COURSE DATA

DATA SUBJECT

Code: 33156
Name: Molecular health parasitology
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Facultat de Ciències Biològiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	Materia de asignaturas optativas	ELECTIVES

COORDINATION

MARCILLA DIAZ ANTONIO

SUMMARY

Parasitic diseases affect one-third of the world's population, causing a large number of deaths as well as serious indirect harm, especially in children, where they can lead to delayed physical and mental development. Of the 23 diseases considered neglected by the World Health Organization (WHO), the majority are parasitic. These diseases are associated with poverty. Therefore, action against these diseases should improve the health, well-being, and livelihoods of these populations and promote their development. Nowadays, when genome sequences are available, as well as advanced molecular and genetic technologies, it is reasonable to consider their applicability to neglected diseases, such as parasitic diseases.

This course will study the biological processes in which parasites participate, delving into the development of new approaches to controlling parasites and the diseases they cause. To this end, the mechanisms that enable new rapid and effective diagnostic systems, the tools used to identify new targets for specific treatment, and technologies that enable the development of vaccines will be analyzed.

The course focuses on the molecular aspects of parasitic infections and will be of interest to those wishing to expand their training before embarking on a research career in diverse areas such as parasitology, molecular biology, or immunology, and to those seeking specialized training in parasitic diseases.

The course objectives are:

1) Provide a comprehensive overview of the biology of parasitic diseases, their transmission, and control.

2) Learn about current research studies on the immunological and molecular aspects of the most important groups of parasites.

3) Provide training in research and modern techniques in the study of parasites and their relationship with the host.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

It is recommended that students must already have a basic understanding of basic concepts in Biology, Biochemistry, and Molecular Biology. These concepts are part of the content of the courses taught during previous years of the degree.

COMPETENCES / LEARNING OUTCOMES

1101 -

Be able to use new information and communication technologies.

Capacidad para el trabajo multidisciplinar en equipo y la cooperación.

Conocer los mecanismos de interacción hospedador-patógeno para entender factores de virulencia en enfermedades infecciosas y parasitarias.

Conocer los organismos patógenos de humanos, las patologías que provocan y conocer los fundamentos de las principales estrategias terapéuticas.

Conocer los principales métodos y técnicas experimentales aplicadas al estudio de la salud y enfermedad humanas, su etiología y la efectividad de los tratamientos.

Desarrollo de habilidades para la aplicación de los conocimientos adquiridos al mundo profesional.

Entender la genómica de patógenos y sus implicaciones para el diseño de fármacos y vacunas.

Have capacity for analysis, synthesis and critical reasoning in the application of the scientific method.

Interpretar de modo crítico el papel de los datos de bioquímica clínica en el diagnóstico, pronóstico, control y monitorización de medidas terapéuticas.

Know how to apply the knowledge gained in the diagnosis, prevention and treatment of human diseases.

Know how to design multidisciplinary experimental strategies in the field of molecular biosciences to solve complex biological problems, especially those related to human health.

Know how to use the different bibliographic sources and biological databases and be able to use bioinformatic tools.

Know the usual procedures used by scientists in the area of molecular biosciences and biomedicine to generate, transmit and disseminate scientific information.

Saber diseñar y preparar nuevas vacunas.

Tener una visión integrada de las técnicas y métodos utilizados por las ciencias Biomédicas.

Understand experimental approaches and their limitations and interpret scientific results in molecular biosciences and biomedicine.

Utilización de terminología específica de la biomedicina.

DESCRIPTION OF CONTENTS

I. INTRODUCTION TO MOLECULAR PARASITOLOGY

Lesson 1. INTRODUCTION TO MOLECULAR PARASITOLOGY. Concept and purpose of Molecular Parasitology. Basics of the history of Parasitology and Tropical Medicine. Parasitic diseases and Molecular Parasitology.

Lesson 2. PARASITIC LIFE: BIOLOGICAL CYCLES. Parasitism. Types of parasitism. Parasitic diseases: clinical and economic importance. Brief description of the types of life cycles exhibited by parasites.

II. BASIC TOOLS IN MOLECULAR PARASITOLOGY

Lesson 3. PURIFICATION OF PARASITES AND THEIR MOLECULES. Isolation and culture of parasites. Specific methodology for the isolation and analysis of nucleic acids and proteins from protozoa and helminths.

Lesson 4. MOLECULAR DIFFERENTIATION TECHNIQUES FOR PARASITES. Molecular techniques: Electrophoretic analysis of enzyme variants (isozymes). Use of antibodies for isotyping. Analysis of nuclear and mitochondrial genes of parasites and vectors. Applications. Examples.

III. MOLECULAR STUDIES OF THE PARASITE-HOST RELATIONSHIP

Lesson 5. MOLECULAR PARASITE-HOST INTERACTIONS. Analysis of host-parasite relationships at the molecular level: examples. Phylogenetic studies.

Lesson 6. PARASITES AND THE IMMUNE SYSTEM. Immune response to parasites. Mechanisms of immune evasion. Antigenic variation.

Lesson 7. ANTIPARASITIC VACCINES. Types of vaccines. Malaria vaccine: principles and current status. Vaccines against other parasitic infections. Factors affecting vaccine development.

