VNIVERSITAT DE VALÈNCIA

Course Guide
33128 Cellular organization

COURSE DATA

Data Subject	
Code	33128
Name	Cellular organization
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Faculty of Biological Sciences	2	First term

Subject-matter

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	5 - Biología celular	Obligatory

Coordination

Name	Department
PEREZ SANCHEZ, FRANCISCO	21 - Cellular Biology and Parasitology

SUMMARY

The course "*Organization of the cell*" provides a detailed overview of the complex structure and organization of eukaryotic cells and their functioning. It also includes basic aspects about the dynamics of cellular components and their regulation providing a background for further study in more advanced courses such as *"Intracellular dynamics and signaling", "Regulation of proliferation and cell fate"*, and *Functional Histology*. Likewise, it addresses certain alterations in cell organization under experimental or pathological conditions. As this course belongs to the *Degree in Biochemistry and Biomedical Sciences*, special emphasis will be made on biochemical-molecular and genetic issues as well as functional morphology.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

OUTCOMES

1101 - Degree in Biochemistry and Biomedical Sciences

- Conocimiento de la estructura de la célula animal y vegetal.
- Comprensión y manejo de los sistemas experimentales y métodos utilizados en la investigación en biología celular.
- Conocimiento de la compartimentación celular y comprensión de los procesos de tráfico de biomoléculas.
- Conocimiento de las bases del ciclo celular, su regulación y su función, incluyendo la meiosis.
- Capacidad para la organización de la información y la preparación de exposiciones públicas.
- Capacidad de interpretar resultados, utilizar fuentes bibliográficas y bases de datos.
- Adquisición de una visión integrada de los diversos mecanismos implicados en la función celular.

LEARNING OUTCOMES

- Demonstrate understanding of cellular organization and the mechanisms involved in cellular function.
- Demonstrate knowledge of the experimental methodologies used in Cell Biology.
- Effectively organize information and public presentations on the basis of rational and scientific arguments.
- Demonstrate ability to solve theoretical and practical issues related to the subject under study.

DESCRIPTION OF CONTENTS

1. CELL BIOLOGY: FUNDAMENTALS AND STUDY TECHNIQUES

Concept and historical perspective. The place of Cell Biology in Science. Prokaryotes and eukaryotes. General organization of animal and plant cells. Origin and inheritance of cellular organelles. Topological relationships between different cellular organelles. Unity and cellular diversity. Introduction to techniques in cell biology.

2. CELL MEMBRANES

Structure of cell membranes. Membrane components. The lipid bilayer: components, physicochemical characteristics and properties. Lipid domains of the plasma membrane. Membrane proteins. Mobility of membrane proteins. Glycocalix: glycolipids and glycoproteins. Membrane unit and compared aspects of cell membranes. Membrane domains and cell polarity. Functional characteristics of membrane proteins.

3. THE CYTOSKELETON

Components and spatial organization of the cytoskeleton. Microtubules: molecular structure and properties related to its polymerization. Microtubule organizing centers. Associated proteins (MAPs): stabilization, compartmentalization and microtubule-dependent intracellular transport (molecular motors). Structure of cilia and flagella. Mechanisms of ciliary movement. Actin microfilaments: molecular structure and dynamics. Proteins associated with the processes of nucleation and assembly. Contractility and cell migration. Microvilli and stereocilia. Submembranal skeleton. Intermediate filaments: molecular structure, physicochemical properties, functions and cellular diversity. Communication and integration between different components of the cytoskeleton.

4. EXTRACELLULAR MATRIX

Chemical characteristics of its components, synthesis, degradation and functional properties. Collagen fibers. Elastic fibers. Proteoglycans. Fibronectins and laminins. Extracellular matrix of plant cells: the cell wall. Composition, structure and specializations.

5. CELL ADHESION AND INTERCELLULAR JUNCTIONS

Cell adhesion molecules: cadherins, integrins, selectins and immunoglobulins. Interactions between extracellular matrix, plasma membrane and cytoskeleton. Functional types of junctions: molecular architecture, dynamics and regulation. Occlusion or tight junctions. Anchoring junctions: adhesion bands, focal contacts, desmosomes and hemidesmosomes. Cell communication and gap junctions. Plasmodesmata.

6. CELL COMPARTMENTS AND PROTEIN SORTING

Endomembrane system and cell organelles. Cytosol. Cytoplasmic inclusions. Intracellular protein trafficking. Signal sequences and signal regions. The rough endoplasmic reticulum (RER) as a structural support for protein synthesis. The smooth endoplasmic reticulum (SER): ultrastructure and function.

7. VESICULAR TRANSPORT OF PROTEINS. BIOSYNTHETIC-SECRETORY, ENDOCYTIC AND LYSOSOMAL PATHWAYS

Molecular mechanisms of vesicular transport. Specificity between compartments and maintenance of their identity. The Golgi complex: structure, polarization and functional partitioning. Protein glycosylation and secretory vesicle formation. Exocytosis. Endocytosis. Lysosomes: intracellular digestion, heterofagosomes and autophagosomes.

8. MITOCHONDRIA AND CHLOROPLASTS

Morphology and general characteristics. Structural topography, functional correlation and biogenesis. Mitochondrial dynamics: fusion, fission, movement and mitofagy. Molecular organization of complexes of capture and transfer of energy. Protein transport. Renewal of organellar components. Peroxisomes.

9. THE CELL NUCLEUS

General characteristics of the structure and function of the nucleus. Nuclear envelope: structure, composition and dynamics. Nuclear lamina. Nuclear pores: transport of macromolecules through the nuclear envelope. Subnuclear organization: chromosome territories and interchromatin granules. Interphase and mitotic chromosomes. Ribosome biogenesis: organization of the nucleolus. Ribosomal genes and nucleolar organizers. Changes in the nucleolus during the cell cycle.

