



Universitat de Lleida

DEGREE CURRICULUM  
**DEVELOPMENTAL BIOLOGY  
AND REGENERATIVE MEDICINE**

Coordination: SOLER TATCHÉ, ROSA MARIA

Academic year 2021-22

## Subject's general information

<b>Subject name</b>	DEVELOPMENTAL BIOLOGY AND REGENERATIVE MEDICINE			
<b>Code</b>	101527			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Bachelor's Degree in Biomedical Sciences	3	OPTIONAL	Attendance-based
	Bachelor's Degree in Biomedical Sciences	4	OPTIONAL	Attendance-based
	Master's Degree in Biomedical Research		COMPLEMENTARY TRAINING	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRALAB	PRAULA	TEORIA
	<b>Number of credits</b>	1.5	1	3.5
	<b>Number of groups</b>	3	1	1
<b>Coordination</b>	SOLER TATCHÉ, ROSA MARIA			
<b>Department</b>	BASIC MEDICAL SCIENCES			
<b>Teaching load distribution between lectures and independent student work</b>	Hours Attendance 60 Hours Non-attendance 90  Due to the pandemic caused by the COVID19 virus, the attendance / non-attendance distribution may be affected.			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	English Catalan Spanish			
<b>Distribution of credits</b>	36 hours of theoretical classes 10 hours of seminars (2 hours sessions) 14 hours of laboratory practice (sessions of 1 or 2 hours)			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CAMBRAY CARNER, SERAFIN	serafi.cambray@udl.cat	2,65	
GARCERA TERUEL, ANA	ana.garcera@udl.cat	2,25	
HERREROS DANES, JUDIT	judit.herrerros@udl.cat	,6	
LLOVERA TOMAS, MARTA	marta.llovera@udl.cat	,8	
SANCHIS MORALES, DANIEL	daniel.sanchis@udl.cat	,6	
SOLER TATCHÉ, ROSA MARIA	rosa.soler@udl.cat	2,1	Ask for an appointment by e-mail

## Subject's extra information

Competences BOE February 15, 2008, Ministerial Order ECI / 332/2008 -

To know the processes of proliferation and those of cellular differentiation - To know the main morphological changes, cellular and molecular mechanisms that occur in the animal embryos during the different stages of their differentiation - Stem cells and their therapeutic potential in the treatment of different human pathologies

Contextualization within the degree

It is an optional subject of the degree of Biomedical Sciences during the first semester of the fourth year. This course provides basic knowledge needed to understand embryonic development, the comparison between the development of different species, the molecular and genetic mechanisms that control it, as well as the experimental models used for its study. This knowledge should be used to solve health problems through a basic scientific language related to Developmental Biology.

## Learning objectives

1- Describe the processes of proliferation and cell differentiation. As well as the mechanisms involved in its

regulation.

2- Differentiate the main morphological changes, cellular and molecular mechanisms that occur in animal embryos during the different stages of their differentiation. As well as changes in gene expression.

3- Define stem cells and their therapeutic potential in the treatment of different human pathologies.

4- Apply the gender perspective to the functions of the professional field.

## Competences

CB1 That students have demonstrated that they have and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

CB2 That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the development and defense of arguments and problem solving within their area of study.

## Subject contents

### Classes

#### Lesson 1. Introduction RMS

From embryology to molecular biology of development: the convergence of genetics and experimental embryology. The basic processes of development: growth, regional specification (pattern formation) and morphogenesis. Specification and cell differentiation.

#### Lesson 2. Fertilization MLL

Fertilization: molecular bases of the gametic recognition and the activation of the ovule. Fusion of genetic material. Intracellular signaling of the initiation of zygomatic responses.

#### Lesson 3. The stages of development in different species MLL

Embryonic stages and time of embryonic development. Segmentation, gastrulation and organogenesis in the human embryo. The stages of development in experimental models of vertebrates: *Xenopus laevis*, zebrafish, chicken and mouse.

#### Lesson 4. From the zygote to the blastula MLL

Variants of segmentation in different species. Cytoplasmic determinants: the example of *Xenopus*. Holoblastic and rotational segmentation in mammals. The blastula. the compaction and the formation of the internal cell mass (ICM) of mammals.

#### Lesson 5. Gastrulation SC

Formation of the trilaminar embryo. Gastrulation mechanisms: different strategies with similar results. Axial determination and presumptive maps.

#### Lesson 6. Gastrulation and axial specification in vertebrates (I) SC

The experiment of Spemann and Mangold (1924) and the organizer of Spemann. Genes for the organizer: the example of gooseoid. The determination of the "organizer", the center of Nieuwkoop and its genes. The molecular model of induction in *Xenopus*.

