Universitat Autònoma de Barcelona

2019/2020

Technology of Reproduction

Code: 100942
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OT	4	0

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

Some of the lectures will be given in English

Teachers

Francesca Vidal Domínguez

Prerequisites

There are no prerequisites for taking this course. In spite of this, in order to ensure the proper monitoring of the subject by the student and the achievement of the learning outcomes proposed, it is recommended that the student have some basic knowledge about cell biology and techniques used in this discipline since many of them will appear throughout the development of the agenda and will be considered as already known.

On the other hand, in a scientific discipline such as Biology of reproduction, it is common to use sources of information in English. It is therefore recommended that students have a minimum knowledge of this language.

Objectives and Contextualisation

Technology of reproduction course aims to provide students with knowledge about cell mechanisms involved in mammalian reproduction, as well as on the practical applications of mammalian gametes and preimplantation embryo manipulation and their repercussions both in the field of human reproduction and livestock production.

The first part of the syllabus is the basic section of the subject and it's focused on providing knowledge about gamete formation, mechanisms of fertilization in mammals and preimplantation embryo development, while offering the necessary background to understand the techniques applied in later thematic blocks. Fertility control, assisted reproduction techniques applied both in humans and animals, and interventions on gametes and embryos are developed in the following sections of the program.

Competences

- Apply the principal techniques for the use of biological systems: recombinant DNA and cloning, cell cultures, manipulation of viruses, bacteria and animal and plant cells, immunological techniques, microscopy techniques, recombinant proteins and methods of separation and characterisation of biomolecules.
- Describe the molecular, cellular and physiological bases of the organisation, functioning and integration of living organisms in the framework of their application to biotechnological processes.
- Design continuation experiments for problem solving.
- Learn new knowledge and techniques autonomously.
- Read specialised texts both in English and ones own language.
- Reason in a critical manner
- Search for and manage information from various sources.
- Work individually and in teams

Learning Outcomes

1. Describe the processes involved in gamete formation, fertilisation and preimplantation embryo development.
2. Design continuation experiments for problem solving.
3. Explain and apply the technologies deriving from intervention on gametes and embryos.
4. Explain and apply the technologies used in the control of human and animal fertility.
5. Explain the pathogenesis associated with reproductive processes.
6. Learn new knowledge and techniques autonomously.
7. Obtain, manipulate and culture preimplantation mammal embryos.
8. Read specialised texts both in English and ones own language.
9. Reason in a critical manner
10. Relate the processes of gametogenesis and fertilisation to the normal functioning of the reproductive system.
11. Search for and manage information from various sources.
12. Work individually and in teams

Content

Theoretical classes program

I. Gamete formation and fertilization

Topic 1. Female gametogenesis. General aspects of female reproductive system. The ovary. Mitotic phase. Meiotic phase. Oocyte and follicle growth. Oocyte maturation. Regulation of oogenesis. Ovulation efficiency, atresia. Oocyte and cumulus-oocyte complex structure.

Topic 2. Male gametogenesis. General aspects of the male reproductive system. The testicle. Spermatogenesis: Mitotic phase. Meiotic phase. Postmeioitic phase (spermiogenesis), spermiation. Gene activity. Control and efficiency of spermatogenesis. Sperm structure.

Topic 3. Sperm maturation. Epididymal functions. Structural and functional modifications.

Topic 4. Ejaculation. Erection. Accessory glands. The semen: Characteristics and seminal parameters.

Topic 5. Sperm capacitation. Characteristics. Structural and functional modifications.

Topic 6. Hyperactivity. Characteristics, control of motility pattern.

Topic 7. Acrosome reaction. Characteristics of acrosome. Control and induction.

Topic 8. Fertilization. Transit through the female genital tract. Interaction between gametes. Egg coat penetration. Membrane fusion. Polyspermy block. Pronuclei formation. First cleavage division.

II. Preimplantation embryo development

Topic 9. Preimplantation embryo development. General aspects and morphological description. Embryo metabolism. Embryo gene activity. Control of gene expression. Imprinting.

Topic 10. Cell differentiation. Morula formation: Compaction, polarization. Molecular bases. Totipotency and cell differentiation. Blastocyst formation: inner cell mass, trophectoderm, blastocel. Hatching.

III. Fertility control in humans

Topic 11. Negative fertility control. Female contraception. Male contraception Post-coital contraception.

Topic 12. Human sterility and infertility. Female: causes and evaluation. Male: causes and evaluation.

Topic 13. Assisted reproduction techniques (ARTs) I. Ovulation induction. Artificial insemination. *In vitro* fertilization (IVF). Embryo *in vitro* culture. Embryo transfer. Gamete donation.

