ESCI upf.
School of International Studies

TEACHING PLAN FOR

Molecular and Cell Biology

1. Basic description

Name of the course: Molecular and Cell Biology
Module: Life Science
Academic year: 2016-2017
Year: 2017
Term: Second
Degree / Course: First
Code: 51206
Number of credits: 6
Total number of hours committed: Complete
Teaching language: English
Lecturer: Berta Alsina is the subject coordinator. Other professors participating in the theoretical classes are Bàrbara Negre, José Ayté and Elena Hidalgo. Berta Alsina, Bàrbara Negre, Laura Taberner and Margarita Cabrera will also contribute to the teaching of seminars and practical classes.

Timetable: Complete

2. Presentation of the course

MCB is a mandatory subject of the *Curriculum* of the Bioinformatics grade. It will be given in the 2nd trimester of the 1st year and will include 6 credits ECTS, 3 of them of theory and 3 practical/seminars.

Objectives

Molecular Biology combined with Cellular Biology means to study the molecular processes occurring and ruling the cell's physiology. The teaching project of this subject pretends, among other goals, to:

1. Introduce the student into the world of Molecular Biology, to understand the transfer of genetic information from nucleic acid till protein synthesis and cell function.

2. Help the student to know the general structure, organization and function of eukaryotic cells. We aim to transmit the student how morphology, structure and function are connected.

3. Teach to student the bases of basic research in molecular and cellular biology, and help them reaching the correct conclusions from their experimental results.

This is an introductory course and basic information on molecular and cellular mechanisms will be given to provide students with basis to comprehend specialized courses of bioinformatics curricula.

3. Competences to be worked in the course

General competences	Specific competences
CB1, CB2, CB4, CG1	CE1, CE2, CE4, CE7

I. General competences

CB1. That the students have demonstrated to have acquired the knowledge and understanding in a field of study that starts from the basis of general secondary education, and is typically at a level that although it is supported by advanced textbooks, includes some aspects that involve knowledge of the forefront of their field of study.

CB2. That the students know how to apply their knowledge to their work or vocation in a professional manner and have competencies typically demonstrated through devising and defending arguments and solving problems within their field of study.

CB4. That the students can convey information, ideas, problems and solutions to both specialist and non-specialist audiences.

CG1. That the students will acquire an intra- and interdisciplinary training in both computational and scientific subjects with a solid basic training in biology.

II. Specific competences

CE1. To acquire biological knowledge from the cellular to the organismal level, with an interdisciplinary vision and special emphasis on biomedical applications.

CE2. To manage and exploit all kinds of biological and biomedical information to transform it into knowledge.

CE4. To integrate clinical and omics data for a greater understanding of biological phenomena.

CE7. To demonstrate knowledge, skills and appropriate practices in the area of the biology of organisms and biosystems.

Learning outcomes

RA1.1, RA1.3, RA1.4
RA2.1, RA2.2
RA4.1

RA1.1. Validate appropriate knowledge and skills in the area of biological sciences.

RA1.3 Understand the stages of gene expression: phenomena of cell division and death in unicellular and multicellular organisms, regulation and use of RNA as a functional molecule.

RA1.4. Identify the main metabolic pathways and the process of transmission of extracellular signals.

RA2.1. Visualize, manipulate and extract biological data.

RA2.2 Improve understanding of disease onset and progression.

RA4.1. Process, manage and interpret basic omics data (genomics, proteomics, transcriptomics).

4. Contents

- **Basic description of contents outlined for the curriculum**

This course covers the basic principles of cell structure and function, in both prokaryotic and eukaryotic cells. Subjects include the cytoskeleton, the endoplasmic reticulum, lysosomes, chromosome, nucleus and cytoplasmic organelles. The course also explores molecular mechanisms and replication, transcription and translation, as well as regulation and control.

- **Provide more detail and expand upon the description of contents**

A) TRANSFER OF GENETIC INFORMATION (15 hours)

Session 1. DNA: base of the genetic information (1.5 h)
Heredity material: DNA. Transfer of genetic information in bacteria. Types of genetic elements. Genetic information and evolution.

Session 2. DNA replication (I) (2 h)
DNA replication as a semiconservative process. General aspects of replication using *Escherichia coli* as a model system. Replication of eukaryotic chromosomes; telomers, telomerase. Replication of RNA genomes such as HIV; reverse transcriptase. Replication fidelity.

