Course Syllabus

2012-2013

1. COURSE DESCRIPTION

Undergraduate Degree:	**Biotechnology**
Combined Undergraduate Degree:	
Subject:	**Cell Biology**
Module:	**Fundamentals of Biology, Microbiology and Genetics**
Department:	**Physiology, Anatomy and Cell Biology**
Academic Year:	**2012-2013**
Semester:	**First Semester**
ETCS:	**6**
Year:	**First Year**
Typology:	**Core Subject**
Language:	**Spanish**

Typology of teaching:	**B1**
a. EB:	**60%**
b. EPD:	**40%**
c. AD:	

Course Syllabus

2012-2013

2. TEACHING TEAM

2.1. Person responsible for the subject	**José A. Sánchez Alcázar**

2.2. Lecturers	
Name:	**José A. Sánchez Alcázar**
Centre:	**Andalusian Centre for Developmental Biology (CABD)**
Department:	**Physiology, Anatomy and Cell Biology**
Area:	**Cell Biology**
Category:	**Tenured Lecturer**
Office Hours:	**Wednesdays 12:00-14:00, Thursdays 12:00-14:00 and Fridays 12:00-14:00, by appointment only.**
Office:	**22.2.4 (building 22, second floor)**
Email:	**jasanalc@upo.es**
Telephone:	**+34 954 97 80 71**

Course Syllabus

2012-2013

Name:	**Claudio Asencio Salcedo**
Centre:	**Andalusian Centre for Developmental Biology (CABD)**
Department:	**Physiology, Anatomy and Cell Biology**
Area:	**Cell Biology**
Category:	**Senior Lecturer**
Office Hours:	**Wednesdays 12:00-14:00, Thursdays 12:00-14:00 and Fridays 12:00-14:00, by appointment only.**
Office:	**22.2.4 (building 22, second floor)**
Email:	**casenci@upo.es**
Telephone:	**+34 954 97 76 37**
Name:	
Centre:	
Department:	
Area:	
Category:	
Office Hours:	
Office:	
Email:	
Telephone:	

Course Syllabus

2012-2013

3. SITUATION WITHIN THE TRAINING PLAN

3.1. Course Objectives

1) To know the structure and function of cells and cell organisms.

2) To know the mechanisms of cell division.

3) To know the cellular mechanisms that allow a response to an external stimulus.

3.2. Contributions to the Training Plan

The course is included within the Training Module 2 (Fundamentals of Biology, Microbiology and Genetics) of Biotechnology. This Module consists of a total of eight core and compulsory subjects taught in different years of the Degree. Moreover, this Module contains the introduction to the complex structural and functional design of living organisms (from micro-organisms to higher organisms: animals and plants) and to the basic properties of these organisms in terms of their energy maintenance and reproduction.
This course, along with "Animal and Plant Biology" (Module 2) and "Biochemistry: Biomolecules" (Module 5), gives the student the essential foundation for understanding the structures and functions of animal and plant cells, tissues and organs. The training received in this course, will be useful in other subjects you study, as is the case of "Plant Physiology", "Animal Physiology", "Plant Biotechnology", "Animal Biotechnology", "Cell Cultures" and "Final Year Project".
Therefore, the course "Cell Biology" is not isolated, but is related to other subjects within the Undergraduate Degree Programme.

3.3. Necessary Previous Knowledge

Knowledge of the concept of cell and cell structure.
Previous book reading about Cell Biology (see the list of recommended readings).
Understanding scientific texts in English.

Course Syllabus

2012-2013

4. SKILLS

4.1 Skills developed through this course

GENERAL SKILLS

1. To know and to understand general biological processes of living organisms from a molecular, cellular and physiological point of view.

2. To work properly in a biological, chemical or biochemical laboratory by knowing and applying the rules and techniques about health and safety, handling laboratory animals and waste management.

