

## 27148 - Molecular Basis of Cell Communication and Cancer

### Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	446 - Degree in Biotechnology
ECTS	6.0
Course	4
Period	Second semester
Subject Type	Optional
Module	---

### 1. Basic info

#### 1.1. Recommendations to take this course

#### 1.2. Activities and key dates for the course

### 2. Initiation

#### 2.1. Learning outcomes that define the subject

#### 2.2. Introduction

### 3. Context and competences

#### 3.1. Goals

#### 3.2. Context and meaning of the subject in the degree

#### 3.3. Competences

#### 3.4. Importance of learning outcomes

### 4. Evaluation

### 5. Activities and resources

#### 5.1. General methodological presentation

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

This course is scheduled to address an intensification of theoretical knowledge with student participation. This strategy will allow the student to revise a topic closely with an outstanding professional who will take you to a basic aspect of the biology of cells has a huge potential for its application to research and treatment of neoplastic diseases . This can facilitate the subsequent professional development os students.

#### 5.2. Learning activities

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During the Course the following activities will be developed to help the student to achieve the expected learning objectives :

Theoretical classes.

The theoretical basis of knowledge of the subject will be presented to students in a number of lectures. The lectures will deal with the specific topics mentioned in the program.

Elaboration and presentation of a work.

In this activity students will collect information on a particular program topic , with the help of teacher. Teacher will supervise the work of students through tutoring sessions . Finally , the work will be presented and discussed in the classroom.

### 5.3.Program

#### MOLECULAR BASIS OF CELL COMMUNICATION AND CANCER

##### Part I: Signal Transduction

**1. Importance of cell communication in multicellular organisms.** Pathways and mechanisms of cell communication. Transmitters, receptors and signal transduction. Main types of chemical messengers in higher animals. Chemical structure of messengers and action mechanism. Proteins as messengers: hormones and growth factors. Other messengers.

**2. Small molecules and proteins involved in signal transduction.** Membrane receptors. Cytoplasmic receptors. Nuclear receptors. Signal transmission from plasma membrane to nucleus: general mechanisms. Protein kinases and protein phosphatases. G-proteins. Importance of binding of covalent lipids. Second messengers.

**3. Signaling through G protein-coupled receptors.** Heptaspanins (7TM receptors). Heterotrimeric G proteins. Adenylyl cyclase and cAMP. Protein kinase A (PKA) and AKAP. Generation of inositol trisphosphate (IP<sub>3</sub>) and diacylglycerol from PIP<sub>2</sub>. Phospholipases C (PLC). Ca<sup>++</sup> as a second messenger: calmodulin. Protein kinase C (PKC) family. Receptors generating cGMP.

**4. Survival and proliferative routes.** Growth factor receptors. Signaling domains: SH2, SH3, PH, WW/WD. Other types of signaling domains. The MAP-kinases (MAPK) pathway. The PI3-kinase (PI3K) pathway. Protein kinase B/Akt (PKB/Akt). Signal transduction through insulin receptor. Growth-inhibitory signals: the TGF- $\beta$  pathway. Signal transduction and the cytoskeleton.

**5. Cytokines.** Cytokine families and biological effects. Properties of cytokines. Cytokine receptor families. Signal transduction: JAKs and STATs. Biotechnological applications of cytokines.

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6. **Steroid hormones and nuclear receptors.** Hydrophobic messengers: steroid and non-steroid hormones. Structure and function of nuclear receptors. Homodimeric receptors. Heterodimeric receptors. Other signaling systems activating nuclear receptors: the Wnt/b-catenin pathway.

7. **Signalling of cell death** . Types of cell death: necrosis, programmed cell death or apoptosis. Apoptosis in *Caenorhabditis elegans* . Apoptosis in mammals. Extrinsic and intrinsic pathway of apoptosis. Apoptotic proteases: caspases. Bcl-2 superfamily proteins.

### Part II: Molecular Basis of Cancer

8. **The nature and origin of cancer.** Characteristics of tumour cells. Cancer causes. Carcinogenic agents. Chemical carcinogenesis. Steps in the development of cancer. Risk factors and prevention of cancer.

9. **Experimental models in cancer research.** Cell cultures. Cell lines. Characterization of cell populations in tumour cell cultures. Animal xenografts. Biological parameters related to tumour progression. Usefulness and limitations of experimental models in cancer research.

10. **Virus and cancer: discovery of oncogenes.** Viral oncogenes. Cellular oncogenes. Human proto-oncogenes and oncogenes. The Src tyrosin kinase.

11. **Growth factors, growth factor receptors and cancer.** Growth factors and receptors (RTKs) involved in tumour pathogenesis. Autocrine growth factor (PDGF, TGF, IL-6) production and impairment of RTK function in human tumours (ErbB, ErbB2/Neu, Ret, Kit) .

12. **Disruption of cytoplasmic signalling circuitry in cancer** . Cytoplasmic proteins involved in mitogenic signal transduction: Ras, Raf, Bcr-Abl. Transcription factors: PML-RAR, Myc.

13. **Tumour-suppressor genes.** Discovery of tumour-suppressor genes. Diversity of oncosuppressor genes and proteins. Retinoblastoma protein (Rb) and regulation of restriction entry point of cell cycle. Structure, function and action mechanism of p53 protein. The MDM2 and ARF proteins.

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14. **Cell-adhesion proteins involved in tumorigenesis.** Tumour progression and extracellular matrix. Integrins. Tumour invasion and metalloproteases. Tumour angiogenesis.

### 5.4.Planning and scheduling

Schedule sessions and presentation of works

The time reserved for this subject and the planned dates for exams, can be found on the website of the Faculty of Sciences : <https://ciencias.unizar.es/consultar-horarios> . Topic Seminars will be carried out in the second part of May.

### 5.5.Bibliography and recommended resources

**CELL SIGNALING: principles and mechanisms (2015).** W. Lim, B. Mayer & T. Pawson. Garland Science, New York.

**MOLECULAR CELL BIOLOGY, 7 th ed. (2013).** H. Lodish, A. Berk, Ch.A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh., A. Amon & M. P. Scott. Chap. 15, 16, 21 & 24. Macmillan, Houndmills, England. (Spanish translation: 5th edition, ed. Panamericana)

**MOLECULAR BIOLOGY OF THE CELL, 6 th ed. (2015).** B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts & P. Walter. Chap. 15, 18, & 20. Garland Science, New York. (Existe traducción en español, ed. Omega).

**THE CELL: A MOLECULAR APPROACH , 6 th ed. (2013) .** G.M. Cooper, R. Hausman. Chap. 15, 17 &18. Sinauer, Massachusetts. (there is a Spanish translation, 2014, "La Célula", ed. Marbán)

**CELLULAR SIGNAL PROCESSING (2008).** F. Marks, U. Klingmüller & K. Müller-Decker. Garland Science, New York.

**The Biology of Cancer (2013), 2 nd ed., R. A. Weinberg .** Garland Science, New York.

**CANCER CELL SIGNALLING (2013) A. Harvey, ed.,** WileyBlackwell, UK.