Universitat Autònoma de Barcelona

2019/2020

Immunology

Code: 100918
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OB	3	2

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 assumed that the student of the Immunology course has acquired enough solid knowledge on subjects such as cell biology, physiology and biochemistry on 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 the importance of the role of each of them in 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

Overwiew. Immunology for biotechnologists.

TU-1: Introduction. What is Immunology? Elements of the immune system: organs, cells and molecules. Definition of innate and adaptive immunity. Types of adaptive immune response: humoral and cellular response. Concepts of immunogenicity, clonality, specificity and memory.

TU-2: Innate Immunity. Molecular elements (membrane attached and soluble molecules) 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. B lymphocytes subpopulations.

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

TU-5: Adaptive immunity. Antigen processing and presentation. Molecules of the Major Histocompatibility Complex. Structure, genetics and biosynthesis. Antigen processing and presentation. Antigen presenting cells.

TU-6: Immune System Organs and lymphocyte recirculation among them. Cytokines and Chemokines. Lymphatic system. Anatomy of primary and secondary lymphoid organs. Recirculation of lymphocytes. Tissue homing.

Block II. ORGANIZATION OF THE IMMUNE RESPONSE

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

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

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

Block III. IMMUNE RESPONSE TO PATHOGENS

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

TU-11: Immune response against viruses. Effector mechanisms of the innate and andadaptive immune responses to viruses. Evasion mechanisms. Pathological consequences of the viral immune response.

TU-12: Immune response to fungi and parasites. Mechanisms of the innate and adaptive immune responses to fungi and parasites. Evasion mechanisms. Pathological consequences of the immune response.

Block IV. IMMUNOPATHOLOGY AND IMMUNOTHERAPY

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

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

TU-15: Immunodeficiencies. Primary (congenital) or secondary (acquired) immunodeficiencies. Innate immunity deficiencies. Adaptive immunity deficiencies.

TU-16: Vaccines and Immunomanipulation. Potentiation of the immune response. Vaccines. Types of vaccines. Immunization systems.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 on experimental techniques (TE) (4 sessions)

To familiarize students with the basis of immunology-related techniques, lectures, discussions and problems solving related to the techniques presented will be carried out. This should help the students to acquire the necessary skills for understanding and debating a research article published in a science journal.

Two questions about each of these techniques will be included in the exam on the theoretical content.

The scheduled sessions and the specific aims are:

- TE1 (2h), to deepen in the antigen-antibody interaction and its use as an antigen-specific detection system in different substrates. Techniques of immunohistochemistry, immunofluorescence, ELISA and ELISPOT. Antibody production.

- TE2 (2h), techniques used for the functional and phenotypic analysis of lymphocytes. Techniques: proliferation, cytotoxicity, cytokine secretion and flow cytometry for phenotypical characterization.

2.- Problem based learning (ABP) or cases (2 sessions)

The goal of these sessions is to reinforce contents previously dealt with in lecture sessions and to help to integrate this knowledge in problem-solving tasks based of case studies. Students prepare cases outside class in groups of 4.

1. Case study. Case description and a study guide which specifies the skills aimed for, will be uploaded onto the CV on an announced date. Study of the case will necessarily require searching for both theoretical and experimental information on public databases.

2. Advising and discussion session for each case, two weeks after case given. Students will share collected information, solve and discuss problems. The discussion will be led by students themselves. Lecturer's role is only to accompany and clarify doubts. Participation in the discussion will be assessed for credit.

Assessment for this activity will be based on a four-question test that the groups are expected to answer and post on the CV within a time frame. Information of the estimated contribution of each member of the group to the report will be required.

3.- Interpretation of results of research articles (AR) (5 sessions)

The goal is to study the hypothesis, experimental design and interpretation of results published in research articles and to discuss them in the classroom. Articles chosen will be relevant to the immunology program contents and should reinforce concepts acquired in lectures.

The articles will be posted on the CV. Before each session students will have to work on the understanding of the concepts and the techniques described inthe article

There will be a class session for presentation and discussion on the article. The students will present thearticle and will discuss its results. The lecturer will ask randomly designated groups to explain different aspects of the article.

