COURSE DATA

Data Subject	
Code	33129
Name	Intracellular dynamics and signaling
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

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

Subject-matter

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

Coordination

Name	Department
ESTRUCH ROS, FRANCISCO	30 - Biochemistry and Molecular Biology
KIRSTEIN, MARTINA	21 - Cellular Biology and Parasitology

SUMMARY

Cell biology within the degree in Biochemistry and Biomedical Sciences is divided into two subjects: 1) *Cell Organization* and 2) *Intracellular Dynamics and Signaling*. In *Cell Organization*, which is taught in the first semester of the second course, students will study the structure and organization of the cell and the functions carried out by cellular organelles. *Intracellular Dynamics and Signaling* is taught in the second semester of the second course and through it, the students will expand their knowledge of cell function and the relationship of the cell with its environment at a molecular level.

The subject *Intracellular Dynamics and Signaling* is divided into two blocks. The first examines the movement of molecules between different compartments of cell membranes and the mechanisms of protein degradation. The second examines how the cell receives extracellular signals produced by nearby or distant cells and how thess signals are transduced within the cell resulting in a specific response. Particular attention will be paid to the relationship of the issues with biomedical research.

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.
- Comprensión de los sistemas de comunicación y señalización intra- e intercelulares.
- Conocimiento de las respuestas celulares a las señales ambientales, incluyendo cambios en la estabilidad de las proteínas.
- 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

Understanding of the cellular organization and the mechanisms involved in cell function.

Mastery on a practical level of experimental methodologies used in cell biology.

Effective organization of information and ability to exhibit rational and scientific arguments.

Demonstration of the ability to solve theoretical and practical issues related to the subject under study.

DESCRIPTION OF CONTENTS

1. Signaling between cells: general aspects.

Concept of signal transduction. General characteristics of signal transduction. Stages and elements of the signaling pathways. Dynamics of signal-receptor interaction. Receptor occupancy and physiological response. Receptor desensitization.

2. Signaling through ion channels and intracellular receptors.

Voltage-operated ion channels and channels operated by ligands. Intracellular receptors. Structure: functional domains. Transcriptional regulation by intracellular receptors. Non-genomic signaling through intracellular receptors.

3. Signaling through G-protein coupled receptors (GPCRs).

Structure and receptor activation. Receptor dimerization. Trimeric G proteins. Effectors of G proteins: generation of second messengers. Adenylate cyclase and cAMP. The phospholipase C: DAG and IP3. The calcium in the cell. Other GPCR effectors. Modulation of the routes involving G proteins.

4. Signaling through receptors with enzymatic activity.

Tyrosine kinase receptors (RTKs). Structure and activation mechanism of RTKs. Recruitment of protein on activated RTKs: SH2, SH3 and PTB modules. Ras protein family. Ras effectors. MAP kinases. The PI3K route. Akt: activation and effectors. Receptors with Ser / Thr protein kinase activity: the TGFb / Smads pathway.

5. Signaling through non-receptor protein kinases.

Cytokine receptors: the Jak / STAT pathway. Src family kinases: structure and activation. Effectors of the Src family kinases. Signaling from the extracellular matrix: integrins. Elements of signaling pathways activated by integrins.

6. Signaling pathways involving proteolytic processes.

Signaling factors involved in cell death: FasR and caspases. The NF-kB pathway. The Canonical and non-canonical pathways. The Notch pathway. Signaling by cholesterol: SREBP. The Wnt pathway. The Hedgehog pathway.

7. Introduction to intracellular trafficking.

Study methods. Communication between compartments. Signal sequences and signal areas that specify location of proteins.

8. Nucleus.

The nuclear pore and nucleoporins. Regulated transport, transport of proteins between cytosol and nucleus. Nuclear transport receptors. Molecular basis of cytoplasmic-nuclear transport (importation) and nuclear-cytoplasm transport (exportation). Diseases associated with nuclear transport. Viral transport between nucleus and cytoplasm.

