Universitat Autònoma de Barcelona

2022/2023

Virology

Code: 100873
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OB	2	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: No
Some groups entirely in Spanish: No

Other comments on languages

Lectures and assessments will be done in catalan and spanish, exclusively, at the discretion of the teaching team. Teaching materials will be offered in English.

Teachers

Neus Ferrer Miralles

Prerequisites

Is essential to have a general background in Biochemistry, Molecular Biology, Cell Biology, Microbiology and Immunology and interest in Virology.

Objectives and Contextualisation

The teaching objectives of the course are the acquisition by the students of basic knowledge about biology, structure, genetics and evolution of viruses. This will be done within the framework of their pathogenesis and considering the 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.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
- Collaborate with other work colleagues.
- Describe the structural, physiological and biochemical characteristics of the different types of cells and explain how their properties fit in with their biological function.
- Integrate scientific and technological knowledge.

- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
- Manage bibliographies and interpret the information in the main biological databases, and also know how to use basic ICT tools.
- Read specialised texts both in English and one's own language.
- Stay abreast of new knowledge of the structure, organisation, expression, regulation and evolution of genes in living beings.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- 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.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Collaborate with other work colleagues.
3. Define rules for the safe handling of microorganisms.
4. Identify the genetic properties of microorganisms.
5. Identify the genetic, physiological and metabolic properties of microorganisms that can potentially be used in biotechnological processes.
6. Identify the physiological and metabolic characteristics of microorganisms.
7. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
8. Master the nomenclature of microorganisms.
9. Read specialised texts both in English and one's own language.
10. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
11. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
12. Think in an integrated manner and approach problems from different perspectives.

Content

1. An introduction to viruses and Virology

The world of viruses. Strict parasitism, multiplication and transmission. The viral disease and the concept of "iceberg". Viral diversity. The viral particle: size, 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: extracellular and intracellular phases. Virus multiplication: productive and non-productive infection. Sequential expression of viral genes. Viruses, mobile genetic elements and living beings.

2. Historical overview of Virology

Hypotheses about the maintenance of life and spontaneous generation. The work of Pasteur. Microscopic infectious agents and Koch's postulates. The nineteenth century: the discovery of viruses. The tobacco mosaic virus: the concept of "filtrable infectious agent". Discovery of animal viruses. The twentieth century: characterization, chemical and genetic structure of viruses. Significant events in the history of virology. The eradication of smallpox and the risk of re-emergence. Clinical aspects of virology and biotechnology. Bioterrorism.

3. Viral multiplication

Cell recognition. Nature and function of receptors. Internalization. Uncoating. The cellular shutdown. Stimulation of cellular functions: papillomaviurs, polyomavavirus and adenovirus. Synthesis of RNA, DNA and viral proteins: temporal sequences. Cytopathic effects. Exit of viral particles with and without lysis. Apoptosis.

Cellular transformationin RNA virus: cellular oncogenes,activation and transduction. Cellular transformation in DNA virus: viral oncogenes and oncoproteins. Processing of viral proteins. Targets for antiviral drugs. RNA interference.

4. Structure of viral particles

Morphology of viral particles. Architectural study of viral particles: electron microscopy and three-dimensional reconstructions. X-ray diffraction: level of resolution. 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 epitope variability. Other structural components of viruses.

5. Genetics and viral genomes

Diversity of viral genomes. Principle of economy and complexity of viral genomes; overlapping genes. Segmented and split genomes. Information encoding the viral genome. Types of viral genomes: gene expression and replication strategy for each type; temporal regulation strategies. The infectious clone. Principles of reverse genetics. Defective viruses.

6. Origin and evolution of viruses

Origin of viruses and regressive theories for a cellular origin. Mechanisms of generation of diversity. Mutation frequencies and relative abundance of mutants. Fixation of mutations. Viral replicases and copying fidelity. Variability and evolution in RNA viruses and retroviruses. The viral quasispecies. Evolutionand evolutionary potential. Darwinian selection and Darwinian mutations. Founding effects and bottlenecks. Genetic and antigenic divergence, the influenza virus.

