VNIVERSITAT DE VALÈNCIA

Course Guide
46469 Interacción Virus - Hospedador

COURSE DATA

Data Subject	
Code	46469
Name	Interacción Virus - Hospedador
Cycle	Master's degree
ECTS Credits	4.5
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2251 - Master¿s Degree in Virology	Faculty of Biological Sciences	1	First term

Subject-matter

Degree	Subject-matter	Character
2251 - Master¿s Degree in Virology	3 - Interacción Virus - Hospedador	Obligatory

Coordination

Name	Department
RODRIGUEZ DIAZ, JESUS	275 - Microbiology and Ecology

SUMMARY

In any infectious process, pathogenic organisms, in this case viruses, must interact with the host at different levels to produce infection. First, they must cross the physical, chemical and biological barriers imposed by the innate immune system of the host. Secondly, once this first barrier has been overcome, the host will react to the pathogen with an adaptive immune response mechanism based on clonal selection of specific T and B lymphocytes. Since many viruses are able to evade the immune response at both levels (innate and adaptive), persistent infections are possible. These defense mechanisms differ according to the type of host. For this reason, in addition to immunity in response to viral infections in vertebrates, the immunity of invertebrates, plants and bacteria will be studied. In the specific case of viruses, which must face a glycocalyx in order to infect, their interaction with the sugars present is highly relevant, so these relationships will also be studied. The cellular receptors of viruses, whether glycosidic or proteic, are genetically encoded, so that some polymorphisms in the genes responsible for the production of viral receptors have an impact on virus-host interaction. Finally, the role of the microbiome in viral infections should not be forgotten, so the latest advances in this field will be reviewed.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

No specific prior knowledge is required, beyond that necessary to access the Master's program.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2251 - Master¿s Degree in Virology

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- To understand natural processes relevant to the field of specialization.
- To combine theoretical contents with their practical application and appreciate the importance of both fundamental and applied knowledge.
- To develop critical thinking, identifying the limits and biases of knowledge in the field of specialization.
- To explore and value the socio-economic implications of the field of specialization.
- To develop communication skills and use a language appropriate to the profile of the interlocutor.
- Place the specialty in the context of other fields and general knowledge.
- To identify common patterns shown by virus-host interactions in different systems (animal, plant, bacterial).
- To understand the molecular, cellular and systemic processes that constitute the host response to a viral infection, in order to correctly interpret observations such as infection symptoms, viral infection cycles, and viral evolution.
- To identify relevant factors in viral infection processes beyond the virus itself and its host, such as co-infections, the composition of the microbiome and others, and to understand how they condition the outcome of a viral infection.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

To acquire an overview of the different types of interactions established between viruses and the host organism.

To know the innate immune system of vertebrates, its components and modes of action.

To describe the adaptive immune system in vertebrates, the mechanisms of molecular recognition and antigen presentation, as well as the organs, cells and molecules responsible for the adaptive immune response.

To understand the mechanisms of viral evasion of the immune response and how chronic and latent infections are established.

To know the innate immune system of invertebrates and the main differences with respect to vertebrates.

To understand the mechanisms by which plants respond to viral infections.

To know the classical phage resistance systems, the CRISPR system and other bacterial specific immunity systems.

To discover the relevance of glycobiology in virus-host interactions, especially in mucosal infections.

Acquire the concept of host genetics and its relevance in viral infections.

To know the role of host microbiota in viral infections.

DESCRIPTION OF CONTENTS

1. Innate immunity in vertebrates

Virus recognition by molecular pattern receptors (PMRs). Type I interferons, types and mechanisms of action. Autophagy as an antiviral response. Regulation and action of antimicrobial peptides. Other antiviral factors, cytidine deaminases and others. Complement system, structure and function. Immunity by NK cells. Antiviral function of macrophages. Trained innate immunity.

2. Inmunidad adaptativa en vertebrados
Nombre de la U.T. (English): Adaptive immunity in vertebrates

Antigen presentation systems, MHCI and MHCII. CD4+ and CD8+ T lymphocytes, generation and effector and memory mechanisms. B lymphocytes, antibody-mediated immunity, generation and effector and memory mechanisms, neutralization, antibody-mediated cytotoxic effects. Immunological basis of vaccination

3. Viral evasion of immune response

Evasion of recognition by PMRs, surface antigen masking, glycosylation and other mechanisms. Evasion of effector mechanisms, viral proteins blocking effector mechanisms of innate and adaptive immunity, reduction of viral antigen presentation. Alteration of antiviral response, immunosuppression caused by viruses. Population scale escape, intrahost scale viral mutations, genetic drift and change (e.g. influenza), population scale HIV evolution in response to MHCI and MHCII. Chronic HIV infection and immunopathogenesis. Chronic HCV infection, chronification of infection, chronic inflammation and cancer. Latency mechanisms in DNA viruses: herpesviruses.

4. Immunity in invertebrates

Specific characteristics of innate immunity in invertebrates: Toll, IMD y Jak/STAT pathways, viral recognition, cellular immunity and humoral immunity. Programmed cell death and apoptosis. RNA interference as antiviral strategy: short-interfering RNAs (siRNAs) and PIWI-interacting RNAs (piRNAs). Endogenous viral sequences and immune memory in invertebrates. Host antiviral pathways targeted by insect viruses.