9. Transmembrane transport.

Molecular basis of protein transport to the different compartments of mitochondria and chloroplasts. Protein translocators and chaperones. Destination of proteins synthesized in the mitochondria. Protein import into peroxisomes.

10. The secretory pathway.

Protein translocation into the endoplasmic reticulum (ER). Post-translational modifications and quality control in the ER. Protein folding and molecular chaperones. ER associated degradation (ERAD). The unfolded protein response (UPR).

11. Vesicular traffic.

Types of coated vesicles: clathrin, COPI and COPII. Coat proteins and adapter proteins. Mechanisms resulting in vesicle formation and pinching off. Regulation of vesicular trafficking and maintenance of compartment diversity.

12. Transit from the ER to the Golgi apparatus and lysosomes.

The intermediate compartment ER-cis Golgi (ERGIC). ER exit sites (ERES). Classification of proteins in the early secretory pathway. The Golgi apparatus and its matrix. Traffic from cis to trans in the Golgi apparatus. Classification of proteins in the trans Golgi network. Transport form the trans Golgi network to lysosomes. Classification of hydrolases to lysosomes. Lysosomes and exocytosis. Lysosomal diseases.

13. Endocytosis.

Pinocytosis and phagocytosis. Receptor-mediated endocytosis. Endosome maturation. ESCRT protein complexes. Lipid domains and caveolae. Retromers. Endocytosis as the entry point of pathogens in the cell. Exocytosis. Exosomes.

14. The lysosomal protein degradation system.

Degradation by autophagy. Different types of autophagy. Protein degradation and human diseases.

15. Non-lysosomal proteolysis in eukaryotes.

Proteasome: structure, activators, substrates and functions. Immunoproteasome. Ubiquitination of proteins. Proteolytic and non-proteolytic processes controlled by ubiquitination. Calpains.

16. Practical seasons

Practice 1. Basic procedures of cell culture techniques.
Practice 2. The effect of colchicine on the localization of cellular organelles.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	47,00	100
Laboratory practices	8,00	100
Classroom practices	5,00	100
Attendance at events and external activities	5,00	0
Development of group work	10,00	0
Development of individual work	5,00	0
Study and independent work	20,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	5,00	0
Resolution of case studies	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Lectures. The course is divided into 40 one-hour lectures at a rate of 2 / 3 hours per week. Before each topic the teacher will issue the key aspects that students should know and prepare at home. In order to promote that the classes can be followed easily, the teacher will expose the appropriate material beforehand in the platform which supports virtual classroom teaching. In class these issues will be treated in depth. According to the topic more or less time will be devoted to it. Special emphasis will be made on crossreferencing other subjects.

Problems classes. During the course, five hours will be devoted to discuss and resolve issues and aspects related to topic items. The questions will be provided to students in advance so they can prepare the answers. To facilitate communication and participation, the class is divided into 2 groups of 40.

Seminars. The course participates in the seminar program which is coordinated with other courses of the second year. In Intracellular Dynamics and Signaling 4 seminars with groups of two students with a duration of approximately 30 minutes each will be given. At the beginning of the course the teacher will provide the students with a list of possible topics, all of them being related to the topics of the lectures. The preparation of the seminars will be supervised by the teacher. Students will have to present the seminar only once during the course. A seminar-conference given by a visiting researcher will be offered as well. The seminars are obligatory.

Practical laboratory sessions. Basic cellular dynamics will be addressed. They consist of 2 sessions with a duration of 4 hours each. During the practical session, the teacher will oversee the performance of the practical part and will stimulate discussion during the session. Attendance of practical laboratory sessions will be compulsory.

EVALUATION

For each of the two parts of the course (Part 1: Signaling and Part 2: Intracellular Dynamics) there will be a written exam consisting of

(I) An objective test type multiple choice

(Ii) A written test on the basis of short questions.

