Virology

Code: 100951
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500253 Biotechnology	OB	3

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Teachers

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Teaching groups languages

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Prerequisites

It is essential to have a general background in Biochemistry, Molecular Biology, Cell Biology, Microbiology and Immunology.

Objectives and Contextualisation

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The teaching objectives of the course are the acquisition by the students of basic knowledge about biology, structure, genetics and evolution of viruses within the framework of its pathogenesis and pharmacological possibilities and research opportunities that Virology can offer in those fields. It will be also focused on emerging applications of the viruses in biotechnology and nanotechnology, and the need for constant updating of information through bibliographic databases.

In this context, the specific learning outcomes (RAs) for this subject are:

- To differentiate viruses, as genetic entities, from living beings (SM16).
- To identify the main discoveries in the history of virology (KM17).
- To recognize the basic elements of the viral structure and genome, relate their role in the viral cycle, and explain their impact on the immune system (KM17).
- To review the constant evolution of viral taxonomy and identify the main viral families (KM17).
- To associate the pathogenesis of diseases caused by some viruses to their symptomatology (KM17).
- To become familiar with the concept of the virome and the host as a holobiont (KM17).

- To understand the evolution of viruses and how new viruses emerge (KM17).
- To apply viral methodology for the design of new indications in nanomedicine and biotechnology (CM17).

Learning Outcomes

1. CM17 (Competence) Evaluate the properties of viruses and viral particles useful for the design of vaccines and antiviral drugs.
2. KM17 (Knowledge) Recognise viral and viral cycle components relevant to the antiviral immune response.
3. SM16 (Skill) Apply the main techniques associated with the use of micro-organisms.

Content

1. Nature and multiplication of viruses

The world of viruses. Strict parasitism, multiplication and transmission. Viral disease and the iceberg concept. Viral diversity and virome. The viral particle: dimensions, chemical composition, morphology and nomenclature. Functions of the capsid; stability and recognition. Chemical composition, structure and organization of the viral genome: structural and non-structural genes. The polarity of the nucleic acid. The viral cycle: extra- and intracellular phases. Viral multiplication: productive and non-productive infections. Sequential expression of viral genes. Viruses, mobile genetic elements and living things.

2. Origins of Virology

The hypotheses about the maintenance of life and spontaneous generation. Pasteur's work. Microscopic infectious agents and Koch postulates. The nineteenth century: the discovery of viruses. The tobacco mosaic: the concept of filterable poison. Discovery of animal viruses. 20th century: chemical, structural and genetic characterization of viruses. Relevant facts in the history of Virology. Smallpox eradication and the risk of re-emergence. Clinical and biotechnological aspects of Virology. Bioterrorism.

3. Structure of viral particles

Morphology of viral particles. Architectural study of viral particles: electron microscopy and three-dimensional reconstructions. X-ray diffraction: resolution level. Molecular architecture in helical and icosahedral symmetries. Trans-membrane proteins in viral envelopes. Receptor- binding sites. Viral antigens and epitopes B and T. Neutralization and evasion of neutralization. Genetic and epitopic variability.

4. Viral genetics and viral genomes

Diversity of viral genomes. Principle of economics and complexity of viral genomes; gene overlapping. Segmented and split genomes. Information encoding the viral genome. Viral genome types and gene expression and replication strategies; time-regulation strategies. The infectious clone. Principles of reverse genetics. Defective viruses.

5. Methods in Virology

Obtaining viral particles. Cell culture at small and medium scale. Purification. Quantitative and qualitative analysis of viral particles. Detection of viral components and applications in diagnostic methodology. The Virology laboratory: areas and distribution. Biological safety. Containment levels: P1 to P4. Air treatment. Effluent treatment.

6. Principles of viral taxonomy

First virus classifications: Baltimore classification of animal viruses. The International Committee on Taxonomy of Viruses and the classification system. Viral properties used in taxonomy. Families of animal viruses and unclassified viruses. Nomenclature changes. Main human pathogens and their diseases.

7. Viral multiplication

Cell recognition. Nature and function of receptors. Internalization. Disassembly. Biosynthetic shutdown. Stimulation of cellular functions: papovaviruses and adenoviruses. RNA, DNA and viral protein synthesis: time sequences. Cytopathic effects. Exit of viral particles with and without lysis. Apoptosis. Cell transformation into RNA viruses: cellular oncogenes; activation and transduction. Cell transformation into DNA viruses: oncogenes and viral oncoproteins. Viral protein processing. Antiviral drug targets. Interfering RNA.

8. Pathogenesis of viral infections

"Good" viruses. Virus-host coexistence. Asymptomatic infections. Characteristics of viral infections. Entrance gates. Transmission routes: horizontal and vertical. Localized and systemic infections. Dissemination. Viremia. Nerve transmission. Target tissues: tropism. Acute and persistent infections. Dissemination. Viremia. Nerve transmission. Target tissues: tropism. Acute and persistent infections. Latent infections. Viral and non-viral factors influencing pathogenesis. Virulence. Evasion of the immune responseby viruses. Immunopathology.

