



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Immunology

2526-2-E0201Q051

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#### Aims

The course aims at providing the basic concepts on the organization and functioning of the immune system. Students attending Immunology teaching are expected to achieve the following goals:

Knowledge and understanding. Knowledge on the bases of innate and adaptive immunity, the mechanisms underlying inflammation, the generation of antigen-receptor diversity, the activation of T and B lymphocytes, the structure and function of antibodies. Knowledge on the basic concepts and principles concerning vaccination.

Applying knowledge and understanding. Students will be able to understand the key role of the immune system in different pathologies and the importance of immunology, also through history.

Making judgments. Students will be able to link the different topics, judge the resolved and unresolved aspects concerning the complexity of the immune system, highlight the shortcomings of current knowledge on the functioning of the immune system.

Critical thinking and judgment skills are developed during the lectures through guided discussions, case analyses, and problem-solving activities proposed by the instructor in class.

Communication skills. Students will be able to effectively describe the contents of the course, in both written and oral form, using the most appropriate technical terms.

Learning skills. Students will be able to consult scientific texts regarding the topics covered and integrate the knowledge acquired with the contents of other scientific disciplines (i.e. cellular and molecular biology, biochemistry etc).

#### Contents

- 1) General features of the immune system
- 2) The antigen
- 3) The B cell antigen receptor (BCR)
- 4) The T cell antigen receptor (TCR)
- 5) The major histocompatibility complex (MHC)
- 6) The process of antigen presentation

- 7) T and B lymphocyte activation
- 8) Cytokines and their receptors
- 9) Pattern Recognition Receptors
- 10) cells of the innate immunity: myeloid cells and lymphoid cells
- 11) Complement
- 12) The inflammatory process
- 13) Effector mechanisms of humoral immunity
- 14) Effector mechanisms of cell-mediated immunity
- 15) Tolerance
- 16) Autoimmunity
- 17) Vaccines
- 18) Monoclonal antibodies

## Detailed program

### 1: General characteristics of the immune system

Description : Innate and adaptive immunity; Organization of the immune system, general characteristics of organs, tissues and cells of the immune system. Primary and secondary lymphoid organs. Distribution and circulation of the cells of the immune system .

### 2: The antigen

Description: Concept of antigen, immunogen, antigenic determinant or epitope, carrier, aptene.

### 3: The B cell antigen receptor (BCR)

Description: Immunoglobulins. structure and function of antibodies and of the BCR. The generation of repertoire diversity. Isotypes and idiotypes. Biological functions of immunoglobulin classes and subclasses. Cellular distribution of FC receptors . Cellular functions mediated by antibodies. monoclonal antibodies. Concept, methodology, applications.

### 4: The T cell receptor (TCR)

Description: organization, rearrangements and expression of TCR and coreceptors; biochemical structure of the TCR; generation of the repertoire diversity

### 5: The major histocompatibility complex (MHC)

Description: Genic organization and polymorphisms. Molecular structure and classification of MHC of class I and II molecules. The groove for antigen binding. MHC of class I and II in antigen presentation. The ternary complex, MHC-peptide-TCR

### 6: Antigen presentation

Description: Antigen recognition by T and B cells. Extracellular and intracellular antigen processing.

### 7: Professional antigen presenting cells

Description: Dendritic cells

### 8: B and T cell activation.

Description: Signal transduction. Adhesion molecules and costimulatory molecules for T cell activation.

### 9: Cytokines and their receptors.

Description: Origin and molecular structure. Mechanism of action and target cells. Role of cytokine in leukocyte differentiation. Role of cytokines in Th1, Th2 and Th17 cell differentiation.

### 10: Interazioni microrganismi-ospite

Description: Pattern recognition receptor and Danger theory. PAMPs and DAMPs

#### 11: The complement system

Description: Mechanism of complement activation, functions of the complement

#### 12: The inflammatory process

Description: Activation of inflammation, leukocyte recruitment, the role of inflammation in response to infection, from inflammation to the activation of adaptive immunity

#### 13: Effector mechanisms of humoral immunity.

Description: T and B cell cooperation. Plasmacells. Isotype switch, hypermutation and affinity maturation. Kinetic of primary and secondary response

#### 14: Effector mechanisms of cell-mediated immunity

Description: macrophage activation. Cytotoxic T lymphocytes and cell killing, effector mechanisms of t helper cells and NK cells

#### 15: Immunological memory

Description: memory of T cells; memory of B cells

#### 16: Vaccines

Description: active and passive vaccination, prophylactic vaccines, therapeutic vaccines, adjuvants

## Prerequisites

Background: none

Specific prerequisites: none.

General prerequisites: Students can take the exams of the second year after passing the examinations of Introductory biology, General and inorganic chemistry, Mathematics, and Foreign Language.

## Teaching form

All teaching activities are carried out in an expository (lecturing) mode.

The course includes 24 in-person frontal lectures, each lasting 2 hours, for a total of 48 hours.

The final two hours of the course are delivered in an interactive format. During these sessions, students engage in discussions, problem-solving activities, and group exercises.

The course is taught in Italian.

A 1-CFU module concerning the actin cytoskeleton of dendritic cells, its remodeling during maturation, and the processes of phagocytosis, pinocytosis and macropinocytosis in dendritic cells and macrophages, is co-taught with Dr. Metello Innocenti, expert in cell biology and cytoskeleton.

## Textbook and teaching resource

The teaching materials consist of slide decks and recorded lectures available on the e-learning platform..

Recommended textbooks:

- Immunobiology from Janeway
- Cellular and Molecular Immunology from Abul Abbas e Andrew Lichtman

## **Semester**

First semester

## **Assessment method**

The final examination consists of an individual oral exam. No midterm tests are foreseen.

The exam includes two to five questions, depending on the student's level of preparation, covering all topics presented during the course.

The exam aims to assess:

- Knowledge and understanding of the mechanisms of innate and adaptive immunity;
- The ability to apply such knowledge to biological and pathological contexts;
- The ability to critically connect the various course topics;
- The use of appropriate scientific terminology and clarity in communication;
- Independent learning skills, including interdisciplinary integration.

Evaluation criteria include:

- Accuracy and completeness of answers;
- Logical connections between topics;
- Correct use of scientific language;
- Clarity and organization of discourse;
- Critical thinking and independent judgment.

The final grade, expressed in thirtieths, reflects the overall level of mastery demonstrated by the student with respect to the criteria above.

## **Office hours**

Contact: on demand, upon request by mail to lecturer

## **Sustainable Development Goals**

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION

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