The value of this exam in the signaling part will be of 4 points and in Intracellular Dynamics part of 4.5 points.

To pass the course the student will need to have a total score equal o greater than 4.25 points and have earned a minimum of 1.6 points in Part 1 (Signalling) and 1.8 in Part 2 (Intracellular Dynamics) (ie 40% of the total score).

It will be possible to keep the note of one part for the second call provided that such part has been approved on first call, ie at least 2 points for the signaling part and at least 2.25 for the Intracellular Dynamics part.

The practical part of the subject will have a value of up to 1 point in the final grade and will be assessed by examination. Attendance of classes will be taken into account. A grade of 0.5 or above in the practical exam is required to pass the course.

Seminars will have a value of up to 0.5 points in the final grade. For their evaluation, the capacity of synthesis and integration of information as well as clarity and quality of the exhibition and the defense, consisting in questions posed by students and teachers, will be assessed.

To pass the course the final score, sum of the test scores, practices and seminar should be of 5 or higher.

REFERENCES

Basic

- Alberts, Johnson, Lewis, Morgan, Raff, Roberts and Walter. (2014) Molecular Biology of THE CELL. 6. ed. Garland Science

  Lodish et, Berk, Kaiser, Krieger, Bretscher, Ploegh, Amon i Scott. (2015). Biologia Cel·lular i Molecular. 7. ed. Panamericana.

Additional

- Hardin, Bertoni and Kleinsmith. (2015) BECKER'S World of the Cell 9.ed. Pearson.

  Cooper and Hausman. (2013) The Cell: A Molecular Approach. 6. ed. Sinauer Associates.

  Hancock, J.T. (2010) Cell signaling. 3. Ed. Oxford.

  Karp (2013) Biologia Cel·lular i Molecular: conceptes i experiments. 6. Ed. McGrawHill

  Wilson and Hunt (2014) Molecular Biology of THE CELL. The Problems Book. Garland Sciences.

ADDENDUM COVID-19

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

1 y 2) Contenidos y Volumen de trabajo.

Sin cambios

3) Metodología.

El punto de inicio dado el número de estudiantes y las aulas disponibles es de plena presencialidad en las actividades. Sin embargo, ante la posibilidad de que la evolución de la situación derivada de la COVID-19 obligue a una reducción de la presencialidad, se tomarán las siguientes medidas:

1) Las actividades presenciales en aula se sustituirían en función de las herramientas tecnológicas disponibles en el aula en el momento de desarrollo del curso, por las siguientes metodologías:

-Videoconferencia síncrona

-Presentaciones Powerpoint locutadas en Aula Virtual

-Propuestas de actividades de resolución de Cuestionarios de Aula Virtual y entrega de tareas y cuestiones por Aula Virtual

2) Las actividades presenciales de prácticas de laboratorio, se sustituirían por las siguientes metodologías:

- Presentaciones Powerpoint locutadas en Aula Virtual

- Trabajo con datos experimentales suministrados

- Discusiones en foros asíncronos en Aula Virtual

3) Para tutorías y dudas se utilizarían las siguientes metodologías:

-Chats síncronos en Aula Virtual

-Foros asíncronos en Aula Virtual

-Comunicación directa profesor-estudiante a través del correo institucional

4) Evaluación.

En caso de reducción de la presencialidad, se reajustará la distribución de la nota de la siguiente manera:

Exámenes teóricos: 7 puntos

Examen Prácticas: 1 punto

Seminarios: 0,5

Trabajos bibliográficos: 1,5 puntos

En caso de que los exámenes no pudieran ser presenciales, se realizarían ‘on line’ en Aula Virtual mediante las herramientas disponibles.

Los detalles concretos de la adaptación a las situaciones que se pudieran producir se supervisarán por la CAT y se comunicaran a los estudiantes a través de Aula Virtual

5) Bibliografía.

Sin cambios