Session 3. DNA replication (II): control of the cell cycle in eukaryots (1,5 h)
Control of DNA replication in eukaryotic cells. Phases and control of the cell cycle. Molecular bases of cancer. Cell cycle modeling.

Session 4. DNA Recombination, damage and repair (2 h)
Molecular bases of genetic variation: recombination and mutation. DNA damage, and DNA repair.

Session 5. Transcription in prokaryots (1 h)
DNA as template of RNA: the transcription process. Basic mechanisms of transcription in bacteria. Regulation of transcription: induction and repression.

Session 6. Transcription in eukaryots (2.5 h)
The eukaryotic genome: size, structure, especial elements, repetitive sequences. Nucleosomes and chromatin. Basic mechanisms of transcription. Regulation of transcription and chromatine compactness. mRNA processing: 3', 5' or capping, splicing.

Session 7. mRNA translation and post-transcriptional regulation of gene expression (2.5 h)
The genetic code: translation of nucleotide triplets to amino acids. Components of the translation machinery: mRNA, tRNA, ribosomes. Control of translation. Mechanisms of post-transcriptional control of gene expression: siRNA, microRNAs, ncRNAs, asRNA.

Session 8. Processing, degradation and intracellular transport of proteins (2 h)
Final steps in protein synthesis: folding, cleavage, covalent modification. Regulation of protein degradation in eukaryots: the lysosomal and ubiquitin-based systems. Intracellular targeting of proteins.

B) BASICS OF EUKARYOTE CELL: FROM STUCTURE TO ORGANIZATION (15 hours)

Session 9. The plasma membrane and extracellular matrix (2h)
The plasma membrane as mediator of the inside and outside cellular milieu. Composition and functions. Cell to cell contacts and cell extracellular matrix. Adherent Junctions, Occluding Junctions, Desmosomes, Communication Unions.
Extracellular matrix components. Collagens: structure and distribution. Elastin, proteoglicans and glucoproteins. Hyaluran. Functional integration. The basal lamina: morphology, structure and function.

Session 10. The extracellular matrix (1h)
Extracellular matrix components. Collagens: structure and distribution. Elastin, proteoglicans and glucoproteins. Hyaluran. Functional integration. The basal lamina: morphology, structure and function.

Session 11. The cytoskeleton and cell shape changes (2 h)
General organization of cytoskeleton. The microtubules, associated proteins and dynamics. Microtubules Organizing Centers (MTOC). Centrosome. Actin microfilaments: organization, dynamics and associated proteins. Intermediate filaments: classification and organization, differences with microfilaments and microtubules. Cilia and flagella. Cellular motility and cellular shape rearrangements.

Session 12: Cell death and cellular aging (2h)
Cell death pathways. Caspases, Telomeres. Balance between aging and cancer.

Session 13: Cytology (2h)
General organization of animal tissues. Basic properties of epithelial, connective, nervous and muscular tissues. Cell polarity. Epithelial-mesechymal transition (EMT)

Session 14: Pluripotency and differentiated cells (2h)
General concepts of pluripotency and differentiation. Stem cells. Symmetric and Asymmetric divisions. Balance between proliferation and differentiation in tissues. Regeneration and reprogramming.

Session 15: Cellular Communication between animal cells (3 h)
Basic principles of cell signaling. Characterization of signaling components: signallng molecules, receptors, second messengers, effectors, signaling complexes. Integration and amplification of signals. Basic classification and characterization of membrane receptors. Intracellular/nuclear receptors.

Session 16: Cell Signaling and Gene Regulation (1 hour)
Basic signaling pathways. Signaling disruption in disease. Cancer

SEMINARS (12 hours)

Seminar 1. Introduction to the Molecular Biology practical laboratory work (1.5 h)
Seminar 2. Introduction to the Cellular Biology practical laboratory work (1.5 h)
Seminar 3. Conclusions from Molecular Biology practical laboratory work (with computers) (2 h)
Seminar 4. Conclusions from Cellular Biology practical laboratory work (with computers) (2 h)

Seminars 5 to 8. Advanced techniques in Molecular and Cellular Biology
Seminar 5. Basic principles in the generation of transgenic and knock-out animals. The CRISP-Cas9 system (1 h)
Seminar 6. Ultrasequencing and chromatin immuno-precipitation techniques (2 h)
Seminar 7. Study of protein structure and proteomes by modelling and mass spectrometry (1 h)
Seminar 8. Basic uses of flow cytometry in cell biology (1 h)

PRACTICAL LABORATORY WORK (24 hours)

The practical work will last 6 days (3 for molecular biology, 3 for cellular biology), with a total of 24 hours.