7. Emerging viruses and viral diseases

Emergence of new viral diseases. Host jump and viral reservoirs. Viral emergence and viral re-emergence. Environmental factors, social and technological factors. Importance of arthropod vectors. The human species as a terminal host. New emerging viruses and humanviruses. Hemorrhagic fevers. The Ebola virus and human immunodeficiency virus, poxvirus and coronavirus. The continuing re-emergence of influenza virus and others. The virome.

8. Virological methodology

Obtaining viral particles. Cell culture. Small and medium scale cultures. 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.

9. 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 viruses not yet classified. Nomenclatural changes. The main human pathogens and their diseases.

10. Peculiar infectious agents

The prion: Infectious proteins. Development of the prion concept. The amyloid. Synthesis and processing of PrPc. PrPsc formation and propagation of prions. Spongiform encephalopathies: inheritance and contagion. Phenotypic diversity of prions; strains. The "scrapie" and bovine spongiform encephalopaty. Interspecific

barriers. The human spongiform encephalopathies: Kuru, Creutzfeldt-Jakob disease and hereditary diseases. Prions in yeast. Viroids: structure and consistency of domains. Possible pathogenetic mechanisms. The satellites. The hepatitis delta virus. The virophages.

11. 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. Systems of selection of antiviral drugs: the case of protease inhibitors.

12. Pathogenesis of viral infections.

"Good" viruses. Virus-host coexistence. Asymptomatic infections. Characteristics of viral infections. Gates of entry. Transmission routes: horizontal and vertical. Localized and systemic 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 response by the virus. Immunopathology.

13. Response to viral infections and vaccines.

Types of vaccines; attenuated and inactivated. Molecular basis of attenuation. New generation of 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.

14. 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. Types of artificial viruses and biomolecules used. Modular strategies. Selection of virus-inspired functional domains. Examples and applications of artificial viruses.

Methodology

Classes will be distributed over 3 hours per week, of which 2 will correspond to master classes and 1 to the resolution of problems, group work in the classroom and presentation of oral works.

The course will comprise classroom lectures and active learning activities with scientific problems and cases by which students will acquire skills necessary to perform literature research, propose experimental approaches and design problem solving strategies. Oral presentations of active learning activities will encourage teamwork, coordination of activities and rational presentation of work plans and results. Active learning activities will be focused on methodological aspects and biomedical, biotechnology, pharmaceutical and nanotechnological applications of virus as well as derived viral structures. Personal tutorial guidance sessions will be available by email appointment and will be held in the office C3/331. In those sessions, students will have the opportunity to receive individual guidance according to their needs.

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			
Preparation and public presentation of papers and projects	48	1.92	1, 11, 10, 2, 7, 9, 12
classroom-based master classes	45	1.8	1, 11, 10, 3, 8, 6, 4, 5, 7
Type: Supervised			
Text reading	50	2	2, 9, 12

Assessment

The assessment will be done through 3 exams, two non-eliminatory partials and one final exam which will include the third part and a synthesis exam. Exams will be distributed during the course, with a total weight on the final mark of 70% (15%, 15% and 35 + 5% respectively). In addition, 30% of the mark will be obtained by the oral presentation of works and solving classroom problems or presenting written works. For these activities (30%) recovery will not be programmed.

The recovery exam will be a test type and can only be accessed by students who have failed the overall grade for the course, but have at least 3.5 on the overall grade. In compliance with article 112 ter point 2 of the UAB Academic Regulations in force, to participate in the recovery, students must have previously been evaluated in a group of activities the weight of which equals a minimum of two thirds of the total grade for the course or module. Therefore, the students will obtain the grade of "No Evaluable "when the evaluation activities carried out have a weight lower than 67% in the final grade.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam: 3 partial + syntesis test. Test exams	40 %	2	0.08	1, 11, 10, 3, 8, 6, 4, 5, 7
Oral and/or written presentation	30 %	3	0.12	1, 11, 10, 2, 7, 9, 12
Partial exams. Multiple choice	30 %	2	0.08	11, 10, 2, 8, 6, 4, 7, 9, 12

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Software

No specific software is foreseen.