

26812 - Biology

Syllabus Information

Academic Year: 2022/23

Subject: 26812 - Biology

Faculty / School: 100 - Facultad de Ciencias

Degree: 297 - Degree in Optics and Optometry

ECTS: 6.0

Year: 2

Semester: Second semester

Subject Type: Basic Education

Module:

1. General information

2. Learning goals

3. Assessment (1st and 2nd call)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this subject is based on the following:

This subject is programmed so that the intensification of theoretical knowledge is completed with an eminently practical and applied orientation. Students are expected to know the basic biological concepts related to their future professional activity and to be able to apply them in practice.

To achieve this, the theoretical classes and practical classes are intercalated to optimize the learning process, reducing the time that elapses since students acquire the theoretical knowledge until they apply them in the laboratory. This strategy progressively adapts to the resolution of practical problems that is ultimately the most applied part of the subject and a way to approach students to the situations they would confront in a work in the field of Optics and Optometry.

4.2. Learning tasks

The course includes 6 ECTS organized according to:

- **Theory sessions (4,4 ECTS): 44 hours.**

- **Practical seminars (0,2 ECTS): 2 hours.**

The seminars aim to deepen the eminently practical aspects of the subject and are designed to foster the interrelation between theoretical and practical learning. Students are divided into groups of 20 to 25 to facilitate greater participation. The following seminars are included:

1.1 Microbiological diagnosis

- **Laboratory sessions (1,4 ECTS): 14 hours.**

Every student will be informed about the risks that can have the accomplishment of the practices, as well as about the dangerous goods to be used and what to do in case of an accident, and they must sign the commitment to comply with labor and safety standards in order to carry them out. For more information, consult the Information for students of the Unit of Prevention of Occupational Risks: [Http://uprl.unizar.es/estudiantes.htm](http://uprl.unizar.es/estudiantes.htm)

Laboratory practices are organized into two blocks:

5.2.1 Biochemical laboratory

?Proteins: Serum protein electrophoresis in cellulose acetate strips.

?Carbohydrates: Starch hydrolysis and determination of reducing sugars.

?Lipids: thin layer chromatography.

?Nucleic acids: Isolation and purification of DNA.

Students will submit a portfolio at the end of the internship, in which a summary of the practices carried out, with the outlines and the complementary documentation they deem appropriate to complement their learning, is presented in a concise and orderly manner. Schemes and / or drawings representing the observations and experiences developed should be included.

5.2.2 Microbiological Laboratory

? Fundamentals and methods of microbiological diagnosis of ocular infections. Collection, transport and storage of samples. Safety rules.

? Microbiological analysis of a conjunctival smear. Direct vision. Culture. Culture media. Identification through biochemical tests. Interpretation of results. Identification of microorganisms of the genera *Staphylococcus*, *Pseudomonas* spp. From cultivation. Microscopic Description. Gram stain. Learn to recognize ocular pathogens.

? Antimicrobial susceptibility study: Methods and foundation. Realization and interpretation of an antibiogram by disc diffusion technique.

4.3. Syllabus

Biology is concerned with the study of life and living organisms including their structure and function at molecular level. We will study three main areas: Structural Biology of the Cell: from biomolecules to cell structure, Metabolism: chemical reactions in living cells and energy production, and Molecular Genetics.

In addition, it includes the study of ocular infections, and its object is the study of microorganisms that causes these infections in aspects of detection, isolation, identification, mechanisms of colonization and pathogenicity, dissemination and transmission, clinical significance, epidemiology and procedures to control and to treat them and also the biological human response to them. They are considered as microorganisms bacteria, viruses, fungi, protozoa and metazoa.

The course will address the following topics:

PART I: MOLECULAR AND CELULAR BIOLOGY

1. The origin and evolution of cells. Chemical evolution. RNA world. The first cell. The evolution of metabolism. Present day prokaryotes. Eukaryotic cells. The origin of eukaryotes. The development of multicellular organisms. Classification of living organisms.

2. Chemical Components of Cells. Chemical bounds. Carbon compounds. Water. Weak interactions in aqueous systems. Biomolecules.

3. Proteins. Amino acids. Peptide bonds. Peptides and proteins. The structure of proteins: primary structure. Protein secondary structure. Protein tertiary and quaternary structures. Protein function.

4. Enzymes. The catalytic activity of enzymes. Mechanisms of enzymatic catalysis. Coenzymes. Regulation of enzyme activity.

5. Carbohydrates. Monosaccharides and Disaccharides. Polysaccharides: structure and function. Glycoconjugates: Proteoglycans, glycoproteins and glycolipids.

6. Lipids. Fatty acids. Triacylglycerols. Structural lipids in membranes: Glycerophospholipids, Sphingolipids. Cholesterol: vitamin D and steroid hormones. Dolichols. Eicosanoids.

7. Nucleic Acids. Nucleotides. Other functions of nucleotides. Nucleic acids structure and function. DNA: the double helix. RNA: types. Ribozymes.

8. Eukaryotic cell: Cell membranes. Cytoplasm. Membrane lipids. Membrane proteins. Cell membrane structure: the phospholipid bilayer. The glycocalyx.

9. Transport across membranes: Passive diffusion and carrier proteins. Ion channels. Active transport driven by ATP hydrolysis. Active transport driven by ion gradients. Endocytosis.

10. The endoplasmic reticulum, the Golgi apparatus and lysosomes. Protein sorting and transport. The endoplasmic reticulum and protein secretion. The smooth ER and lipid synthesis. Export of proteins and lipids from the ER. Organization of Golgi. Protein glycosylation within the Golgi. Lipid and polysaccharide metabolism in the Golgi. Protein sorting and export from the Golgi. Vesicular transport. Cargo selection, coat proteins and vesicle budding. Vesicle fusion. Lysosomal acid hydrolases. Endocytosis and lysosome formation. Phagocytosis and autophagy.