Molecular Biology practical work. Basic techniques – generation and sequencing of DNA

The student will learn some basic techniques in molecular biology, such as transformation of bacteria, purification of plasmid DNA and sequencing and analysis of this DNA, as well as PCR amplification of some template DNAs.

Cellular Biology practical work. Basic Techniques in cell culture and analysis of cell processes

The student will learn basic techniques in cell biology such as practical manipulation and culture of mammalian cells. Cell transfection and beta-galactosidase activity analysis. Fluorescent labelling of cellular components and visualization. Proliferation interference.

5. Assessment

A series of exams are used to measure the success in meeting the course learning objectives. In order to successfully complete this course, the student must pass at least with 50 % on the final mandatory examination. All exams are compulsory.

The course assessment will be performed as follows: from 10 points, 7 points will correspond to the evaluation of the theoretical contents (5 points theoretical final exam, 1 point mid-term theoretical exam, 1 point essay), 3 points to the evaluation of practical and seminar contents.

5 points, Evaluation of theoretical final exam will consist in:
a) Multiple Choice: 70%
b) Short Questions: 30%

1 point, Evaluation of mid-term theoretical exam will consist in:
True/False type of exam:100%
Grades given after 15 days maximum

1 point, Evaluation of written essay of a topic of the course provided by the teachers
Grades given after 15 days maximum

3 points, Evaluation of practical and seminars contents will consist in:
Short questions: 80%
Assistance and participation: 20%

The laboratory practices and seminars are mandatory. The assessment will be individual. Assistance and participation to practical and seminars will be part of the grade.

Copy in any exam or plagiarism in the essay implies failing the course.
A specific exam will be provided to the student only when particular impossibility to attend to the exam (death of close relative, student medical problem).

Recuperation Information

Only the students that after the evaluation have not passed the course can go retake the final theoretical exam in July. The grades obtained at the new exam will substitute the grades of the previous failed exam during the trimester and

will be used to calculate the final grade according to the percentages reported above.

Assessment elements	Time period	Type of assessment		Assessment agent			Type of activity	Grouping		Weight (%)
		Comp	Opt	Lecturer	Self-assess	Co-asses s		Indiv	Group (#)	
Written essay		x		Berta Alsina			synthesis-based	x		10%
Evaluation of Practicals and seminars		x		Bàrbara Negre			applicatio n-based	x		30%
Theoretical Final Exam	20-27 March	x		All			synthesis-based	x		50%
Theoretical Mid- Term Exam		x		Elena Hidalgo/J ose Ayté			synthesis-based	x		10%

Working competences and assessment of learning outcomes:

																	Learning outcomes

Text books:

TYMOCZKO, BERG, STRYER. Bioquímica, Curso básico. 2ª edición. Ed. Reverté. 2013

BERG, J. M.; TYMOCZKO, J. L.; STRYER, L AND GATTO, G. J. Biochemistry. 7th ed. Londres, UK, WH FREEMAN. ISBN. 9781429276351. 2011.

LODISH, KAISER, BRETSCHER, AMON, BERK, KRIEGER, PLOEGH, SCOTT. Molecular Cell Biology, seventh Edition. 2013.

MATHEWS, C. K.; VAN HOLDE, K. E.; AHERN, K.G. Biochemistry. 3ª ed. San Francisco: Benjamin/Cummings, 2002.

GARRETT, R. H.; GRISHAM, C. M. Biochemistry. Saunders. Orlando (Fla.): Brooks/Cole, 2005.

VOET, D.; VOET, J. G.; PRATT, C. W. Fundamentos de bioquímica. 2ª ed. Editorial Médica Panamericana, 2007.

LEWIN, B. Genes IX. Nova York: Oxford University Press, Inc., 2007.

ALBERTS, B.; JOHNSON, A.; LEWIS, J.; RAFF, M.; ROBERTS, K.; WALTER, P. Molecular Biology of the Cell. Garland Science, 5ª ed., 2008.

