Universidad Zaragoza

Academic Year/course: 2022/23

27148 - Molecular Basis of Cell Communication and Cancer

Syllabus Information

Academic Year: 2022/23
Subject: 27148 - Molecular Basis of Cell Communication and Cancer
Faculty / School: 100 - Facultad de Ciencias
Degree: 446 - Degree in Biotechnology
ECTS: 6.0
Year: 4
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The subject and its expected results respond to the following approaches and objectives:

It is an optional topic that provides specialized information within the Degree in Biotechnology.

The general objectives that are pursued are the following:

- That the student knows the basic molecular mechanisms of communication between normal cells in mammals.

- That the student knows how the alterations in these communication processes are in the molecular basis of the behavior of the tumor cells.

These approaches and objectives are aligned with Sustainable Development Goals 3 and 9 of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of learning outcomes of the subject provides training and competence to contribute to some extent to its achievement.

1.2. Context and importance of this course in the degree

This course is part of the module of optional training for students of the Degree in Biotechnology and will allow students who take it to understand the cancer problem at the molecular and cellular level and will open a possible further specialization in molecular oncology.

1.3. Recommendations to take this course

It is recommended to have studied General Biology, Physiology, Genetics and Biochemistry.

2. Learning goals

2.1. Competences

Upon learning the topic, the student will be able to to ...

Identify the complexity levels of communication between cells from local communication to long-distance communication

Understand the mechanisms and general strategies of communication between cells in mammals

Understand the general molecular principles that govern intracellular communication.

Understand the relationship between altered cellular communication and the development of cancer

Understand the mechanism by which the main oncogenes and tumor suppressor genes act

In addition to these specific competences, the student has to improve:

1) The capacity of association and deduction.

2) The ability to solve specific problems.

3) The critical analysis of the information.

4) The synthesis and integration of information.

5) The public presentation of topics.

2.2. Learning goals

The student, to pass this subject, must demonstrate the following results ...

Understand the basic mechanisms of intercellular communication

Understand the basic mechanisms of intracellular communication

Know the main signal transduction routes

Understand and know the main molecular and behavioral characteristics of human tumor cells

Know the molecular mechanisms that are at the base of the transformation of tumor cells

Understand the cause-effect relationship between molecular alterations in the signal transduction pathways and the tumor phenotype

2.3. Importance of learning goals

All work is aimed to familiarizing the student with the aspects described above. This subject shows the student how cells communicate and the importance of cellular communication mechanisms in the normal functioning of the organism as well as its alteration in neoplastic diseases.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that he has achieved the expected learning outcomes through the following assessment activities

To pass this subject, the student must reach a minimum global score of 5 points out of a total of 10.

The criteria described below will be adopted, with their corresponding level of demand.

Presentation and exhibition of an individual work or in small groups (2-3 people):

The works will deal with a subject related to the subject, which will be specified by the teacher for each group. The teacher will supervise the student's personal work, guiding him in the search for information and in his assessment. The work should be translated into a presentation in ppt format and exposed and debated in class.

Assessment criteria and levels of requirement: The completion of the written work and its presentation to the class will be scored from 0 to 10 and will contribute 30% to the final grade. The evaluation criteria will be the following:

- Information coherence
- Clarity in the exhibition
- Degree of preparation of the presentation.
- Degree of interiorization of the contents with own suggestions.

Performing an objective test

The specific competences will be evaluated through a written test consisting of short questions and small essays. It will be scored from 0 to 10 and will contribute 70% to the final grade.

The test will consist of a series of questions about the theoretical contents of the subject.

The syllabus that students must use to prepare the different tests can be found in the section "Activities and resources" of this same teaching guide

In addition to the evaluation modality indicated in the previous points, the student will have the possibility of being evaluated in a global test, which will judge the attainment of the learning results indicated above.

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 and the elaboration and presentation of a work. 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.

4.2. Learning tasks

The course includes the following learning tasks:

- Lectures. 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.
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- "The teaching and assessment activities will be carried out in person unless, due to the health situation, the provisions issued by the competent authorities and by the University of Zaragoza compel them to be carried out electronically. ?

The teaching and evaluation activities will be carried out in face-to-face mode, unless, due to the health situation, the provisions issued by the competent authorities and by the University of Zaragoza require them to be carried out telematically

4.3. Syllabus

The course will address the following topics:

MOLECULAR BASIS OF CELL COMMUNICATION AND CANCER

Section 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-couled receptors.** Heptaspanins (7TM receptors). Heterotrimeric G proteins. Adenylyl cyclase and cAMP. Protein kinase A (PKA) and AKAP. Generation of inositol trisphosphate (IP_3) and diacylglicerol from PIP2. Phospholipases C (PLC). Ca++ 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-b. 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.
- 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.

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

4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the Facultad de Ciencias website https://ciencias.unizar.es/grado-en-biotecnologia.

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.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27148