

**Animal Development and Embryonic Manipulation Techniques**

Code: 100861  
ECTS Credits: 6

**2025/2026**

| Degree       | Type | Year |
|--------------|------|------|
| Biochemistry | OP   | 4    |

## Contact

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## Teachers

Maria Plana Coll

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## Teaching groups languages

You can view this information at the [end](#) of this document.

## Prerequisites

There are no prerequisites for taking the course. However, in order to achieve the learning aims, a basic knowledge of Cell Biology, Genetics, Histology, Cell Culture, Molecular Biology, Cell Signaling, Biochemistry and Animal Physiology is recommended. It is also recommended to be familiar with the techniques used in these disciplines.

Sources of information are usually in English and it is recommended that students have knowledge of this language.

## Objectives and Contextualisation

The aim of the course is to provide the student with knowledge about the cellular and molecular mechanisms involved in reproduction, preimplantation embryo development and early post implantation embryo development. Throughout the course, practical applications of the manipulation of gametes and embryos, fertility control and assisted reproduction techniques will also be discussed.

## Learning Outcomes

1. CM39 (Competence) Explain alterations in the pre- and postimplantation development of embryos, procedures for identifying vaccine and pharmacological targets, and the mechanisms of various types of drugs.
2. KM41 (Knowledge) Describe the processes involved in gamete formation and fertilisation, as well as in pre- and postimplantation embryonic development.
3. SM43 (Skill) Apply technologies for embryo manipulation, gene therapy and the production of transgenic drugs, vaccines and animals.
4. SM44 (Skill) Analyse the ethical and legal aspects of cell therapy in humans, embryo manipulation, and the requirements for R+D, clinical and preclinical trials, and applications for patents and licences.

## Content

### Theoretical classes program

#### I. Gametogenesis, fertilization, pre-implantation embryo development

Topic 1. Female gametogenesis. Male gametogenesis: General aspects of the male reproductive system. Spermatogenesis. Maturation of sperm: Epididymal functions. Ejaculation: characteristics and seminal parameters.

Topic 2. Fertilization.

Topic 3. Pre-implantation embryo development. Cell differentiation. Hatching

#### II. Assisted Reproduction Techniques (ARTs)

Topic 4. Assisted reproduction techniques (ARTs). Introduction to human sterility and infertility. Induction of ovulation. Artificial insemination. "In vitro" fertilization (IVF). Intracytoplasmic Sperm Injection (ICSI). "In vitro" embryo culture. Embryo transfer. Gamete donation. Epididymal and testicular sperm recovery. Sperm selection. Preconceptional and preimplantation genetic diagnosis.

Topic 5. Cryopreservation of gametes and embryos. General characteristics of cryopreservation. Vitrification. Cryopreservation of embryos. Cryopreservation of sperm. Cryopreservation of oocytes and ovarian tissue. Gamete and embryo banks

Topic 6. Genetic risk related to ARTs.

Topic 7. Assisted reproduction in animals.

#### III. Technologies emerging from embryo manipulation

Topic 8. Cloning. Cell reprogramming and stem cells (ESC and IPS) in the field of reproduction.

#### IV. Post-implantation embryo development. Gastrulation and formation of axes.

Topic 9. Primary development in sea urchin. Embryonic division patterns. Formation of the blastula. Specification of the embryonic axes. Gastrulation.

Topic 10. Primary development in Drosophila. Formation of primary axes during oogenesis. Antero-posterior polarity of the oocyte. Generation of the antero-posterior pattern. Generation of the dorso-ventral pattern. Segmentation.

Topic 11. Primary development in amphibians. Gastrulation. Progressive determination of the axes. Molecular mechanisms of the formation of axes in amphibians. Regional specificity of neural induction.

Topic 12. Primary development in birds. Gastrulation and specification of axes. Organization in birds. Antero-posterior pattern. Left-right axis

Topic 13. Primary development in mammals. Gastrulation Antero-posterior axis. Dorsal-ventral axis. Left-right axis.