4.2. Skills module developed through this course

1) To understand the cell theory and to identify different cellular components

2) To understand the cell division cycle and the factors that regulate it

4.3 Specific skills of this course

AIMS-SKILLS

The overall aim of the course is the knowledge of the eukaryotic cell structures and the ability to relate these structures to their specific functions, by integrating them into a global view of the cell and the mechanisms that ensure their division and response to an external stimulus. Through passing this course, you will achieve the following specific aims-skills:

a) Cognitive skills (know what):

1. To understand the concept of cellular organization and the two possible forms of this organization.

2. To know the different cell structures and their functions.

3. To learn the molecules and structures involved in the relationship between cells and their environment, and the mechanisms that ensure this relationship.

4. To understand the eukaryotic cell cycle and its regulation, as well as the molecular mechanisms involved.

b) Instrumental skills (know-how)

5. To learn how to use the optical fluorescence microscopy to see the cells and to distinguish subcellular structures microscopically.

6. To understand the subfractionation techniques and the methods used to analyse biochemical cell structures: protein electrophoresis.
7. To recognize microscopically different stages of mitosis.
8. To learn how to perform cell and cell viability counts.
9. To give a brief talk to a non-specialist audience about a general topic in Cell Biology with possible impact on current society.

c) Attitudinal skills
Independent learning.
Ability to apply theoretical knowledge into practice.

Course Syllabus

2012-2013

5. COURSE OUTLINE

THEORETICAL CLASSES

I. FUNDAMENTALS

Unit 1. INTRODUCTION TO THE CELL. Cell theory. Concept and definition of cell and tissue. Cell theory. Prokaryotic and eukaryotic cells. General characteristics of the eukaryotic cell: general structure. Comparison between animal and plant cells.

II. ORGANIZATION AND FUNCTIONING OF THE EUKARYOTIC CELL

Unit 2. CELL MEMBRANES AND THE PLASMA MEMBRANE. Concept of membrane. Chemical composition. The lipid bilayer. Membrane asymmetry. Membrane proteins. Fluid mosaic model. Properties and functions. Plasma membrane proteins. Cell surface: carbohydrates membrane, glycocalyx. Transport through membrane . The membrane as selective barrier: molecular and ionic gradients. Transport of ions and small molecules: simple diffusion, passive and active transport.

Unit 3. THE NUCLEUS AND NUCLEOLUS. Structure of the nuclear envelope, lamina and pores. Bidirectional nuclear-cytoplasmic transport. The nucleolus: synthesis and ribosome structure. Chromatin and heterochromatin: organization in the interphase nucleus and during mitosis.

Unit 4. THE CYTOSOL. Cytosol: features and functions. Protein synthesis. Components and molecular mechanisms of protein synthesis. Protein maturation and recycling. Protein degradation.

Unit 5. INTRACELLULAR COMPARTMENTS AND PROTEIN DISTRIBUTION. Compartmentalization in the eukaryotic cell. The organelles. Processing and distribution of proteins. The signal peptide.

Unit 6. ENDOPLASMIC RETICULUM. VESICULAR TRAFFICKING. The endoplasmic reticulum: structure and composition. Functions of the endoplasmic reticulum: lipid synthesis and cellular detoxification. Functions of the rough endoplasmic reticulum: protein synthesis and modification, quality control and retention of resident proteins. The secretory pathway. Basis of vesicular transport. Types of coated vesicles: formation and fusion with the target membrane.

Unit 7. GOLGI APPARATUS AND EXOCYTOSIS. Concept and structure of the Golgi apparatus. Functions. Golgi apparatus polarity. Processing and distribution of proteins. Exocytosis. Constitutive and inducible secretion mechanisms

Unit 8. ENDOCYTOSIS. ENDOSOMES, LYSOSOMES AND VACUOLES. Endocytosis: mechanisms of endocytic vesicle formation. Types of endocytosis. Lysosomes: definition and characteristics. Synthesis and transport of lysosomal enzymes. Lysosomal digestion.

