Universitat Autònoma de Barcelona

2017/2018

Development Biology

Code: 100783
ECTS Credits: 6

Degree	Type	Year	Semester
2500250 Biology	OT	4	0

Contact

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Use of languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Aurora Ruíz Herrera Moreno
Ignasi Roig Navarro

Prerequisites

There are no official prerequisites. However, it is assumed that the student has assimilated the learning skills of "Cell Biology".

To access to study "Histology" the student must have passed the safety test. This can be found in the virtual campus.

Objectives and Contextualisation

It is a course fourth year, optional, developed the fundamentals of cellular processes that lead to the formation of an animal from the fertilized egg. It has been designed assuming students have basic knowledge of Histology him to achieve an integrated vision of the origin and development of the animal organism until it manifests its structure or adult is able to lead an independent life.

Finally, note that "Developmental Biology" is a theoretical and practical course. This makes it possible to continually interact theoretical concepts and practical sessions

Objectives:

1.- To Understand the physiological characteristics of the animal gametes that allow fertilization and the subsequ

2.- To know, in terms of cell biology, the diversity of mechanisms involved in the embryonic development of the a

3.- To distinguish the main morphogenetic processes and their chronology embryo.

4.- To know the main items of the experimental embryology and to study its experimental models.

5.- To aAcquire the integrated concept of the establishment of the embryonic body plan.

6.- Understand the principles of the embryonic organogenesis in a morpho-functional context.

7.- To know the genesis and biological significance of the various embryonic annexes.

8.- To identify, at the light microscopic level, the successive stages of embryonic development of various animals

Skills

- Analyse and interpret the development, growth and biological cycles of living beings.
- Be able to analyse and synthesise
- Be able to organise and plan.

Learning outcomes

1. Be able to analyse and synthesise.
2. Be able to organise and plan.
3. Describe the cellular bases for embryo development.
4. Explain the processes of cell division, migration, differentiation and death.
5. Identify microscopically development stages of animal embryos.

Content

LECTURES SESSIONS

I. INTRODUCTION TO ANIMAL DEVELOPMENT

Chapter 1. The development of livings beings. The stages of animal development. Cellular basis of morphogenesis

II. BEGINNING A NEW ORGANISM

Chapter 2. Spermatozoa. Structure and variety of form. Flagellate spermatozoa. Non-flagellate spermatozoa. Structure of mammalian spermatozoa. Non-flagellate spermatozoa. Acrosomal process. Acrosomal filament. Spermatogenesis.

Chapter 3. Egg. Oogenesis and nuclear activity. Oocyte structure. Yolk structure. Types of egg and yolk distribution: oligolecithal, heterolecithal, telolecithal and centrolecithal. The alecithal egg. Structure of the mature oocyte: animal and vegetal poles.

Chapter 4. Egg membranes. Oocyte extracellular matrix. Structure of the vitelline membrane. Genesis and development of the egg membranes: morphogenetic pattern. Bird's albumen and egg shell. Cellular components of corona radiata in mammalians.

Chapter 5. Fertilization and zygote. Fertilization: preparatory processes. The acrosome reaction of the spermatozoa. Oocyte membrane capacitation. Pronuclei and fusion of pronuclei. Prevention of polyspermy. Cortical reaction. Ovular activation.

III CELLULAR DIVERSITY

Chapter 6. Mechanisms of embryonic development. Differential genetic expression. Cell proliferation and differentiation. Cell interactions and cell movements. Cell determination. Induction and competition. Signaling molecules: morphogens. Extracellular inhibitors. Embryo polarity: axes and reference planes.

Chapter 7. Cleavage. General scheme of the process. Subdivision of the zygote: blastomeres. Cell cycle characteristics. Morula. Patterns of embryonic cleavage holoblastic and meroblastic. Blastula and blastocoele. Blastomeres capacity. Specific regions and fate maps.

Chapter 8. Gastrulation. Germ layers. Tripoblasty and corporal pattern. Archenteron and blastopore. Cell movements in the gastrulation: invagination, delamination, involution, ingression, epiboly. Blastomeres differentiation and embryonic gene expression

IV MODELS OF EMBRYOGENESIS

Chapter 9. Early development of echinoderms. Cleavage and genesis of the blastocoel. Fate maps. Gastrulation. Ingression of the primary mesenchyma. Fibronectin and cell migration. Invagination of the vegetal plate. Genesis of the secondary mesenchyma. Archenteron. Embryo polarity.

Chapter 10. Predetermination of the amphibian body axis. Cortical rotation of the zygote: the "gray crescent". Segregation of maternal cytoplasmic determinants. Bilateral zygote symmetry. β-catenin and dorsalization.

Chapter 11. Amphibian's cleavage. Cell divisions and animal/vegetal polarity of the ovule. Genesis of the blastocoel. Functional integrity of blastomers Fate maps in the blastulae.

