UAB
Universitat Autònoma de Barcelona

Virology

Code: 100873
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500252 Biochemistry	OB	2

Contact

Name: Neus Ferrer Miralles
Email: neus.ferrer@uab.cat

Teachers

Neus Ferrer Miralles
Ugutz Unzueta Elorza

Teaching groups languages

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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. 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.

2. 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.

3. 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.

4. Viral multiplication

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

5. 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.

6. 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.

7. 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.

8. 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/Cas9.

9. 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.

10. 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. Evolution and evolutionary potential. Darwinian selection and Darwinian mutations. Founding effects and bottlenecks. Genetic and antigenic divergence, the influenza virus.

11. 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 human viruses. Haemorrhagic fevers. The Ebola virus and human immunodeficiency virus, poxvirus and coronavirus. The continuing re-emergence of influenza virus and others. The virome.

12. Peculiar infectious agents

The prion: Infectious proteins. Development of the prion concept. The amyloid. Synthesis and processing of PrP^{C}. PrP^{Sc} formation and propagation of prions. Spongiform encephalopathies: inheritance and contagion. Phenotypic diversity of prions; strains. The "scrapie" and bovine spongiform encephalopathy. 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.

13. 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.

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.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom seminars	15	0.6	2, 3, 4, 5, 6, 8, 9, 12
classroom-based master classes	30	1.2	1, 3, 4, 5, 6, 7, 8, 10, 11
Type: Supervised			
Individual/group tutoring	2	0.08	3, 4, 6, 8
Type: Autonomous			
Bibliographic search	4	0.16	9
Group work: preparation of reports	20	0.8	1, 2, 10, 11, 12
Oral preparation of assignments	10	0.4	12
Personal study	52	2.08	3, 4, 5, 6, 8

Text reading	10	0.4	9

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.

Assessment

Continous Assessment Activities

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

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 grade obtained in the theory exams (1P + 2P + 3P + synthesis) (or in the recovery exam) must be equal to or greater than 5.0 to be used in the calculation of the final grade for the course. In the case of obtaining a grade lower than 5.0 in the theory exams, even if the weighted average of all evaluative activities (theory + seminars) is 5 or higher, the maximum score obtained would be 4.5.

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 isrequired. 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 compliancewith 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, thestudents 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 make-up test will be applied. The evaluation of the seminars will follow the same process than the continuous evaluation and the score obtained will represent 30% of the final score of the subject.

Bibliography

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Software

No specific software is foreseen.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	321	Catalan/Spanish	second semester	afternoon
(TE) Theory	32	Catalan	second semester	afternoon