

27103 - General Biology

Syllabus Information

Academic Year: 2022/23

Subject: 27103 - General Biology

Faculty / School: 100 - Facultad de Ciencias

Degree: 446 - Degree in Biotechnology

ECTS: 12.0

Year: 1

Semester: Annual

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 methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, practice sessions, and seminars.

Students are expected to participate actively in class throughout the semester.

Further information regarding the course will be provided the first day of course in the classroom.

4.2. Learning tasks

The course will address the following learning task:

- Learning activity 1: Lectures.

Acquisition of basic knowledge of biology (9 ECTS).

Methodology:

1) Participatory lectures. The basic material will be provided by the professors to the students through the UNIZAR learning platform, on the website: <http://add.unizar.es:800/newweb/web/index.html>.

2) Tutorials.

- Learning activity 2: Practice sessions. Training of working with biological materials (2 ECTS).

Methodology:

1) Practices in the laboratory.

2) Individual work.

3) Elaboration of a report.

- Learning activity 3: Seminars (1 ECTS).

Methodology:

- 1) Problem-based learning.
- 2) Work in group and individual.

"The teaching and assessment activities will be carried out in person unless, the provisions :
to be carried out electronically. "

4.3. Syllabus

The course will address the following topics:

1st part: CELL BIOLOGY (1st semester)

- 1. Origin and overall view of cells. Introduction to Cell Biology. Origin and evolution of cells. Eukaryotic cells and cell diversity. Cells as experimental models.
- 2. Techniques to study cells. Light microscopy. Fluorescence microscopy. Electron microscopy: SEM, TEM. Physical methods for cell separation. Subcellular fractionation.
- 3. Chemical components of cells. Basic cell molecules and macromolecules. Cell localization and function of sugars lipids, proteins and nucleic acids. Basic relationships between chemical structure and cell function.
- 4. Enzymes in cells. Basic features and actions of enzymes. Cofactors. Active site. Enzyme kinetics. Effect of pH, temperature and inhibitors on enzyme activity.
- 5. The cell membranes. General functions of biomembranes. Structure of plasma membrane. Asymmetry of membrane lipids. Types of membrane proteins. Membrane dynamics. Lipid rafts and membrane domains.
- 6. Membrane transport. Overview of membrane transport. Simple diffusion and facilitated diffusion. Protein-mediated transport: channels, permeases. Cotransport. Active transport: ionic pumps, ABC transporters.
- 7. Endocytosis. Phagocytosis and pinocytosis. Receptor-mediated endocytosis. The endocytic route: ligands and receptors sorting.
- 8. The Endoplasmic Reticulum. Protein intracellular traffic: overview and mechanism of protein sorting to organelles. Sorting signals. Rough and smooth endoplasmic reticulum (RER, SER). Secretory protein synthesis. Membrane protein synthesis. Protein glycosylation. Quality control in endoplasmic reticulum. Chaperones. Membrane lipid synthesis.
- 9. The Golgi Apparatus. Export of proteins from ER: the ERGIC. Structure and dynamics of Golgi apparatus. Golgi biogenesis models. Glycoprotein and glycolipid synthesis. Protein transport and the Golgi. Constitutive and regulated secretion. Lysosomes.
- 10. The Nucleus. Structure of interphase nucleus: nuclear membrane, nuclear lamina, chromatin, nucleolus. Chromosomes. Nucleus during mitosis: assembly and disassembly of nuclear membrane. The nuclear pore complex and nuclear-cytoplasmic traffic. Protein import and export. Control of nuclear transport.
- 11. Mitochondria and peroxysomes. Structure and phylogeny of mitochondria. Mitochondrial DNA. Mitochondrial biogenesis. Useful energy generation in mitochondria. Electron transport protein complexes. ATP synthase functioning. Structure, function and biogenesis of peroxysomes.
- 12. The cytoskeleton. General characteristics and composition. Actin filaments: molecular turnover in vitro and in vivo. Actin-binding proteins: assembly of bundles and networks. Microtubules: structure and properties. Dynamic instability in vitro and in vivo. Microtubule-organizing centers and centrosome. Microtubules and cell division. Microtubules, microfilaments and cell motility. Transport of vesicles organelles and cell structures on microtubules and microfilaments: motor proteins. Intermediate filaments: structure and functions.
- 13. The cell cycle. The life destiny of a cell: proliferation, differentiation and apoptosis. Cell cycle phases. Cell cycle checkpoints. Regulators of cell cycle progression: cyclins and cyclin-dependent kinases (cdk). Types of cyclins and cdk. Regulation of cyclin activity: cyclin inhibitors. Mitosis and meiosis.