COOPER, G.M. i HAUSMAN, R.E. The Cell. A molecular approach. Washington D.C. and Sunderland, 2007.

GARTNER, L. P.; HIATT, J. L. Histología. Texto y Atlas. Mèxic: McGraw-Hill Interamericana, 2007.

Other books:

MATHEWS, C. K.; VAN HOLDE, K. E. Bioquímica. Madrid: McGraw-Hill/Interamericana de España, S.A.U., 1998.

ZUBAY, G.; WM, C. Biochemistry. Dubuque (Ia.): Brown Publishers, 1998.

LEWIN, B. Genes VI. Nova York: Oxford University Press, Inc., 1997.

FRAYN, K. N. Regulación del metabolismo. Barcelona: Ediciones Omega, S.A., 1998.

CHAMPE, P. C.; HARVEY, R. A. Biochemistry. Filadèlfia: Lippincott Company, 1994.

MADIGAN, M. T.; MARTINKO, J. M.; PARKER, J. Brock Biology of Microorganisms. Nova Jersey: Prentice-Hall, Inc., 1997.

7. Methodology

Theoretical classes, seminars and practicals: Face-to-face
Essay: Independent

8. Scheduling activities

PAD BMC 2016-17 (6 ECTS)- 66 classroom hours

Each student will receive 66 hours of class:
30 h theoretical
12 h seminars (2 group, 20 alumni/group)
24 h practical lessons (2 groups, 18-20 alumni/group, 1 teacher/group)

1) Scheduling activities under the curriculum, from:
   - In the classroom: 1) Lecture classes, 2) Seminars, 3) Face-to-face tutorials, 4) "Regulated" practical classes (lab…)
   - Outside the classroom: 5) Group work, 6) Individual work (reports, exercises…), 7) Internships (outside companies), 8) Independent study

Week	Activity in the classroom Grouping/type of activity	Activity outside the classroom Grouping/type of activity
Week 1	• Theoretical classes -3 hours (Sessions 1 and 2)	8-Study hours 3 hours
Week 2	• Theoretical classes -3 hours (Sessions 2 ,3, 4)	8-Study hours 3 hours
Week 3	• Theoretical classes- 3 hours (Sessions,4, 5 and 6) • Seminars 1 and 3 – 3.5 hours • Practical Classes BM- 12 hours	8-Study hours 5 hours
Week 4	• Theoretical classes- 3 hours (Sessions 6, and 7)	8-Study hours 3 hours
Week 5	• Theoretical classes- 3 hours (Session 7 and 8) • Seminars 5 and 6 - 3 hours	8-Study hours 5 hours
Week 6	• Theoretical classes- 3 hours (Session 9 and 10) • Mid-term exam (until session 6)- 1 hour	8-Study hours 5 hours
Week 7	• Theoretical classes-3 hours (Sessions 11 and 12) • Seminars 2, and 4- 3.5 hours • Practical classes BC-12 hours	8-Study hours 5 hours
Week 8	Theoretical classes- 3 hours (Sessions 12, and 13) Seminars 7 and 8- 2 hours	8-Study hours 5 hours 6-Essay- 2 hours work
Week 9	• Theoretical classes-3 hours (Session 14) • Exam Practicals and Seminars	8-Study hours 3 hours
Week 10	Theoretical classes-3 hours (Session 15)	8-Study hours 3 hours
Week final exams		

La còpia i/o plagi total o parcial als treballs i/o exàmens comportarà suspendre l'assignatura amb una qualificació de zero sense dret a recuperació, sense perjudici de l'aplicació de les altres sancions previstes al Reglament de Règim disciplinari dels estudiants de la Universitat Pompeu Fabra en funció de la gravetat de la infracció.

La copia y/o plagio total o parcial en los Trabajos y/o exámenes comportará suspender la asignatura con una calificación de cero sin derecho a recuperación, sin perjuicio de la aplicación de las otras sanciones previstas en el Reglamento de Régimen disciplinario de los estudiantes de la Universitat Pompeu Fabra en función de la gravedad de la infracción.

Total or partial copy and/or plagiarism will imply a failure in the subject with a final grade of zero points and no access to the make-up exam. According to the academic regulations specified in the Disciplinary rules for students of Universitat Pompeu Fabra, other additional sanctions may apply depending on the seriousness of the offence.