Unit 9. MITOCHONDRIAS. Cellular bioenergetics. Mitochondria: structure, composition and functions. Ultrastructure: mitochondrial compartments. Origin and biogenesis of mitochondria. Mitochondrial functions. Participation of cytosol in mitochondrial respiration: glycolysis. Mitochondrial respiration: the Krebs cycle and mitochondrial electron transport chain. Oxidative phosphorylation. Energy yield of glycolysis and respiration. Other mechanisms coupled to mitochondrial electrochemical proton gradient: transport of substances and heat.

Unit 10 PEROXISOMES. Characteristics and composition. Biogenesis: import of lipids and proteins. Functions: oxidative reactions. Specific functions in plant cells.

Unit 11. THE CYTOSKELETON I. General organization and elements. Intermediate filaments: structure and organization. Microfilaments: structure and composition. Actin polymerization. Actin-associated proteins. Microtubules: structure and composition. Tubulin polymerization. Microtubule-associated proteins. The phenomenon of dynamic instability. Centrioles, cilia and flagella: structure, biogenesis and function.

IV. FUNCTIONAL REGULATION OF THE EUKARYOTIC CELL

Unit12. CELL SIGNALING. The basic principles of cell signaling. Intracellular receptors. Cell surface receptors associated with: channels, G proteins and enzymes. Integration of signals.

Unit 13. CELL CYCLE. Cell cycle phases. Features of transitions G1-S and G2-M. Cell cycle control: components and control points. Mitosis. Cell division: mitosis and cytokinesis. Phases of mitosis. The mitotic apparatus. Molecular mechanism of chromosome behaviour during mitosis. Control of the mitosis process. The cytokinesis process. Meiosis. Sexual reproduction strategy: meiosis. First meiotic division: meiotic prophase. Synaptonemal complex and genetic recombination. Second meiotic division. Life cycles: gametic and zygotic meiosis.

Unit 14. CELL DEATH. APOPTOSIS. Types of cell death. Apoptosis: extrinsic and intrinsic pathways.

PRACTICAL CLASSES

1. - Introduction to optical microscopy.
Theoretical basis and fundamentals of the different types of optical microscopes. Description and use of optical and mechanical components of the optical microscope. Observation of samples with Bright Field, Dark Field and Phase Contrast Microscopes.
2. - Electron microscopy and autoradiography.
Theoretical basis and fundamentals of the Transmission Electron Microscope and the Scanning Electron Microscope. Comparison between electron microscopy and optical microscopy. Demonstration of processing, cut and contrast methods for electron microscopy. Observation and comments of micrographs and electron microscopy slides in which various organelles and animal and plant cellular structures are presented.
3. - Cell fractionation.
Techniques required to prepare and to generate subcellular components in biological samples. This is achieved by first addressing the basic cell culture techniques, common source of biological material under investigation. The different processes used in cell fractionation are then generally explained, indicating the suitability of each for each type of sample and its foundation.
4. - Protein electrophoresis and Western blotting.
Separation of proteins by polyacrylamide gel electrophoresis: types (SDS-PAGE, non-denaturing electrophoresis, isoelectric focusing, bidimensional gels). Observation of gel proteins: Coomassie staining and silver staining. Western blotting (electroblotting and immunostaining).
5. - Mitosis
Extension of meristematic cells and chromosome staining on crushed onion root meristem stained with Feulgen. Determination of the mitotic index and phase index.
6. - Fluorescence Microscopy. Fluorochromes. Fluorescence microscopy: fundamentals and applications. Fluorescent proteins and applications. Observation in vivo and in vitro of cells stably transfected with tubulin-GFP.

6. METHODOLOGY AND RESOURCES FOR TEACHING

1. - Theoretical classes: Theoretical lectures will be devoted to the explanation and discussion of the theoretical foundations of cell biology, using drawings and diagrams. The material will be presented on transparencies, slides or computer presentations to help students in their learning. All complementary doubts and questions shall be settled by the lecturer. To help to

assimilate course content more effectively, students should create schemes and/or concept maps and supplement classroom learning with the help of the suggested readings.

2. - Practical classes: During laboratory practical classes the teacher will make a brief introduction about the methodology to apply and will explain the objective to fulfill. Students should meet this objective with the available material by interpreting the results obtained and learning from mistakes. Practical classes and a lab notebook are mandatory for this course.