2nd part: Histology

- 15. Introduction to animal histology. Definition of histology and tissue. Determining factors for the maintenance of the cellular organization in the tissues. Overview of the basic tissues types. Basic Histological Techniques: fixation, embedding, sectioning, mounting, staining and observation.
- 16. Epithelial tissue. Definition and common types of epithelial tissues. Epithelial: types and descriptions, properties, localizations and cell junctions. Functions of the epithelial. Basement membrane. Introduction to glandular tissue. Development of epithelial tissues.
- 17. Connective proper tissue. Definition and classification. Connective tissue proper: cells, and extracellular matrix (ground substance and fibers). Types of connective tissue proper: loose connective tissue, dense connective tissue (regular and irregular) and reticular connective. The functions of connective tissues proper. .
- 18. Cartilage tissue. Definition and classification. Hyaline cartilage: structure, growth and remodelling, cartilage matrix and cells (chondroblasts and chondrocytes). Fibrocartilage and elastic cartilage
- 19. Adipose tissue. White adipose tissue: structure, distribution, adipocytes and functions. Brown adipose tissue:

structure, distribution, adipocytes and functions.

- 20. Blood. Components of blood: plasma and blood cells. Description and function of blood cells: erythrocytes, thrombocytes and leucocytes Functions of blood tissues.
- 21. Bone tissue. Definition, classification and structure of bone tissues. Extracellular matrix of bone tissue. Bone cells: osteocytes, osteoblasts, osteoclasts. Functions of the bone tissues.
- 22. Muscle tissue. Types of muscle tissue: smooth muscle, cardiac muscle and skeletal muscle. Smooth muscle: cellular organization. Skeletal muscle: cellular organization, striations, the sarcomeres. Cardiac muscle: cellular organization and intercalated discs.
- 23. Nervous tissue. Structure: components and classification of tissue. Neurons: structure, functions and types. Neuroglia cells: functions and types

3rd part: Ecology and evolution

- 24. Evolution. History and evidences. Historical overview. Lamarck's hypothesis of Evolution. The origin of species through natural selection. Evolution: scientific evidence.
- 25. Evolution of populations. Variability in populations. Hardy-Weinberg principle. Change's agents.
- 26. Speciation and macroevolution. Reproductive barriers. How do new species arise? Speciation ways: allopatric and sympatric speciation. Macroevolution: adaptive radiation. Key features. Extinction. Punctuated equilibrium theory.
- 27. Reconstruction and use of phylogenies. Taxonomy, phylogeny and systematics. Construction of phylogenetic trees. Homology and analogy. Parsimony and probability. Application of phylogeny.
- 28. Taxonomy and phylogeny of living beings. Archaea, Bacteria and Eukaria domains.
- 29. Population ecology. Density, dispersion and demographics. How does a population grow? Regulation of population growth. Population dynamics. Application.
- 30. Community ecology. Interspecific competition: Principle of competitive exclusion. Fundamental and realized niche. Predation. Herbivorism. Symbiosis. Facilitation. Species diversity. Species with great impact on the community.
- 31. Ecosystem ecology. Dynamics of energy and nutrients in an ecosystem. Primary and secondary production in ecosystems. Trophic structure. Biogeochemical cycles.
- 32. Conservation biology. Biodiversity crisis. Main threats to biodiversity: Habitat destruction, introduced species, overexploitation, alteration of interaction networks, global change. Action pathways of conservation biology

Seminars and laboratory. Seminars are intended to develop the practice of tissue recognition from microscopic slide viewing

Laboratory classes are intended to teach the student the microscopic anatomy of prokaryotic and eukaryotic cells.

4.4. Course planning and calendar

Schedules of lectures and problems will coincide with the officially established and will be available at:

<https://ciencias.unizar.es/grado-en-biotecnologia>.

The places, calendar and groups for training and practical sessions will be established in coordination with the rest of subjects at beginning of course. The Coordinator will produce the groups of students for these activities at beginning of course to avoid overlaps with other subjects.

For students enrolled in the subject, places, times and dates of lectures and practical sessions will be public via Bulletin Board advertisements of the grade on the platform Moodle at the University of Zaragoza, <https://moodle2.unizar.es/add/>, and in the moodle page for the course. These routes will be also used to communicate enrolled students their distribution by groups of practical sessions, which will be organized by the coordination of degree. Provisional dates will be available on the website of the Faculty of Sciences in the corresponding section of the Degree in Biotechnology: <https://ciencias.unizar.es/grado-en-biotecnologia>.

In this web there will be also available the dates of exams.

4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27103>