IV. MOLECULAR DIAGNOSIS AND EPIDEMIOLOGY OF PARASITES

Lesson 8. MOLECULAR DIAGNOSIS OF PARASITOSES. Summary of the main molecular diagnostic techniques applied to parasites.

V. PARASITOSIS BY PROTOZOANS

Lesson 9. INTESTINAL PROTOZOOANS. Study of *Entamoeba histolytica*, *Giardia intestinalis*, and *Cryptosporidium* spp. Molecular aspects and applications to diagnosis and treatment.

Lesson 10. TOXOPLASMOSIS. Morphological forms and life cycle of *Toxoplasma gondii*. Host cell invasion. Molecular aspects and applications to diagnosis and treatment.

Lesson 11. MALARIA. Molecular approaches to understanding the *Plasmodium* spp. genome. Molecular aspects and applications to diagnosis and treatment. Studies of anopheline vectors.

Lesson 12. Leishmaniasis. Study of kinetoplast DNA: DNA minicircles. Analysis of nuclear DNA. Molecular aspects and applications to diagnosis and treatment. Canine leishmaniasis.

Lesson 13. African trypanosomiasis. Survival mechanisms of *Trypanosoma brucei*. Antigenic variation of surface glycoproteins. Genetic mechanisms of antigenic variation. Antigenic coating of the parasite. Molecular aspects and applications to diagnosis and treatment.

Lesson 14. American trypanosomiasis. Heterogeneity of the *Schyzotrypanum cruzi* group based on DNA analysis. Use of PCR. Chromosomal analysis. Molecular aspects and applications to diagnosis and treatment. Triatomine vectors and evolutionary relationships.

VI. HELMINTHS

Lesson 15. FOODBORNE TREMATODES. Molecular studies of the genera *Fasciola*, *Echinostoma*, *Clonorchis*, *Opistorchis*, and *Paragonimus*. Transcriptomic and proteomic studies. Molecular aspects and applications in diagnosis and treatment.

Lesson 16. SCHISTOSOMOSIS. Molecular studies of *Schistosoma* spp. Genomes, transcriptomes, and proteomes. Molecular aspects and applications in diagnosis and treatment.

Lesson 17. CESTODIASIS: TAENIA AND CYSTICERCOSIS. Differentiation of *Taenia* species using molecular techniques: PCR and DNA probes. Molecular aspects and applications in diagnosis and treatment.

Lesson 18. NEMATODES I: INTESTINAL NEMATODES. Molecular studies of *Trichinella spiralis* and *Strongyloides stercoralis*. Molecular aspects and applications in diagnosis and treatment.

Lesson 19. NEMATODES II: BLOOD-BORNE NEMATODES. Molecular studies of the main filarial worms affecting humans and their applications in diagnosis and treatment.

VII. ANTIPARASITIC TREATMENT

Lesson 20. MOLECULAR TECHNIQUES APPLIED TO THE RATIONAL TREATMENT OF PARASITOSES. Currently used antiparasitic treatments and biochemical pathways. Analysis of protein structures and applications of genetic techniques.

Lesson 21. RESISTANCE TO ANTIPARASITIC DRUGS. Clinical and economic importance of the emergence of resistance. Description of resistance cases and molecular origin. Identification of strains and isolation of genes involved. Recommended therapeutic guidelines.

Lesson 22. DESIGN OF NEW ANTIPARASITIC DRUGS. Role of Molecular Parasitology in the design of new antiparasitic drugs. Generation of new drugs. Implications.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	4,00
Theory	41,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	2,00
Individual or group project	10,00
Independent study and work	34,00
Preparation of lessons	10,00

Preparation for assessment activities	9,50
Resolution of case studies	2,00
Total hours	**67,50**

TEACHING METHODOLOGY

The course is based on lectures in which the professor will present the most relevant content from each group of lessons, supported by audiovisual media. Supporting materials will be made available to the Aula Virtual in advance. The course will be complemented by seminars prepared by students, where bibliographical material will be critically discussed, as well as by attending lectures given by renowned professionals in the field of Molecular Parasitology.

EVALUATION

- Objective tests on subject content: written test (90%)

- Assessment of oral presentations: seminar presentation (10%)

REFERENCES

- Rodrigo Morchón (2024). Biología y Diagnóstico de Enfermedades Parasitarias Humanas Relevantes en España. Ediciones Universidad de Salamanca. ISBN: 9788413119038
- P.K. Bandyopadhyay, N.R. Das, Amit Chattopadhyay (2022). Biochemical, Immunological and Epidemiological Analysis of Parasitic Diseases. Springer Singapore. DOI: https://doi.org/10.1007/978-981-16-4384-2.
- Luis Miguel de Pablos Torró, Jacob-Lorenzo Morales (2018). Protozoan parasites: from omics to prevention and control. Caister Academic Press. DOI: https://doi.org/10.21775/9781910190838.
- Urusa Thaenkham, Kittipong Chaisiri, Abigail Hui En Chan (2022). Molecular Systematics of Parasitic Helminths. Springer Singapore. DOI: https://doi.org/10.1007/978-981-19-1786-8
- Paul Schmid-Hempel (2021). Evolutionary Parasitology. The Integrated Study of Infections, Immunology, Ecology, and Genetics. ISBN: 9780198832140