, 4, 5, 7, 8, 14, 13, 21
2. Consolidation of experimental learning techniques	4	0.16	10, 6, 9, 14, 13, 18, 12, 21, 20
3. Bibliography search	7	0.28	16, 14, 18, 21
4. Reading and proposal of a research project	6	0.24	10, 19, 2, 16, 17, 6, 11, 8, 9, 14, 18, 15, 21
54. Research project proposal development	10	0.4	10, 19, 16, 17, 6, 14, 18, 12, 15, 21
6. Reports and presentation preparation	8	0.32	19, 16, 11, 14, 18, 15, 21
7. Self-assessment sessions preparation	3	0.12	1, 2, 3, 4, 5, 7, 8, 13, 12, 15

Assessment

The evaluation activities programmed are:

Individual learning:

• Midterm exams: two midterm exams, at the end of Block I and IV, which will include questions from the corresponding experimental techniques seminars. Each test will be worth 35% of the final grade. The exam will consist on 30-40 multiple choice questions with 5 options with a single correct one. To be evaluated, 70% of the questions must be answered. One fith of the value of each question will subtracted by each incorrect answer. The duration of the test will be of a maximum of 120 minutes.

Students must reach a minimum of 1.5 points in each midterm exam to be able to add up both marks. The sum must be equal to or greater than 3.2 points to be able to add with the grade of classroom practicals.

• Reassessment exam: A final exam will be scheduled for those students who have not achieved the minimum points required or those who wish to get a higher mark on one or both midterm exams. Reassessment will have a value of 70% of the final mark of the subject.

Cooperative learning:

• Research project development (DPR). The search and selection of information as well as the ability to design experiments to develop the project will be evaluated. Also the ability to summarize and focus the proposal for each one of the sessions and the participation in the discussion during the seminar. The evaluation will be based on a rubric for each group in each of the seminars and the final project proposal. The proposal will be submitted to a similarity detection software (URKUND). Similarity percentages higher than 20% with a published text or the proposal of another group will not be accepted. The set of rubrics for these sessions will account for 25% of the final grade of the course.

The aim of this activity is to encourage students' team work skills so all the group member should be actively involved in the development of the project. Therefore, the final grade will be based on the the contribution of each group member to the tasks assigned.

• Presentation of research project (PPR). The grade of the oral presentation will be worth a 5% of the final mark of the subject. Presentation, discussion and responses to the questions posed by students and teacher will be evaluated.

The final grade of classroom practicals will be the result of adding the DPR (25% maximum) and the PPR (5% maximum) marks.

Classroom practicals marks will be maintained until the following academic year only. After that, the student will have to do the classroom practicals again.

A minimum mark of 32% in the midterm or final exams is required to be able to add up the individual and the cooperative learning marks (see Table II). Students who do not reach this score can be reassessed (one or both midterm exams) as previously described. If the exams score is under a 32% the mark shown in the student report is that of the exams. From the moment the student agrees to be reassessed, he renounces to the previously obtained grade.

To be eligible for the reassessment, the student should have been previously evaluated in a set of activities whose weight equals at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Evaluable" if the weight in of all conducted evaluation activities is less than a 67% ofthe final score.

Table II. Assessments

	TEST TYPES	ACTIVITY	Number of test	% final
INDIVIDUAL LEARNING	MIDTERM EXAMS	MULTIPLE CHOICE TEST	EXAM 1	35'
			EXAM 2	35'
	REASSESSMENT	MULTIPLE CHOICE TEST	1	70'

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1. Midterm exam 1	35	2	0.08	10, 1, 2, 17, 3, 4, 5, 6, 7, 8, 9, 13, 20
2. Midterm exam 2	35	2	0.08	10, 1, 2, 17, 3, 4, 5, 6, 7, 8, 9, 13, 20
3. Evaluation of the research project development	25	2	0.08	10, 19, 16, 11, 14, 18, 12, 15, 21
4. Evaluation of the research project presentation	5	2	0.08	17, 11, 14, 21

Bibliography

TEXT BOOKS

- Janeway's Immunobiology by K Murphy, P. Travers, M. Walport. Ltd/Garland Science, NY & London, 8th ed., 2011.
- Kuby Immunology by J Owen, J Punt, S Stranford. W.H. Freeman Co., 7th ed, 2012.
- Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders, 7th ed, 2012.
- Immunology by David K. Male, Jonathan Brostoff, David B. Roth, Ivan Roitt. Elsevier, 8 th ed, 2013.
- Essential Immunology, by Peter J. Delves, Seamus Martin, Dennis Burton, Ivan Roitt. Wiley-Blackwell Ed., 12th ed, 2011.
- Immunology, Infection and Immunity by gb Pier, JB Lyczak, LM Wetzler. ASM Press, 2004.
- Medical Microbiology and Immunology by Warren Levinson. Lange Medical Books / McGraw-Hill, 10 th ed. (2006).
- Review of Medical Microbiology and Immunology by Warren Levinson. Lange Basic Sicence / McGraw - Hill Education, 13th (2014).

EXTRA BIBLIOGRAPHY

1. Immunology Journals

Advances in Immunology: http://www.sciencedirect.com/science/bookseries/00652776

Annual Review of Immunology: http://arjournals.annualreviews.org/loi/immunol

Current Opinion in Immunology: http://www.sciencedirect.com/science/journal/09527915

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

Nature Biotechnology: http://www.nature.com/nbt/index.html

Seminars in Immunology: http://www.elsevier.com/wps/find/journaldescription.cws_home/622945/description#description

Trends inImmunology: http://www.cell.com/trends/immunology/

Frontiers in Immunology: http://journal.frontiersin.org/journal/immunology

2. Immunology related websites

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

Essential Immunology, by Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt. Wiley-Blackwell Ed., 12th ed, 2011; http://www.roitt.com/

Kuby Immunology (with web support) by T.J. Kindt, R.A. Goldsby, B.A. Osborne. W.H. Freeman Co., 6 th ed, (2006); http://www.whfreeman.com/kuby/

Janeway's animations (you can also find movies from Janeway's Immunology text book in youtube http://www.blink.biz/immunoanimations/

Software

Nospecific software will be used.