Chapter 12. Amphibian gastrulation. Blastoporic groove: bottle cells invagination. Yolk plug: Internment of the future yolk endoderm. Involution of the presumed mesoderm. Fibronectin and cell migration. Epiboly of the alleged ectoderm. Germinal line.

Chapter 13. Regulation in amphibians. Spemann's embryonic organizer. Dorsal lip of the blastopore. Maternal morphogens in vegetal hemisphere. Mesodermal induction. Nieuwkoop's center.

Chapter 14. Early fish development. Cleavage. Blastodisc and yolk cell. Blastoderm epiboly. Vitelline syncytial layer. Gastrulation: the "embryonic shield". β-catenin and embryonic organizer.

Chapter 15. Cleavage in birds. Cell divisions in the blastodisc. Blastoderm. Subgerminal area and yolk. Regionalization of the blastodisc: the areas pellucida and opaque. Genesis of the blastocoel: epiblast and hypoblast. Marginal posterior zone and secundary hypoblast: predetermination of embryonic polarity. Epiblast fate maps.

Chapter 16. Gastrulation in birds. The primitive groove: Hensen's node. Extension and regression of the primitive groove. Adhesion of epiblast cells: endoderm and ectoderm. The germinal crescent.

Chapter 17. Regulation in birds. Relationship between primitive groove and secondary hypoblast. Hensen's node as embryonic organizer. Inducing activity of the posterior marginal zone (center of Nieuwkoop). Inhibitor effect of the primary hypoblast.

Chapter 18. Cleavage in mammalians. Pre- and post-implantation development. Early activation of the genome embryonic. Compactation. spatial segregation: embryo-trophoblast. Cavitation of the morula: the blastocist. Genesis of the blastocoel: epiblast and hypoblast. Relationship between blastocoel and yolk sac. Surface or interstitial implantation.

Chapter 19. Gastrulation in mammalians. Development of theprimitive groove. Development of the trilaminar germ disk. Germinal line. Cordal plaque. Cordamesoderm cavitation. Cylindrical rodent egg. Predetermination of the body axis.

V. **ORGANOGENESIS**

Chapter 20. Neurulation. Neural plate: neuroectodermical cells. Mechanisms of neural folding. Destination of the neuroectoderm: neural tube. Neural crest cells. Neural induction: notochord and pharyngeal endomesoderm. Antagonism and neural and epidermal inductions: diffusible proteins.

Chapter 21. **Body folding in amniotes**. Development of embryonic body folds. Relationship between body and neural folding. Delimitation of the embryonic and extraembryonic portions: the yolk peduncle. Intestinal portals. Embryo buckling.

Chapter 22. Development of the neural tube. Origin of the central nervous system. Encephalon and spinal cord morphogenesis. Histogenesis: germinal neuroepithelium and tripartite pattern. Cerebellar cortex. Neocortex. Induction and dorso-ventral specification. Antero-posterior patterns

Chapter 23. Neural crest derivatives. Neural crest regionalization. Cellular migratory pathways. Cell differentiation. Origin of the peripheral nervous system. Cell pluripotency.

Chapter 24. Development of the mesoderm. Axial mesoderm. Paraxial mesoderm: somites. Induction, segregation and fate of somites cells. Lateral plates and coelom. Origin of the hearth.

Chapter 25. Endoderm derivatives. Cell differentiation and fate of the pharyngeal bursas. Early digestive tract. Epithelial cells in the digestive and respiratory tracts.

VI. **ORGANOGENESIS**

Chapter 26. Embryonic attached cells in ammniotes. Constitution of extra-embryonic membranes: somatopleure and splanchopleure. Extraembryonic coelom. The vasculous area of birds. Yolk sac of birds: splanchopleure and yolk. Splanchnic mesoderm: angiogenesis and hematopoietic stem cells. Relationship between yolk circulation and embryonic circulation.

Chapter 27. Chorion and amnion of birds. Chorioanmiotic folding: Extraembrionary somatopleure. The amnion. Mixed origin of the chorion: epiboly of opaque area and amniotic folding. Chorionic ectoderm.

Chapter 28. Allantoids of birds. Origen and growth of the allantoids in the extraembryonic coelom. Chorioallantoic membranes: angiogenesis in the mesoderm. Respiratory exchanges and calcium transport. Relationship between allantoic circulation and embryonic circulation.

Chapter 29. Embryonic attached cells in mammalian. The yolk sac: hypoblast and lecithocoele lining. Amnion and chorion. Trophoblast and chorion formation. Genesis of the amnion due to cavitation and folding. Human and rodent models.

Chapter 30. Allantoids of birds. The allantoic mesoderm: vascular differentiation and its relationship with the embryonic circulation. Trafficking of nutrients and respiratory gases.

Chapter 31. Placenta. Functional significance of maternal and fetal placentas. The Chorioallantoic placentas. Chorionic villus. Cytoarchitecture of the placental barrier. The fetal and maternal connection: decidua and indecidua placentas.