5. Immunity in plants

Plant-pathogen interaction (general). Levels of defense. Basic defense mechanisms (PAMP triggered immunity). Effector-mediated response. Gene-to-gene response. Systemic acquired resistance. Plant viruses. Classification. Disease symptoms. Host specificity. Factors influencing the course of infection and disease. Plant virus genomes. Single-stranded RNA viruses, double-stranded RNA viruses and DNA viruses. Mechanisms of virus replication. Basic mechanisms of defense against viruses. Plant viruses. Gene silencing and systemic silencing. Suppression of silencing. Strategies to generate virus resistance. Early responses in plants, cellular scale responses, hypersensitive response. Gene silencing, RNA interference (RNAi) and viral genes that suppress them.

6. Immunity in bacteria

Classical bacteriophage resistance systems, receptor-dependent resistance, restriction systems. CRISPR system, mechanism by which it confers immunity against bacteriophages. Other recently described defense systems. Phage evasion

7. Glycovirology

Introduction to glycobiology, blood group systems (ABO, Lewis, Secretor), glycans and lectins relevant to viral infections. Glycovirology of respiratory infections, interaction of influenza virus and coronaviruses with sialic acid, importance of neuraminidase and esterase enzymes. Glycovirology of intestinal infections, importance of histo-blood group antigens in rotavirus and norovirus infections.

8. Host genetics and virus infection

Relevant genetic polymorphisms in HIV, SARS-CoV-2, rotavirus and norovirus infections.

9. Microbiome and viral infections

Role of the microbiome in respiratory viral infections. Role of the intestinal microbiome in intestinal viral infections. Role of the virome in viral infections.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	45,00	100
Study and independent work	49,00	0
Readings supplementary material	12,00	0
Preparation of evaluation activities	4,00	0
TOTAL	110,00	

TEACHING METHODOLOGY

The course is based on the use of different teaching/learning activities among which the following are included:

- **Lectures**, in which the teacher will provide an overview of the fundamental concepts in each of the topics. Prior to the class, the material presented will be accessible to students through the university's teaching support platform.

- **Invited talks** by national or international experts on a topic related to the subject.

- **Face-to-face review of content** and discussion led by the faculty, which will function as group tutorials. It will serve for the follow-up and, if necessary, continuous evaluation of the students. Likewise, students will raise doubts and questions about the subject.

- **Discussion and debate** in the classroom of scientific articles and current issues, usually as a final part of the subject, where topics of interest will be addressed. For example, questions such as how many different viruses are estimated to exist in nature, whether there are evolutionary relationships between different virus families or whether they have independent origins, whether viroids are relics of the RNA world, why certain types of viruses are more abundant in plants/animals/bacteria than others, whether it is possible to predict pandemics, etc. will be discussed.

- **On-line tutorials**, for the resolution of doubts and specific problems, the raising of questions of interest and debate on current scientific and social issues related to the subject.

- **Autonomous self-evaluation activities**, such as performing tests through Aula Virtual, which allow the students to evaluate their own learning.

- **Autonomous study of materials and contents**, where students will review and, if necessary, expand the knowledge imparted by using notes, presentations, relevant bibliography, etc.

Bibliographic review and synthesis carried out by students (individually or in teams), a voluntary activity where students may review a topic of their choice and preferably present it during class time.

EVALUATION

- **Exam.** It will be held at the end of the course and it will be an indispensable condition to pass the course to obtain at least a score of 5 out of 10. It will preferably be a written test, although it may also be oral if the teacher considers it more convenient.

- **Continuous evaluation** by means of partial tests on each subject through the Aula Virtual platform. This mode of evaluation is optional and will be carried out if the teacher considers it appropriate. If implemented, it will determine between 20% and 40% of the grade obtained in the subject, the rest corresponding to the final exam (the need to obtain a 5/10 in the final exam is maintained regardless of the continuous assessment). In case of failing the course, the grade obtained in the continuous evaluation will be maintained for the next call, but not for the next enrollment.

- **Assessment of voluntary work presented by the students**, preferably orally and during class time. These works may increase the final grade by up to 2 points out of 10. In case of failing the course, the grade of this work will be maintained for the next call and also for the following enrollment.

It will not be possible to renounce the grade obtained in the course once it has been published.

REFERENCES

Basic

- Knipe, D.M., Howley, P.M. 2020. Fields Virology: Emerging Viruses. 7ª ed. Wolters Kluwer/Lippincott, Williams & Wilkins, Philadelphia. ISBN-10 : 1975112547
- Knipe, D.M., Howley, P.M. 2021. Fields Virology: DNA Viruses 7ª ed. Wolters Kluwer/Lippincott, Williams & Wilkins, Philadelphia. ISBN-10 : 1975112571.
- Knipe, D.M., Howley, P.M. 2022. Fields Virology: RNA Viruses 7ª ed. Wolters Kluwer/Lippincott, Williams & Wilkins, Philadelphia. ISBN-10 : 1975112601.
- Referencia b4: Abbas, A.K., Lichtman, A.H. Pillai, S. 2018. Inmunología celular y molecular. 9ª ed. Elsevier, Madrid.

Additional

- Ayllón, María Angeles, Mariano Cambra, Enrique Moriones, César Llave, SEF (Sociedad Española de Fitopatología). 2016. Enfermedades de plantas causadas por virus y viroides. ISBN 978-84-686-8985-2
- Levinson, W. 2006. Microbiología e inmunología médicas. 8ª ed. McGraw-Hill Interamericana, Madrid
- Hull, Roger. 2013. Plant Virology (Fifth Edition), Academic Press, ISBN 9780123848710