3. - Learning portfolio: Students should elaborate a learning portfolio with training activities, once these activities have been corrected and supervised by the teacher. This folder or portfolio must include the following activities, which will be continuously assessed by the teacher:
3.1) A concept map should be elaborate at the end of each theoretical unit; in this way it would be possible to monitor attendance, which will be assessed throughout the course.
3.2) Lecturer's assignments: expansion of a topic, comments about articles, etc.
3.3) Lab notebook.
4. - Office hours: The lecturer will resolve the doubts raised by students and he will also guide their work, providing, among others, useful information about how to obtain relevant information on Cell Biology in certain Internet websites. Wednesday, Thursday and Friday from 12:00 to 14:00 hours, by appointment only.

7. GRADING

Formative continuous assessment.
The subject assessment will be applicable during the entire course. With this the lecturer pretend to motivate students and to involve them in the learning process.
I. CONTINUOUS ASSESSMENT. Students should elaborate a learning portfolio with training activities. This folder or portfolio must include the following activities, which will be continuously assessed by the teacher:
I.1) A concept map should be elaborate at the end of each theoretical unit. In this way it would be possible to monitor attendance, which will be assessed throughout the course.
I.2) Assessment of questions asked by students, as well as evaluation of the answers given by students to the lecturer's questions. These questions and answers will be included in the learning portfolio if the lecturer considers it appropriate.
I.3) Assessment of comments made by students in online discussion forums about a topic suggested and discussed in class. These comments will be also included in the individual learning portfolio.
I.4) Critical reading of a scientific article. This reading will be assessed through a written comment made by the student. Comments must be sent to the lecturer by email.
I.5) Practical report. This report should demonstrate the correct interpretation of the objective to be achieved during the practical sessions of the course.

II. The practical part of the course will be assessed through A PRACTICAL EXAM that demonstrates the correct interpretation of the objective to be achieved during the practical sessions of the course.

III. A WRITTEN FINAL EXAM. This semestral examination has to accredit the minimum knowledge acquired by the student. The exam is composed by three different sections:
a) True-false questions, with penalty
b) Questions requiring medium length responses about concept-relationship
c) Practice problems

III) Final Evaluation. The course grade will be based on a written final exam, a practical exam, a learning portfolio and attendance at office hours and personal interviews. The final grade will be determined using the following weights:
- Written final exam 50% (February).
- Practical exam 25% (February).
- Assessment of the contents of the learning portfolio 20%.

- Attendance at office hours and personal interviews as a learning activity 5%.

To pass the course, the student has to obtain a grade equal to or higher than 5 at the end of the semester. If the student fails the course, the student must take a second exam in June-July. The exam will include all the skills and abilities listed in this syllabus (according to the regulations of June 29, 2012 of the Vicerrectorados de Planificación Docente y Profesorado y de Estudiantes, Deporte y Medio Ambiente).

The student will pass this exam with a grade equal to or higher than 5.

8. GENERAL BIBLIOGRAPHY

-ALBERTS, B. and others (2008) Molecular Biology of the Cell Garland Science (5 edition), 2008. 978-0-8153-4105-5

-COOPER, GM (2006) The Cell. A molecular approach. Fourth edition. ASM Press, Washington. 0-87893-219-4

-De Robertis, EMF and HIB, J. (2003) Fundamentals of Molecular Cell Biology and de Robertis. Editorial El Ateneo. 950-02-0384-7

-KARP, G. (2007) Cell and Molecular Biology. Fourth edition. John Wiley and Sons, Inc, New York. 978-0-470-04217-5

-Lodish, H. and others (2008) Molecular Cell Biology (Sixfth edition). WH Freeman and Co., New York. 978-0-7167-7601-7

-POLLARD, DT et al (2008). Cell Biology (Second edition). Saunders. 978-1-4160-2255-8

Additional information, complementary bibliography, presentations and other documents about the course are available in WebCT site.