#### V. Organogenesis

Topic 14. Formation of the central nervous system. Formation of the neural tube. Differentiation. Differentiation of neurons in the brain. Cell differentiation into the vertebrate eye.

Topic 15. Miogenesis: Generation of muscle.

#### VI. Post-embryonic development

Topic 16. Maintenance of cell and tissue differentiation. Tissues with permanent cells. Compensatory regeneration in the mammalian liver. Renewal from stem cells: epidermis. Renewal from pluripotent stem cells: hematopoiesis.

Topic 17. Aging. Cellular senescence and apoptosis. Metabolic alterations related to aging. Possible molecular bases of aging.

#### Laboratory sessions program

Male and female gametogenesis

In vitro embryo manipulation and embryo culture

In vitro oocyte maturation

Freezing of gametes and embryos.

Embryo splitting

Analysis of a semen sample

Audio-visual tutorials

## Activities and Methodology

| Title                            | Hours | ECTS | Learning Outcomes      |
|----------------------------------|-------|------|------------------------|
| Type: Directed                   |       |      |                        |
| Lectures                         | 40    | 1.6  | CM39, KM41, SM44, CM39 |
| Practical sessions               | 12    | 0.48 | SM43, SM43             |
| Type: Autonomous                 |       |      |                        |
| Study and self learning concepts | 79    | 3.16 | KM41, SM43, SM44, KM41 |
| Topic preparation                | 16    | 0.64 | KM41, KM41             |

#### Theory classes

The content of the theory program will be taught mainly by the teacher as lectures with audio-visual support. The presentations used in class by the teacher will be available in the Virtual Campus. It is recommended to the students to obtain this material and to use it as support when taking notes. Although it is not essential to extend the contents of the classes, unless specifically requested, students are advised to consult regularly the

books and texts recommended in the bibliography section of this guide to consolidate and clarify, if necessary, the topics of the program.

In addition to the attendance to the classes, the follow-up of the topics will also imply an active role of the student, who will have to develop individually or in team parts of the theory program.

#### Laboratory practices:

The practical sessions are designed to learn the basic methodologies used in Reproductive Biology laboratories and to complement the theoretical training. The students will take a total of 4 sessions of 3 hours each, working in groups of 2 and, during the sessions, they will have to answer a questionnaire.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## **Assessment**

### **Continous Assessment Activities**

| Title                             | Weighting | Hours | ECTS | Learning Outcomes      |
|-----------------------------------|-----------|-------|------|------------------------|
| Evaluation of laboratory sessions | 20        | 1     | 0.04 | CM39, KM41, SM43       |
| First term examination            | 40        | 1     | 0.04 | CM39, KM41, SM43       |
| Second term examination           | 40        | 1     | 0.04 | CM39, KM41, SM43, SM44 |

To pass the subject it will be necessary to obtain a final grade equal to or greater than 5 points (out of 10) and have attended to the practical sessions.

The scheduled evaluation activities are:

- First term exam: It will count on 40% of the final grade. The topics taught in the first term of the theoretical sessions will be evaluated.
- Second term exam: It will count on 40% of the final mark. The topics taught in the second term of the theoretical sessions will be evaluated.

In order to pass the subjects evaluated in these two theoretical exams and to use the mark obtained for the final mark, it will be necessary to obtain a minimum mark of 3.5 out of 10 in the two examinations.

- Retake exam: addressed to students who have not obtained a final mark to pass the subject and those who want to improve their mark. The mark obtained in this examination will prevail. The methodology of the exam may be different from that used in previous assessments.

To participate in the retake exam, the students must have previously been evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject. Therefore, students will obtain the "No-evaluatable" qualification when the assessed activities correspond to less than the 67% of the activities.