Topic 14. ARTs II. Micromanipulation: tools, general procedures. Assisted hatching. Intracytoplasmic Sperm Injection (ICSI). Epididymal and testicular sperm recovery.

Topic 15. ARTs associated technologies. Sperm selection. Preconception and preimplantation genetic diagnosis. Oocyte *in vitro* maturation.

Topic 16. Genetic risks associated with ARTs.

IV. Gamete and embryo cryopreservation

Topic 17. Cryopreservation. Biological consequences of the temperature decrease. Characteristics of freezing and thawing protocols. Vitrification. Embryo cryopreservation. Sperm cryopreservation. Oocyte and ovarian tissue cryopreservation. Gamete and embryo banks.

V. Fertility control in animals.

Unit 18. Reproduction in animals. Reproductive cycle in males. Reproductive cycle in females. Gestation. Reproductive Efficiency.

Topic 19. Assisted reproduction techniques. Oestrus induction and synchronization. Artificial insemination. Superovulation. Embryo recovery. Oocyte retrieval. I*n vitro* Fertilization (IVF). Embryo *in vitro* culture. Embryo transfer. Oocyte *in vitro* maturation. Sperm selection. Embryo preimplantation selection.

VI. Embryo manipulation derived technologies.

Topic 20. Transgenesis. Methods of gene construction transfer. Methods of transgenic animal production. Detection of transgenic animals. Establishment of transgenic lines. Detection of the expression of the transgene. Transgene applications.

Topic 21. Cloning. Methods of cloning in animals: blastomer isolation, embryo splitting, nuclear transfer. Applications

Topic 22. Stem cells and reproduction. Cell reprogramming and stem cells (ESC and IPS).

Laboratory practice program

Male and female gametogenesis

In vitro embryo manipulation and culture

Oocyte *in vitro* maturation

Gamete and embryo freezing

Embryos splitting

Analysis of a human semen sample

Related videos

Methodology

Technology of reproduction course incorporates theoretical classes, laboratory practices and classes of problems. The following text describes the organization and teaching methodology that will be followed in these three types of training activities.

Theoretical classes:

The content of the theory program will be mainly taught by the teacher in form of lectures with audio-visual support. Presentations used in class by the teacher will be previously available on Virtual Campus. It is recommended that students bring this material to class and use it as a support when taking notes. Although it is not essential to extend the contents of the lectures, unless expressly requested by the teacher, it is advised that students regularly consult the books and recommended texts in the Bibliography section of this syllabus in order to consolidate and clarify, if necessary, the contents explained in class.

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

Practical sessions:

Practical sessions are designed so that the students learn the basic methodologies used in a Biology of reproduction laboratory and complement the theoretical training. Students will do a total of 4 sessions of 3 hours each, working in groups of 2 and, during the practical sessions, they will have to answer a questionnaire.

Practical guidelines will be available on Virtual Campus. During each practical session, students must bring their own practical guidelines and always wear their own lab coat and glasses (when requested to).

Students must complete the laboratory safety and biosecurity questionnaire, or appropriately document they have passed it previously.

Solving problems sessions:

The classes of problems are designed so that the students work in small groups. Its objective is to initiate the student in the reasoning and interpretation of scientific results, as well as in the elaboration and formal proposal of theories and experimental designs that allow to achieve certain objectives proposed to them. On the other hand, they intend to be an instrument for the teacher who can use them to carry out a "guided discovery teaching" strategy, so that the student acquires certain knowledge based on the conclusions that can be drawn from each problem. Finally, it also seeks to familiarize the student with the interpretation of graphs and tables and with the most common notations in scientific literature.

Moreover, since problems are intended to be solved by reduced working groups, the aim is to promote the habit of teamwork and critical argumentation among peers.

Students will do 2 deliveries of 4 problems each. Groups will be composed of between four and six students each.

Tutorials

At students' request, there will be tutorials aimed at solving doubts about the theory content and the solving problem process.

Activities

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Practical sessions	12	0.48	6, 1, 3, 4, 5, 8, 7, 9, 10, 12
Solving problems sessions	2	0.08	6, 11, 1, 2, 3, 4, 5, 9, 10, 12
Theoretical sessions	40	1.6	6, 11, 1, 3, 4, 5, 8, 9, 10, 12
Type: Supervised			
Tutorials	2	0.08	11, 1, 2, 3, 4, 5, 8, 9, 10, 12
Type: Autonomous			
Solving problems	16	0.64	6, 11, 1, 2, 3, 4, 5, 8, 9, 10, 12
Study	70	2.8	6, 11, 1, 2, 3, 4, 5, 8, 9, 10, 12

Assessment

To pass the course it will be essential to obtain a final grade of the subject equal to or greater than 5 points (out of 10) and have attended the practical sessions. The scheduled evaluation activities are:

First term theoretical test

It will count 30% of the final mark. The first part of the subject taught in the theoretical classes will be evaluated.