PRACTICAL SESSIONS

Session 1. Microscopic analysis of the fertilization and early embryonic development in invertebrates.

Session 2. Microscopic analysis of the embryonic development in amphibians.

Session 3. Microscopic analysis of the early development and neurulation in birds.

Session 4. Microscopic analysis of the organogenesis and embryonic attachments in amniotes.

Methodology

Methodology

The contents of "Developmental Biology" include theory, seminars and talks lessons.

Theory lessons

The program theory is taught in 36 classes. They will be done using audiovisual material, which will be at the disposition of the students in the Virtual Campus.

Seminars

There are 3 seminars. They are designed so that the students work in small groups, and acquire skills of teamwork and critical reasoning. The students were divided into groups of 4 to 6 people.

The organization of the groups and the distribution of topics to be discussed will take place during the first class. In the seminars, some groups of students must submit in writing the proposed topic the teacher. The same groups of students orally present the issue to the rest of the class with the resources available in the classroom. The literature will be included in the Virtual Campus. The seminars attendance is mandatory.

Individual coaching sessions

Individual coaching sessions will take place in a personalized way in the professor room. These sessions should be used to clarify concepts and to establish the acquired knowledge. They can also take advantage to resolve questions that students have about the preparation of seminars.

Practical sessions

The practical sessions will be done in small groups of students (about 20 per session) in the laboratory. They are

The goal of these sessions is to microscopic diagnosis and individual delivery of questionnaires. The practical se

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Practical sessions	12	0.48	5, 1, 2
Seminars	3	0.12	3, 1, 2
Theory lessons	36	1.44	3, 4
Type: Supervised			
Custom tutorials	5	0.2	3, 4
Type: Autonomous			
Preparation of seminars	25	1	3, 4, 1, 2
Resolution of practical seminars	2.5	0.1	5, 1, 2
Study	60	2.4	3, 4, 1, 2

Evaluation

Evaluation

The evaluation of the course will be continued through individual test that assess:

- Individual learning by students from theory lessons, seminars and practical sessions.

Evaluations activities planned in the course of "Developmental Biology" are:

Exams: two partial exams. Each test will be worth 70% of the final grade. Exams will be multiple choice questions 25 with two options and only one correct (part A), and 25 with three options and only one correct (part B). A correction value will be subtracted 1/2 and 1/3 per wrong answer for each question in part A and B, respectively. To pass this part of the course, students must achieve a minimum of 4 points (from 0 to 10) in each partial exam. Whether this minimum is not achieved, students must do a final full or partial exam.

Seminars: They will be worth 10% of the final grade as follows:

i) 50% for the written work (this work will be assessed by the professor).

ii) 20% for the oral presentation of the collective work (this work will be assessed by the professor).

iii) 15% for the intra-group evaluation

iv) 15% for the inter-group evaluation

The attendance at seminars is mandatory. If a student do not attend any of the seminar sessions, because not justified, there will be a penalty in the final grade of the seminars.

i) Absence to 1 session = discount of 20% of the grade.

ii) Absence to 1 session = discount of 40% of the grade.

iii) Absence to 1 session = discount of 80% of the grade.

Practical sessions: They will be worth 20% of the final grade as follows:

i) Evaluation of the contents at the end of each practical session (50% of the grade). This test consist of a set of questions as well as recognition of microscopic structures. The final grade of this section is obtained from the average of the grades obtained in each practical session. The attendance at the practical sessions is mandatory. If a student do not attend any of the practical session, because not justified, the grade will be zero.

ii) Test of microscopic diagnostic (50% of the grade). This test will consist in the diagnosis of microscopic structures proposed along the course. To be able to weigh the notes obtained in each section, it will be essential that students get a rating equal to or greater than 4 points (out of 10) in each one of them. Students who have received a final grade lower than 5 (of 10) required to write an examination of recovery, which will consist of a microscopic diagnosis test and a questionnaire.

Successful completion of the course

To pass the course, the following two requirements must be met.

.- To obtain at least 5 out of 10 in the overall calculation of the written tests of theory and seminars.

.- To obtain at least 5 points out of 10 in the practices.

The presentation of the student to any recovery exam (theory and / or practice) entails the waiver previously obtained qualification.

A student will get a grade not evaluated if the number of assessment activities carried out was less than 50% of the programmed course.

Repeaters

Repeaters do not need to repeat the written tests, seminars or practices if the student had previously obtained a minimum of five in any of these tests. This exemption will be maintained for a period of three additional registrations.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Exams	Weight 70%	5	0.2	3, 4, 1, 2
Practical sessions	Weight 20%	1	0.04	5, 1, 2
Seminars	Weight 10%	0.5	0.02	3, 4, 1, 2

Bibliography

BOOKS

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ATLASES

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