9. Response to viral infections and vaccines

Types of vaccines; attenuated and inactivated. Molecular basis of attenuation. New generation vaccines. Recombinant vaccines and synthetic peptides. Vaccination with nucleic acids. New vectors in vaccines. SARS-CoV-2 vaccines. Herd immunity. Innate and adaptive immune response. Sentinel cells, complement, inflammation, interferons. Communication between innate and adaptive response. Adaptive immune response: humoral and cellular. The importance of the antiviral cellular immune response. The bacterial immune system CRISPR / Cas.

10. Origin and evolution of viruses

Origin of viruses; regressive theories and those in favor of a cellular origin. Mechanisms for the generation of diversity. Mutation frequencies and relative abundance of mutants. Fixation of mutations. Viral replicases and fidelity of copy. Variability and evolution in RNA and retrovirus viruses. Viral quasi-species. Evolution and evolutionary potential. Darwinian and non-Darwinian selection of mutations. Foundational effects and bottlenecks.

11. New viral diseases and emerging viruses

Emergence of new viral diseases. Host jump and viral reservoirs. Viral emergency and re-emergence. Determining environmental, social and technological factors. Importance of arthropod vectors. The human species as a terminal host. New viruses and emerging viral diseases. Hemorrhagic fevers. Ebola virus and human immunodeficiency virus. The continuous re-emergence of the influenza virus.

12. The virome

The concept of virome and methods for its study. Viruses in the planet. The iceberg concept and the Global Virome Project. Acquisition of viruses in humans. Horizontal transmission of the viruses. The horizontal transmission of phenotypes. The human holobiont. The role of the virome in biology of the holobiont, in health and disease. Virome and sexuality.

13. Peculiar infectious agents

Prions: Infectious proteins. Development of the concept of prion. The amyloid. PrPc synthesis and processing. PrPsc formation and prion propagation. Spongiform encephalopathies: inheritance and infection. Phenotypic diversity of prions; the strains. "Scrapie" and bovine spongiform encephalopathy. Interspecific barriers. Human spongiform encephalopathies: Kuru, Creutzfeldt-Jakob syndrome and hereditary diseases. Prions in yeast. Viroids: structure and constancy of domains. Possible mechanisms of pathogenesis. The Satellites. The delta hepatitis virus. Virophages.

14. Bacteriophages

Use of bacteriophages in molecular genetics and biotechnology. The "phage display". The generation of antibodies without immunization and the search for new ligands. Directed molecular evolution. Drug selection systems.

15. Artificial viruses

Viruses as new manipulable nanomaterials. Viral gene therapy; important features and biological risks. Gene therapy products on the market. Artificial viruses as alternatives to viral gene therapy. Kinds of artificial viruses and biomolecules used. Modular strategies. Selection of virus-inspired functional domains. Examples and applications of artificial viruses.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom or remote classes	42	1.68	CM17, KM17, SM16
Type: Supervised			
Preparing public presentation of projects	50	2	CM17, KM17, SM16
Type: Autonomous			
Study	20	0.8	CM17, KM17, SM16
Texts reading	30	1.2	CM17, KM17, SM16

The subject will be taught through lectures and active learning with activities and scientific cases, in which students acquire skills in bibliographic research, experimental approaches and problem solving. Students will do oral presentations derived from practical work, and teamwork will be encouraged, as well as activities' coordination and rational presentation of work projects and results. It will be focused on methodological aspects as well as in biomedical, biotechnological, pharmacological and nanotecnology applications of virus and derived structures.

"*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

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
Final exam: third partial + synthesis exam. Multiple choice	40%	2	0.08	CM17, KM17, SM16

Midterm exams multiple choice	30%	3	0.12	CM17, KM17, SM16
Oral presentations and/or written projects	30%	3	0.12	CM17, KM17, SM16

The evaluation will be done through 3 exams, two non-eliminatory partials and a final exam that will include the third partial and a synthesis part. The exams will be distributed during the course, with a total weight over the final qualification of 70% (15%, 15% and 35 + 5% respectively). Furthermore, 30% of the qualification will be obtained through oral presentations of problems and resolution of classroom problems or presentation of written exercices (in teams). For these activities (30%) no remedial test is programmed.

The remedial exam will be a multiple-choice test and will have questions from the entire syllabus. The exam will be open to students who have failed in the global score of the subject, but also to those who want to improve their scores. Prior registration is required. Separate remedial exams for each part examination cannot be made. The remedial will cover the whole subject and the score obtained will be that of the recovery exam (70%), regardless of the scores obtained in the previous exams. In compliance with article 112 ter point 2 of the current Academic Regulations of the UAB, to be eligible for the remedial test, students must have been previously evaluated in a set of activities equaling at least two thirds of the final qualification of the course. Therefore, the students will obtain the "No Avaluable" qualification when the evaluation activities carried out have a weight lower than 67% in the final score.

For those who have voluntarily chosen the single evaluation, this will consist of a single multiple-choice exam in which the contents of the entire program of theory and seminars of the subject will be evaluated. The score obtained in this test will account for 70% of the final score. The single evaluation test will coincide in the calendar with the last test of the continuous evaluation and the same remedial test will be applied. The evaluation of the seminars will follow the same process than the continuous evaluation and thescore obtained will represent 30% of the final score of the subject.

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Software

It is not necessary to use specific programs in this subject.

Language list

Name	Group	Language	Semester	Turn
(TE) Theory	43	Spanish	second semester	morning-mixed