Second term theoretical test

It will count 30% of the final mark. The second part of the subject taught in the theoretical classes will be evaluated.

In order to eliminate the material from these two theoretical examinations and use the mark obtained to count in the final grade of the subject, students must obtain a mark equal to or greater than 4 out of 10 in each one.

Problems assessment

It will count 15% of the final mark. A problem will be assessed individually during the Second term theoretical test or during the Recovery Exam for those students not attending the Second term theoretical test.

Recovery test

There will be a general recovery test for those students who have not passed (<4) or have not attended some of the partial tests.

To participate in the recovery, 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 or module. Therefore, students will obtain the "Non-Valuable" qualification when the assessment activities carried out have a weighting of less than 67% in the final grade.

The student will have the option of renouncing the mark of any theoretical exam or problem and attend the recovery exam.

Exams reviewing

The review of exams will be done by previous appointment and within the schedule proposed by the teacher.

Exam model

There will be an exam model available to students on Virtual Campus.

Delivery of problems

It will count 10% of the final mark. A group assessment will be carried out correcting 4 out of the 8 problems delivered and the average of the best 3 notes will be taken into account.

Practical sessions assessment

It will count in 15% of the final mark. Laboratory practices will be assessed while carrying them on by answering questions included in the corresponding practical questionnaire. Attendance is mandatory. Students will obtain the "Non-Valuable" qualification when assessment activities carried out have a weighting of less than 67% in the final grade.

Global rating

In order to pass the course students will have to perform the tests of each of the 2 terms tests, as well as the problems assessment and practices and to obtain an overall grade greater than 5 out of 10. Students who do not attain the minimum qualification of 4 points in any of the two theoretical partial tests will not be able to pass the course and will receive a maximum final grade of 4 points.

Non-valuable: Students will be considered as "Non-valuable" when evaluation activities carried out have a weighting of less than 67% of the final grade.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of problems	10%	2	0.08	6, 11, 1, 2, 3, 4, 5, 8, 9, 10, 12
First theoretical test	30%	1.5	0.06	6, 11, 1, 8, 9, 10, 12
Practical sessions assessment	15%	2	0.08	6, 11, 1, 3, 4, 5, 8, 7, 9, 10, 12
Problem assessment	15%	1	0.04	6, 1, 2, 3, 4, 5, 8, 9, 10, 12
Second theoretical test	30%	1.5	0.06	6, 11, 3, 4, 5, 8, 9, 10, 12

Bibliography

It is not easy to find texts that can fully cover the variety of topics that will be treated during the course. On the other hand, the contents of many of their blocks make up a new discipline therefore their content do not usually appear in "classical" books. As reference and reference texts, the following books are proposed that cover the contents and various aspects of the subject:

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

De Jonge C, Barratt C. (Eds). The sperm cell. Cambridge University Press. New York. 2006

Durfort M, Vidal F. (Eds). Biologia de la Reproducció. Societat Catalana de Biologia. Barcelona. 2009.

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

Fauser B.C.J.M. (Ed.). Molecular Biology in Reproductive Medicine. The Parthenon Publishing Group. New York. 1999

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

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.

Houdebine L.M. (Ed.). Transgenic animals. Generationand use. Harwood Academic Publishers. Amsterdam. 1997.

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.

Lanza R. Et al. (Eds.) Handbook of Stem Cells. Excerpts. Elsevier Academic Press. Amsterdam. 2004.

Lanza R. Et al. (Eds.) Handbook of Stem Cells. Vol 1 i 2. Elsevier Academic Press. Amsterdam. 2004.

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

Nadal J. (Ed.). Donación de ovocitos. Momento Médico Iberoamericana. Madrid. 2010.

Remohí J., Pellicer A., Simón C., Navarro J. (Eds.). Reproducción Humana. 2ª Edición. McGraw Hill-Interamericana. Madrid. 2002.

Remohí J., Romero J.L., Pellicer A., Simón C., Navarro J. (Eds.). Manual práctico de esterilidad y reproducción humana. McGraw Hill-Interamericana. Madrid. 2000.

Thibault C., Levasseur M.C., Hunter R.H.F. (Eds.) Reproduction in Mammals and Man. Ellipses, Paris. 1993.

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

Along the course, some recomendations on specific bibliography refering to those topics to be prepared by the students will be suggested.

Extra problems to be solved by the students can be foundin:

Santaló J., Vidal F. Biologia de la Reproducció. Problemes. Servei de Publicacions de la Universitat Autònoma de Barcelona. Col. Materials, vol 63, 3ª edició. 2010