10. CELL CYCLE: PROLIFERATION, DIFFERENTIATION AND CELL DEATH

Overview of the cell cycle. Cell cycle phases: G1, S, G2 and M. Duration and major cellular events. Cell division: phases and cellular organization during mitosis. Cytokinesis in animal and plant cells. Fundamentals of cell cycle regulation. Cell differentiation. Cell death.

11. MEIOSIS AND GAMETOGENESIS IN ANIMALS. FERTILIZATION

Biological significance of meiosis. Phases of meiosis: the double miotic cycle and its relation to gametogenesis. Chromosome pairing and exchange: the synaptonemal complex. Spermatogenesis and spermiogenesis: phases, morphological and functional maturation of germ cells. Oogenesis: stages, morphological and functional maturation of the oocyte and its covers. Structure of mature sperm and oocyte. Fertilization: processes and mechanisms involved in recognition and activation of gametes.

12. PRACTICAL LABORATORY SESSIONS

Practice 1. A) Examination of an oral mucosal swab. Study of prokaryotic and eukaryotic cells. B) Carry out a peripheral blood swab: study and implementation of a differential leukocyte count.

Practice 2. Pigment granule transport in fish chromatophores: introduction to the experimental model. Basic manipulations to induce bidirectional transport of melanosomes in intact and permeabilized melanophores.

Practice 3. Pigment granule transport in fish chromatophores: bibliographic documentation, designing and conducting experiments.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	43,00	100
Laboratory practices	12,00	100
Classroom practices	5,00	100
Attendance at events and external activities	0,00	0
Development of group work	10,00	0
Development of individual work	3,00	0
Study and independent work	35,00	0
Readings supplementary material	7,00	0
Preparation of evaluation activities	0,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	15,00	0
Resolution of case studies	0,00	0
Resolution of online questionnaires	0,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theoretical classes. The teacher will present the fundamental aspects of the course contents, focusing on those that need special supervision to be understood and guide their integration with the contents of the other activities of the course, as well as point out their significance in relation to other courses. The teacher will provide students with a selection of teaching resources and bibliography for the preparation of the topics during non-presential study and work. Active participation of students will be pursued by posing questions and problems, some of which will be discussed during the lectures and other reserved for resolution in the classes of questions and problems.

Questions and problems classes. Conducted in groups of 40 students. They will be devoted to discussion and resolution of experimental questions and problems, with the aim to promote the active participation of students. Previously, the teacher will provide collections of problems and activities to be studied individually or in groups outside of class, among which selected examples will be discussed in class.

Practical laboratory sessions. Consists of experimental approaches that address the basic cellular organization and dynamics. During practical sessions, the teacher will guide the implementation and acquisition of student skills, and raise issues for discussion in groups during class or its inclusion in a report of laboratory activities that students must prepare for grading. Attendance at practical classes will be compulsory.

Seminars. Student participation in seminar activities involve the preparation and presentation of a seminar lasting approximately 30 minutes (in groups of two students) and their active participation in the discussion of the seminars. These activities will be organized jointly with other courses in the second year. The preparation of the seminars, which will be compulsory, will be supervised by the teacher through the tutorials.

EVALUATION

The **evaluation of the contents of the theoretical program**, including those for questions and problems classes and seminars, will be addressed through a single exam consisting of different kinds of questions (multiple choice, reasoning, resolution of experimental issues) which will assess the knowledge gained by the student and his ability to use scientific language. The grade obtained in this test represents **80% of the final grade**.

For the **evaluation of the practical sessions**, the following items will be considered: student assistance and participation, and quality of the activity report in format of scientific article. The grade for practical sessions will represent **15% of the final grade**.

For the evaluation of the mandatory **seminars**, the capacity for synthesis and integration of information from participating students, the clarity and quality of exposure, and the defense of the questions asked by students and teachers will be assessed. The score of the presentation of the seminar chosen among those proposed in the different subjects in the second year, will represent **5% of the final grade**.

To pass the course it will be essential to attend practical classes, participate in seminar activities, and **get a minimum of 5 points out of 10 in the exam of theory and in the practice report**. The final grade will be the result of the sum of both parts to which the grade for the seminar will be added, given that both, the theoretical and the practical parts have been successfully passed. In case of having passed only one part (theoretical or practical), the grade will be conserved until the second call.

REFERENCES

Basic

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2016). Biología Molecular de la Célula. 6ª ed. Ediciones Omega

Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. (2008). The World of the Cell. 7th ed. Pearson/ Benjamin Cummings

Becker, W.M., Kleinsmith, L.J., Hardin. (2007). El mundo de la célula. 6ª ed. Pearson/ Addison Wesley. (traducido de la 6ª ed. inglesa, 2006)

Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th.ed: Sinauer Associates, Inc

Gilbert, S.E. (2006). Developmental Biology. 8th ed. Sinauer Associates, Inc

Karp, G. (2010). Cell Biology. 6th ed. Wiley

Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. (2007). Molecular Cell Biology. 7th.ed. W. H. Freeman

Additional

- Libre acceso a libros on-line (NCBI Bookshelf):
  http://www.ncbi.nlm.nih.gov/sites/entrez/query.fcgi?db=Books

  Libre acceso a artículos científicos a través de PubMed:
  http://www.ncbi.nlm.nih.gov/sites/entrez

  Revistas científicas especializadas en revisiones:
  Annual Review of Cell Biology, Current Biology, Current Opinion in Cell Biology, Methods in Cell Biology, Seminars in Cell and Developmental Biology, Trends in Cell Biology.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available