#### Lesson 7. Gastrulation and Axial Speciation in Vertebrates (II) SC

Gastrulation in birds. Gastrulation in mammals. Counterparts of Spemann's organizer. The Hensen's nodule. The genes of the nodule. The generation of the anteroposterior axis. Molecular bases of the left-right axis specification.

#### Lesson 8. Developmental models: *Drosophila melanogaster* MLL

Introduction to the model. Initial development, no maternal effect and positional information from morphogenic gradients. Genes that control anteroposterior differentiation. Genes that control dorso-ventral differentiation, the dorsal protein. No segmentation: gap genes, even rule and segmental polarity. Nothing homeotic selectors. Terminal differentiation: organogenesis, imaginary discs.

#### Lesson 9. Hox genes of vertebrates MLL

Structure and classification of vertebrate Hox genes. Patterns of expression. The example of the *Drosophila* segmentation.

#### Lesson 10. Cellular communication to development I JH

Induction and competition. Cell interactions in proximity and distance. Signaling factors. Introduction to morphogens.

#### Lesson 11. Cellular communication to development II JH

TK receptors, growth factors and FGFs. The TGF $\beta$  / BMPs and Smad pathway. The Wnt /  $\beta$ -catenin pathway. The Hedgehog Way. The Notch. Cell signaling in pluripotency.

#### Lesson 12. The formation of the organs RMS

Structure and development of the somites. The generation clock of the somites. Notochord and paraxial mesoderm. Differentiation and regionalization of the somites: dermomyotome and sclerotome. The skeletal muscle system. Myogenesis and the MyoD family. Osteogenesis.

The cardio-respiratory system. Specification of the cardiogenic mesoderm. Formation, fusion and rotation of the cardiac sketches. The genes of the bilateral specification: angiogenesis. Fgfs, VEGF. Hematopoiesis.

Development of the respiratory system.

The digestive and uro-genital systems. Development of the liver and pancreas. The kidney: pronephros, mesonephros and metanephros. Interactions epithelimesenchymals. Reciprocal induction: the molecular model of nephron formation. The development of the gonads. Germ cells. Sexual determination.

#### Lesson 13. Cellular engineering DS

Reprogramming (generation of induced stem cells) and transdifferentiation (modification of the fate of differentiated cells).

#### Lesson 14. Cell therapy DS

Types, applications, technical and ethical challenges. Main basic and technical concepts. Ethical aspects.

Strategies in regenerative medicine in diseases of the nervous and cardiovascular system, current applications and perspectives.

#### Lesson 15. Tissue Engineering DS

Bases, applications, technology. Main concepts and applications. Creation of ex-vivo organs.

#### Lesson 16. Bone marrow transplantation. Albert Esquirol.

### Seminars

Preparation and statement of a recent research article related to the contents of the subject.

### Lab practices

Differentiation of embryonic stem cells to mature cells.

## Methodology

### Metology:

### Lectures.

These will be with all students and are not compulsory.

They aim to give an overview of the thematic content highlighting those aspects that will be useful in their training.

### **Seminars.**

These will be with all students and are mandatory. Students should prepare a recent paper related to the subjects of the course and they should expose to their classmates. The communication and participation in the presentation sessions will be evaluated.

The seminars are focused to apply theoretical concepts and to further analyze the more relevant and complex aspects of the subjects.

### **Lab practices**

These will be done with all students divided into small groups. Students will participate in the differentiation of an embryonic stem cell culture into neurons.

### **Laboratory practices Biomedicina**

It is mandatory for the students to use during teaching practices:

- lab coat
- protective glasses (not in the case of observation under the microscope)
- chemical protective gloves (not in the case of observation under the microscope)

Not wearing the EPI / PPE (personal protective equipment) or not following the general safety standards detailed below, will mean that the student cannot go to the laboratories or that he/she must leave them.