- Evaluation of practical sessions: It will count on 20% of the final mark. The laboratory practices will be evaluated during its realization by a questionnaire. Attendance to the practical sessions is mandatory. The students will obtain the "No-evaluatable" qualification.
- Taking into account that practical sessions attendance is mandatory, an unjustified absence implies a penalty in the mark applying the following criteria:

- To miss one day implies a reduction of 30% in the laboratory practice mark.
- To miss two or more days implies a zero on the practice mark.

Students who can not attend their group session due to a justified cause are exempt from this penalty. The justified cause is understood to be health problems (the corresponding medical certificate must be brought to the coordinator of the practices) or serious personal problems. In this case, the practice will be recovered whenever possible.

Exam revisions: Exam revisions will be made individually, upon request, within the established deadlines.

#### UNIQUE EVALUATION

The unique evaluation consists of a synthesis written test in which the contents of the entire theoretical program of the subject will be assessed. This test will weigh 80% on the final qualification of the subject. This test will be held on the same date fixed in the calendar for the second exam of the continuous evaluation, and the same recovery system will be applied as for the continuous assessment. In order to use the qualification obtained in this synthesis test to calculate the final mark of the subject, students must obtain a minimum score of 3.5 points in this exam.

The evaluation of laboratory practices will be carried out in the same way as described in the continuous evaluation, and will also have the same weight in the final mark (20%).

The same retake process and the not evaluated criteria will be applied as for continuous evaluation.

## Bibliography

Bajo JM, B. Coroleu B. (Eds.) Fundamentos de Reproducción. Editorial Panamericana. Madrid. 2009.

Browder, Erickson, and Jeffery, Developmental Biology, Third Edition, 1991

Elder K., Dale B. *In vitro* fertilization. (3rd edition). Cambridge University Press. New York. 2011.

Gardner D.K. et al. (Eds.). Textbook of assisted Reproductive Techniques. Martin Dunitz Pub. Hampshire. 2001.

Gilbert, S.F. Developmental Biology 9a ed. Ed. Sinauer Associates, Inc. 2009

*Free online book resource (4th edition):*

<https://www.ncbi.nlm.nih.gov/books/NBK9983/>

Gupta S.K. et al. (Eds.) Gamete Biology. Emerging frontiers in Fertility and Contraceptive Development.

Nottingham University Press. Nottingham. 2007.

Hafez B. and Hafez E.S.E. (Eds.). Reproduction in farm animals. 7th edition. Lippincott Williams and Wilkins. USA. 2000.

Harper J. (Ed.) Preimplantation Genetic Diagnosis. (2nd Edition). Cambridge University Press. New York (USA).2009.

Johnson M.H. and Everitt B.J. (Eds.) Essential Reproduction. 5th Edition. Blackwell Science. Oxford. 2005.

Knobil E. and Neill J.D. (Eds.). "Encyclopedia of Reproduction". Vol 1-4. Academic Press. San Diego (CA), USA. 1998.

Matorras R, Hernández J. (Eds.). Estudio y tratamiento de la pareja estéril. Adalia. Madrid. 2007.

Slack, Jonathan M. W. Essential Developmental Biology 3. Edition (2012) John Wiley & Sons

Wolf D.P. and Zelinski-Wooten M. (Eds.). Assisted fertilization and nuclear transfer in mammals. Humana Press. New Jersey. USA. 2001.

Wolpert Lewis, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith. Principles of Development, Second Edition. (2002) Oxford University Press

Specific bibliography will be recommended for the preparation of sections of the syllabus by the students.

Reviews and updated papers will be recommended during the course.

Web links containing rigorous and up-to-date information will be suggested.

## Software

No specific software is used.

## Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject.

| Name                          | Group | Language | Semester       | Turn          |
|-------------------------------|-------|----------|----------------|---------------|
| (PLAB) Practical laboratories | 341   | Catalan  | first semester | afternoon     |
| (TE) Theory                   | 34    | Catalan  | first semester | morning-mixed |