11. The cytoskeleton and cell movement. Structure and organization of actin filaments. Actin, Myosin and Cell movement. Microtubules. Microtubule motors and movement. Intermediate filaments.

12. The nucleus. The structure of nuclear envelope. Nuclear lamina. The nuclear pore complex. Transport of proteins to and from the nucleus. Transport of RNAs. Chromatin. The nucleolus and rRNA processing.

13. Mitochondria. Peroxisomes. Organization and function of mitochondria. Mitochondrial genetic system. Structure and function of peroxisomes.

14. Bioenergetics and Metabolism. Energy, Catalysis, and Biosynthesis. Free energy and ATP. The generation of ATP from glucose, lipids and amino acids. Krebs cycle. The electron transport chain. Chemiosmotic coupling. Cell Communication.

15. Molecular genetics. Chromosomes: centromeres and telomeres. Genomes. Asexual and sexual reproduction. Mendelian inheritance. Genes. Introns and exons. Genetic variation. Mutations. Repetitive DNA sequences. Gene duplication

and pseudogenes.

16. From DNA to proteins. DNA replication. DNA repair. DNA transcription. RNA processing. Translation of mRNA. Genetic code. Control of gene expression.

17. The Cell Cycle and Apoptosis. The eukaryotic cell cycle. Regulators of the cell cycle progression. Mitosis. Meiosis. Cell death: necrosis and apoptosis. Programmed cell death.

18. Light induced molecular changes of vision process. Photoreceptor Cells (Rods and Cones). Isomerization of Retinal (11-*cis*-Retinal vs. All-*trans*-Retinal). Protein Conformational Changes Resulting from Retinal Isomerization. Signal Transduction Cascade to Generate a Nerve Impulse. Ion channels. Recovery.

PART II: MICROBIOLOGY AND DIAGNOSTIC OF OCULAR INFECTIONS

19. Introduction to Microbiology and Parasitology. Historical memory. Current concept and content of the discipline. Discovery of ocular infections. Applications of Microbiology for optical/optometrist.

20. General characteristics of bacteria. Structure and composition of the bacterial cell. Capsule, flagella, fimbriae, glycocalyx. Cellular wall. Cytoplasmic membrane. Cytoplasm. Nuclear equivalent. Bacterial division. Sporulation and germination.

21. Nutrition and microbial growth. Nutrition. Aerobic and anaerobic respiration. Fermentation. Growth and reproduction. Bacterial growth curve.

22. Bacterial Genetics. Mutations. Plasmids, insertion sequences, transposons and integrons. Bacterial transfer and recombination. Transformation, transduction, conjugation, transposition.

23. Microbiology applied to the practice of the optical/optometrist. Action of physical and chemical agents on microorganisms. Disinfection and sterilization. Antiseptics and disinfectants. Terms of use. Biofilms: Deposits, adhesion and growth of microorganisms on contact lenses.

24. Antimicrobials. Classification and mechanisms of action. Study methods of antimicrobial susceptibility. MIC and MBC. Antimicrobial resistance mechanisms. Bases of clinical use of antimicrobials.

25. Relations bacteria-host. Epidemiology and prophylaxis. Microbiota of healthy eye. Bacterial ecology. Pathogenicity and virulence. Determinants of microbial pathogenicity and host defense mechanisms. Epidemiology and prevention of infectious diseases. Epidemiological chain. Exposure and disposal prophylaxis.

26. Ocular infections. Overview and main characteristics of microbial infections. Conjunctivitis, keratitis, endophthalmitis and ocular adnexal infections. Microbiological diagnosis of ocular infections.

27. Bacteria that cause ocular infections. Study of microbiological characteristics, ocular manifestations, prevention and treatment of infections caused by Gram-positive bacteria (*Staphylococcus aureus*, *Streptococcus pyogenes* and *Streptococcus pneumoniae*) and Gram-negative bacteria (*Pseudomonas aeruginosa* and *Neisseria gonorrhoeae*).

28. Ocular infections caused by Clamydias. Study of trachoma. Inclusion conjunctivitis and other eye infections. Prevention and treatment.

29. Viruses that cause ocular infections. Nature of the virus. Characteristics of the virus particle. Microbiological study, Ocular manifestations, prevention and treatment of ocular herpes infections, adenovirus and enterovirus.

30. Fungi that produce ocular infections. The fungi. Growth and reproduction. Classification of fungi. Fungi as etiological agents causing eye infections. Features of ocular mycoses. Prevention and treatment.

31. Parasites that cause ocular infections. Study of some protozoa that produce ocular manifestations: *Toxoplasma*, *Acanthamoeba*, *Onchocerca* and *Toxocara*. Prevention and treatment.

4.4. Course planning and calendar

? The theoretical classes will be held on Mondays, Tuesdays and Wednesdays.

? The practical seminars will be carried out when indicated by the corresponding professor.

? Laboratory practices will be held on Mondays, Tuesdays, Wednesdays, Thursdays and Fridays.

? The tutorials will take place in appointments arranged with the corresponding teacher.

? The delivery to the guardian of the report regarding the regulated practices will be concluded after the completion of the same.

? The theoretical exam will be done in the corresponding calls:

1st Call: June

2nd Call: September

For further details concerning the timetable, classroom and further information regarding this course please refer to the "Facultad de Ciencias" website (<https://ciencias.unizar.es/calendario-y-horarios>) and in the learning platform Moodle within the *Biología 26812* course.

4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=26812>