

Virologia

2015/2016

Codi: 101002

Crèdits: 6

Titulació	Tipus	Curs	Semestre
2500502 Microbiologia	OB	2	2

Professor de contacte

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Utilització de llengües

Llengua vehicular majoritària: anglès (eng)

Equip docent

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Prerequisites

Is essential to have a good level of spoken and written English and a general background in Biochemistry, Molecular Biology, Cell Biology, Microbiology and Immunology.

Objectius

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 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.

Competències

- Aplicar les metodologies adequades per aïllar, analitzar, observar, cultivar, identificar i conservar microorganismes d'ambients, aliments i productes o objectes elaborats per l'home
- Aplicar microorganismes o els seus components al desenvolupament de productes d'interès sanitari, industrial i tecnològic
- Caracteritzar els agents causals de malalties microbianes en l'home, en els animals i les plantes per diagnosticar-les i controlar-les, fer estudis epidemiològics i conèixer la problemàtica actual i les estratègies de lluita contra aquestes malalties
- Identificar els mecanismes moleculars de la patogènia i relacionar-los amb la resposta contra la infecció per dissenyar i desenvolupar estratègies de diagnosi i de lluita contra les malalties causades per microorganismes
- Obtenir, seleccionar i gestionar la informació
- Saber treballar individualment, en grup, en equips de caràcter multidisciplinari i en un context internacional
- Utilitzar bibliografia o eines d'Internet, específiques de microbiologia i d'altres ciències afins, tant en llengua anglesa com en la llengua pròpia

Resultats d'aprenentatge

1. Comprendre les bases microbiològiques que s'utilitzen per desenvolupar productes d'interès sanitari
2. Conèixer els grups més importants de microorganismes patògens
3. Conèixer els processos moleculars del cicle víric i identificar les dianes potencials de fàrmacs antivírics
4. Conèixer i identificar les aplicacions biotecnològiques i nanomèdiques dels virus en microelectrònica, com a biosensors i per al lliurament dirigit de fàrmacs
5. Conèixer les bases moleculars de la invasivitat i la virulència vírica i reconèixer el valor de les variants víriques atenuades en el disseny de vacunes
6. Identificar els elements vírics útils per al disseny d'antígens, immunògens i vacunes
7. Identificar els elements vírics útils per dissenyar reactius de diagnòstic
8. Identificar i descriure els microorganismes utilitzats per al bioterrorisme
9. Identificar les tècniques utilitzades per a la conservació i l'emmagatzematge de microorganisme
10. Identificar les tècniques utilitzades per a la multiplicació, la detecció i la identificació de virus
11. Obtenir, seleccionar i gestionar la informació
12. Saber treballar individualment, en grup, en equips de caràcter multidisciplinari i en un context internacional
13. Utilitzar bibliografia o eines d'Internet, específiques de microbiologia i d'altres ciències afins, tant en llengua anglesa com en la llengua pròpia
14. Utilitzar les tècniques de les òmiques per identificar gens i proteïnes relacionats amb la patogenicitat i virulència i utilitzables en el disseny de vacunes i compostos antimicrobians

Continguts

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 not 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: papovavirus 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.

4. Viral genomes and genetics

Principle of economy and complexity of the viral genome, overlapping genes. Segmented and multipartite genomes. Sequencing of viral genomes and function prediction. Recombination, rearrangement and phenotypic mixing. Types of viral mutants. Defective viruses: integrated genomes, satellite virus and defective interfering particles. Complementation. The infectious

clone. Gene expression in different types of viruses, temporary regulation strategies. Principles of reverse genetics. Tools for viral gene transfer and gene therapy. Presentation of antigen and peptides in recombinant viruses. Gene cloning and expression vectors of viral origin.

5. Viral taxonomy

Early classifications of viruses: Baltimore classification of animal viruses. The International Committee on Taxonomy of Viruses and the classification system. Properties used in viral taxonomy. Families of animal viruses and viruses not classified. The major human pathogens and their diseases.

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. Evolution and evolutionary potential. Darwinian selection and Darwinian mutations. Founding effects and bottlenecks. Genetic and antigenic divergence, the influenza virus. Analysis of the viral phylogeny

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 human viruses. Hemorrhagic fevers. The Ebola virus and human immunodeficiency virus. The new hepatic viruses. The continuing re-emergence of influenza virus and others.