The accuracy on the description of the article as well as the discussion when defending the topic will be assessed. Information on the participation of each member of the group will be required.

The final score of this activity is the mean of the evaluation of each member of the group during the presentation. The participation of the rest of the students to the discussion will be assessed. A minimum attendance (80%) to this sessions 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. a sessió d'autoavaluació abans of each partial exam. The lecturer will upload a test model to the CV that will be solved during the sessions and the correct and incorrect options will be discussed.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case studies preparation and resolution	2	0.08	10, 19, 16, 17, 6, 11, 14, 13, 18, 15, 21, 20
Experimental techniques seminars	4	0.16	10, 19, 16, 17, 6, 8, 9, 14, 13, 18, 12, 21, 20
Master class	30	1.2	10, 1, 3, 4, 5, 7, 8, 9, 18
Research articles presentation and discussion	5	0.2	17, 11, 12, 15, 21, 20
Self-assessment sessions	2	0.08	1, 2, 3, 4, 5, 7, 18, 15, 21, 20
Type: Autonomous			
Bibliography search	8	0.32	16, 14, 18, 21
Case studies preparation	6	0.24	10, 19, 16, 17, 6, 14, 18, 12, 15, 21
Consolidation of experimental learning techniques	5	0.2	10, 6, 9, 14, 13, 18, 12, 21, 20
Consolidation of the theoretical lessons	58	2.32	10, 1, 2, 16, 3, 4, 5, 7, 8, 14, 13, 21
Reading and preparation of the research articles presentation	16	0.64	10, 19, 16, 17, 11, 9, 14, 18, 15, 21
Reports preparation	3	0.12	19, 16, 11, 14, 18, 15, 21
Self-assessment sessions preparation	4	0.16	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 partial exam to be able to add the note from both.

• 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:

• Cases (ABP). Assessment for this activity will be based on a four-question test that the groups are expected to answer and post on the CV within a time frame.

The search and selection of information will be evaluated as well as the ability to summarize the answers to the written report prepared by each team.
The evaluation of the cases will represent 15% of the final mark.

Information of the estimated contribution of each member of the group to the report will be required. Therefore, the members of each group will sign a document stating the % contribution of each of them to the report delivered.

• Articles (AR). Accuracy when describing the article contents as well as the answers to the questions posed by both lecturer and students will be evaluated. The final mark for each member of the group will be the average of that of each member of the group. Information of the participation of each member of the group will be required.

Participation in the discussion when defending the topic by the rest of the students will be also assessed. The assessment of the articles will be worth a 15% of the final mark in immunology.

The final grade of classroom practices (30% of the total) will be the sum of the ABP mark (15% maximum) plus the obtained in AR (15% maximum).

Classroom practices mark will be only be maintained until the next academic year. After that, the student will have to be again evaluated on the classroom practices.

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 included in the student report is that of the exams. From the moment they agree to be reassessed, students renounce to the grade previously obtained.

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% of the final score.

Table II. Assessments

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

REASSESSMENT	MULTIPLE CHOICE TEST	1	70%

Assessment Activities

INDIVIDUAL SCORE			70%
COOPERATIVE LEARNING (PAUL)	CASE STUDIES	QUESTIONAIRE	2	15%
ARTICLE	ORAL PRESENTATION	1	15%
PAUL SCORE			30%
FINAL SCORE		100%	50%

Title	Weighting	Hours	ECTS	Learning Outcomes
ARTICLES EVALUATION	15	1	0.04	17, 11, 14, 21
CASE STUDIES EVALUATION	15	2	0.08	19, 16, 11, 14, 18, 12, 15, 21
MIDTERM EXAM 1	35	2	0.08	10, 1, 2, 17, 3, 4, 5, 6, 7, 8, 9, 13, 20
MIDTERM EXAM 2	35	2	0.08	10, 1, 2, 17, 3, 4, 5, 6, 7, 8, 9, 13, 20

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/