### **General safety standards in laboratory**

- keep the place clean and tidy. The work table/bench must be free of backpacks, folder, coats ...
- wear closed shoes during the practices
- wear long hair always collected
- keep the lab coat fastened to protect against splashes and chemical spills
- do not wear bracelets, necklaces or wide sleeves that can get caught in equipment, assemblies ...
- avoid contact lenses since the effect of chemicals is more dangerous if it is inserted between the lens and the cornea.
- do not eat or drink in the laboratory
- smoking is forbidden inside laboratories
- always wash your hands after contact with a chemical and before leaving the laboratory
- follow the teacher's instructions and ask any questions about safety

## **Development plan**

The teachers responsible for the activities are:

Lesson 1. Introduction. Rosa Soler (2hr)

Lesson 2. Fertilization. Marta Llovera (2hr)

Lesson 3. The stages of development in different species. Marta Llovera (1hr)

Lesson 4. From the zygote to the blastula. Marta Llovera (1hr)

Lesson 5. Gastrulation. Serafín Cambray (1hr)

Lesson 6. Gastrulation and axial specification in vertebrates (I) Seraph cambray (1hr)

Lesson 7. Gastrulation and Axial Specification in Vertebrates (II) Serafín cambray (2hr)

Lesson 8. Development models: Drosophila melanogaster Marta Llovera (2hr)

Lesson 9. The Hox genes of vertebrates. Marta Llovera (2hr)

Lesson 10. Cellular communication to development I Judit Herreros (3hr)

Lesson 11. Cellular communication to development II Judit Herreros (3hr)

Lesson 12. The formation of organs. Rosa Soler (8hr)

Lesson 13. Cellular engineering. Daniel Sanchis (2hr)

Lesson 14. Cell therapy. Daniel Sanchis (2hr)

Lesson 15. Tissue engineering. Daniel Sanchis (2hr)

Lesson 16. Bone marrow transplantation. Albert Esquirol (2hr)

### Seminars

Oral presentation of a work prepared individually by the student and supervised by two teachers (Marta Llovera and Ana Garcerá). Students participate by asking questions to the speaker.

### Lab practices

They will be carried out in the cell culture laboratory under the supervision of two teachers (Ana Garcerá and Serafí Cambray). Culture and differentiation of a line of mouse stem cells into neuronal cells.

## Evaluation

The final mark will be the sum of the different aspects evaluated:

Class/lessons: Conceptual and theoretical knowledge will be evaluated in two periods using a multiple-choice test. The result obtained in this examination will constitute 50% of the final mark. To pass the subject the mark of this part should be 5 out of 10.

Practices: The acquisition of practical skills and instrumental activities will represent 25% of the final mark. To pass the subject the mark of this part should be 5 out of 10.

Seminars: The acquisition of skills in the presentation of a paper will represent 25% of the final mark. To pass the subject the mark of this part should be 5 out of 10.

Rubric evaluation of the seminars:

- 1- suitability of the chosen paper
- 2-presentation: adequacy, structure and format
- 3-ability to communicate and oral expression (the power point of the presentations will be in English and it will be positively valued the English expositions and defense)
- 4-answers to the teacher's and classmates questions
- 5-participation in the discussion

If one of the parts has not reached the minimum grade of 5, it can be averaged with the others, as long as the grade is not less than 4.

## Bibliography

ALBERTS . Biología molecular de la célula. 4a. ed. Capítols 15, 20 i 21. Ciutat: Garland Science, 2002.

GILBERT SCOTT, F. Developmental Biology. 6a. ed. Sinauer Massachusetts: Sinauer Associates, 2000. [\[www.devbio.com\]](http://www.devbio.com).

WOLPERT, Lewis. Principles of development. Oxford: Oxford University Press / Current Biology Ltd., 2002. [\[www.oup.cou.uk/best.textbooks/biology/wolpert/\]](http://www.oup.cou.uk/best.textbooks/biology/wolpert/).

LARSEN, William. Larsen's Human Embryology, 5th Edition, Elsevier 2014

### Internet addresses

NCBI/Books: Developmental Biology, 6th edition, Scott F Gilbert (<http://www.ncbi.nlm.nih.gov/books/NBK9983/>)

Developmental Biology 10e Online (<http://10e.devbio.com>)

Developmental Biology Courses and Resources (<http://www.sdbonline.org/archive/SDBEduca/courses>)

Gastrulation: From Cells To Embryo (<http://www.gastrulation.org/>)

LA BIOLOGIA DEL DESENVOLUPAMENT PRENATAL ([http://www.ehd.org/resources\\_bpd\\_illustrated.php?language=15](http://www.ehd.org/resources_bpd_illustrated.php?language=15))

Focus: Issues in Developmental Biology Education (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2262129/>)

WormClassroom | Learning biology with the worm (<http://www.wormclassroom.org/>)

Development of Drosophila (<http://people.ucalgary.ca/~browder/virtualembryo/flies.html>)

The Interactive Fly (<http://www.sdbonline.org/fly/aimain/1aahome.htm>)

FlyMove (<http://flymove.uni-muenster.de/Homepage.html>)