8. Viral structure

Morphology of viral particles. Architectural study of viral particles: electron microscopy and three-dimensional reconstructions. The X-ray diffraction: requirements and level of crystallographic resolution. Architecture molecular of helical and icosahedral symmetry. Trans-membrane proteins in viral envelopes. Receptor binding sites. The viral antigens and epitopes B and T. The neutralization and evasion of antibody neutralization. Genetic and epitopic variability.

9. Prions and viroids

Infectious proteins: the prion. 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 hepatitis delta.

10. 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.

11. Methods in Virology

Obtaining viral particles. The cell culture. Small and medium scale cell culture. Purification. Quantitative analysis of viral particles. Detection of viral components and applications in the diagnostic methodology. The virology laboratory: areas and distribution. The biological safety

levels of containment: P1 to P4. Air treatment. Tributary treatment. Vaccine factories: industrial-scale up production of viral particles.

12. Viral pathogenesis

Characteristics of viral infections. Entry routes. Localized and systemic infections. Invasiveness. Viremia. Nerve transmission. Target tissues: tropism. Virulence. Role of organic response in the pathogenesis. Infection: transmission routes. Vectors and reservoirs. Persistent viral infections, mechanisms of persistence. The measles virus. The Epstein-Barr virus. Viral hepatitis. HIV infection; dynamic aspects of persistence. The movement of plant viruses.

13. Responses to viral infection

Nonspecific antiviral mechanisms. Induction and activity of interferons. Induction and evolution of the immune response. Role of antibodies and T cells. Prophylaxis of viral infections: vaccination. Types of vaccines: attenuated and inactivated. Polio vaccines. Molecular basis of attenuation. New generation vaccines. Antigens and immunogens. Recombinant proteins and peptides. Pseudo-capsid vaccine. The vaccine against hepatitis B and papilloma viruses. Vaccination with DNA.

14. Artificial viruses

Viral gene therapy; important features and biological risks. Artificial viruses as alternatives to viral gene therapy. Type of artificial viruses and used biomolecules. Modular strategies. Selection of functional domains. Examples and applications of artificial viruses.

Metodologia

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 C3/037/039. In those sessions, students will have the opportunity to have individual guidance according to their needs.

Activitats formatives

Títol	Hores	ECTS	Resultats d'aprenentatge
Tipus: Dirigides			
Active learning activities	15	0,6	11, 12, 13
Lectures	30	1,2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14
Tipus: Supervisades			
Personal tutorial guidance sessions	2	0,08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Tipus: Autònomes			
Literature search	28	1,12	11, 13
Personal study	45	1,8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14

Reading	20	0,8	11, 12
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Avaluació

The evaluation will be done through one midterm exam and one final exam. The sum of the marks obtained in the evaluation of all written exams will represent 70% of the final grade (10% and 60% respectively). Remedial exam will be scheduled for the final exam. 30% of the grade will be obtained by oral and written presentations of assignments and classroom problem solving activities. The mark obtained in the Final Exam (or Remedial exam) must be higher than 4.5 to be used in the final mark calculation. In the case of obtaining a lower mark than 4.5 in the Final Test (Remedial Exam), the maximum mark would be 4.

Evaluation of classroom lecture competencies (70% of final grade)

-During the course two written tests will be scheduled for this evaluation form. The first test will have a weight of 10% and the second a weight of 60%.

Evaluation of oral and written presentations (30% of the final grade)

-Students will present the reports of the assigned active learning exercises in classroom sessions. Oral presentations will be evaluated on content, organization and communicative skills. Additional written reports will be evaluated on content and organization.

Delay in the delivery of activity assignments will represent a 10% reduction in the final mark obtained in the evaluated activity.

We consider that a student will be graded as "NO AVALUABLE" if the assessment of all conducted evaluation activities does not allow the student to achieve the overall grade of 5 on the assumption that he had obtained the highest grade in all of them.

Activitats d'avaluació

Títol	Pes	Hores	ECTS	Resultats d'aprenentatge
Final exam	60%	3	0,12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
First midterm exam	10%	2	0,08	2, 5, 8, 9, 10
Oral and written presentation of reports	30%	5	0,2	11, 12, 13

Bibliografia

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-E. K. Wagner and M.J. Hewlett. 2008. Basic virology . (3rd Ed) Blackwell Publishing. Oxford.

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