Genetically Modified Animals

Code: 101925
ECTS Credits: 6

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<th>Type</th>
<th>Year</th>
<th>Semester</th>
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<td>OT</td>
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</table>

**Contact**

Name: Maria Fátima Bosch Tubert
Email: Fatima.Bosch@uab.cat

**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

**Teachers**

Pedro José Otaegui Goya
Miguel García Martínez
Anna Maria Pujol Altarriba
Ivet Elias Puigdomenech
Verónica Jiménez Cenzano

**Prerequisites**

There are no prerequisites to attend this course. However, to facilitate the student's understanding of the subject matter and the achievement of the learning goals proposed, it is advisable that the student has previous knowledge on Cellular Biology, Genetics, Molecular Biology and Recombinant DNA technology.

It is also advisable that the students have basic knowledge of English, so that they can use the information sources of the field, which are mostly in this language.

**Objectives and Contextualisation**

The objective of the subject "Transgenic animals" is to provide the students with up-to-date knowledge in transgenesis and related technologies. Thus, the content of the subject will cover the following topics: Description and classification of transgenic animal models; Study of the different methodologies employed to obtain transgenic animal models of different species, and technologies that allow the overexpression of genes or the blockage or modification of endogenous genes, either ubiquitously or in a tissue-specific and/or inducible manner; Establishment and management of transgenic animal colonies; Cryopreservation of embryos and sperm, IVF, Health rederivation, Ethical aspects related to the generation and utilization of transgenic animals; Legislation on the use of laboratory animals; Application of animal transgenesis to the fields of biomedicine, biotechnology and livestock breeding.

**Skills**
• Contribute to public discussions on cultural matters.
• Develop independent learning habits and motivation to continue training at postgraduate level.
• Develop scientific knowledge, critical reasoning and creativity.
• Display knowledge of techniques related to genetic and reproductive technologies.
• Identify and understand the advances and challenges of research.
• Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
• Show respect for the ethical and legal aspects of research and professional activities.
• Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning outcomes

1. Contribute to public discussions on cultural matters.
2. Develop independent learning habits and motivation to continue training at postgraduate level.
3. Develop scientific knowledge, critical reasoning and creativity.
4. Display knowledge of techniques related to genetic and reproductive technologies.
5. Explain and apply techniques for intervening in gametes and embryos.
6. Identify and understand the advances and challenges of research.
7. Interpret the principles behind transgenesis in animals, techniques for the generation of genetically-manipulated animals and methods for studying these.
8. Read specialised texts both in English and ones own language
9. Recognise the ethical principles and current legislation in relation to animal genetic manipulation and animal experimentation, gene therapy and reproduction techniques, in their application to biomedicine.
10. Search for and manage information from various sources
11. Show respect for the ethical and legal aspects of research and professional activities.
12. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

Knowledge on the following topics will be imparted during the theoretical classes:

**TOPIC 1**

Introduction to the technologies used for animal genetic engineering. Transgenic animals: definition and classification. Advantages of the mouse as an animal model in biomedicine.

**TOPIC 2**


**TOPIC 3**

Design and production of chimeric genes/transgenes: promoters, inducible systems, insulators, enhancers. Analysis of transgene expression *in vitro*: technologies for the introduction of exogenous DNA to cultured cells. Transient and stable transfections. BACs and YACs.

**TOPIC 4**


**TOPIC 5**
Generation of transgenic animals using viral vectors (lentivirus). Generation of transgenic animals from sperm.

**TOPIC 6**

Targeted mutagenesis in animals through Embryonic Stem cells (ES cells): definition of ES cells, properties, obtainment and culture. Reprogramming and *Induced Pluripotent Stem cells (iPS cells)*.

**TOPIC 7**


**TOPIC 8**


**TOPIC 9**


**TOPIC 10**


**TOPIC 11**

Use of transposons for obtaining transgenic animals.

New technologies: Generation of Knockout / Knockin animals though genome editing using *Zing Finger Nucleases, TALENs o CRISPR-Cas9*. Advantages and limitations. Applications.

**TOPIC 12**


**TOPIC 13**

Establishment and maintenance of genetically modified mouse and rat colonies. Nomenclature. Phenotype: alterations arising due to transgenesis technology, environmental factors or genetic background.

**TOPIC 14**

Technologies to support the establishment and the management of colonies of genetically modified animals: Cryopreservation of embryos and sperm. *In vitro* fertilization (IVF). Health rederivation. Ovary transfer.

**TOPIC 15**

Housing and handling of transgenic animals. Current legislation on animal genetic engineering and use of laboratory animals.

**TOPIC 16**


**TOPIC 17**
Large International consortia on mouse mutagenesis. Large-scale phenotyping centres: "Mouse Clinics".

**TOPIC 18**

Obtainment of transgenic fish. Applications in Biotechnology.

**TOPIC 19**

Use of transgenic animal models for the study of diseases (I): Diabetes mellitus. Obesity. Use of transgenic animal models for the development of new gene therapy products for these diseases.

**TOPIC 20**

Use of transgenic animal models for the study of diseases (II): Cancer. Study of oncogenic and anti-oncogenic genes in transgenic animals.

**TOPIC 21**

Use of transgenic animal models for the study of diseases (III): Models of inherited diseases.

**TOPIC 22**

Use of transgenic animal models in neurosciences. Use of transgenic animal models in the field of immunology.

The laboratory practice classes will cover the design of different types of transgenic animals and Knockout / Knockin mutants, the establishment and maintenance of colonies of transgenic mice and the genotypic analysis of the genetically engineered animals. Students will also carry out several techniques as part of the phenotypic analysis of genetically engineered mice. Using a transgenic mouse model, an *in vivo* phenotyping study will be performed.

Content of the laboratory practice classes:

- Generation of transgenic and Knockout / Knockin animals. Videos.
- Design of transgenes, gene targeting recombination vectors and components of the CRISPR/Cas9 system.
- Handling and *in vitro* culture of pre-implantational embryos.
- Genotype analysis. Establishment of colonies of transgenic animal and Knockout / Knockin mutants.
- Phenotype analysis. Histopathology, necropsy and *in vivo* studies.

**Methodology**

The subject "Transgenic Animals" consists of theory and laboratory classes, and tutored oral presentations of relevant literature. The formative activities of the subject are complementary.

**Theoretical classes**

The contents of the theoretical classes will be imparted by a Professor in a series of master classes supported by audio-visual material. The slides used by each professor in each class will be available to the students through the subject's Campus Virtual/Moodle. These master classes will constitute the main form of transfer of theoretical contents. Students are advised to periodically consult the books and links suggested in the Bibliography section of this document and at the Campus Virtual/Moodle to consolidate and clarify, if necessary, the contents explained in class.

**Laboratory practice classes**


The laboratory practice classes have been designed to help students get familiarized with the methodologies used to produce transgenic animals, establish animal colonies, genotype genetically engineered animals, and design and perform different phenotypic analyses in these animal models. We expect that, during these laboratory practice classes, students will be able to experience a "real world" situation in which they need to design an experiment, obtain a genetically engineered animal model and study in vivo their phenotype. We would like students to experience the excitement associated to the research that uses the technology of animal transgenesis.

The laboratory practice classes are composed of 3 sessions of 4 h each (from 3PM to 7PM), during which students will work in groups of 2-3 people under the supervision of an experienced professor. The date assigned to each laboratory practice group will be published in the subject's Campus Virtual/Moodle with sufficient anticipation.

Attendance to laboratory practice classes is mandatory.

By the end of the laboratory practice classes, students will need to have answered a questionnaire. Both the laboratory practice guide and the questionnaire will be available through the Campus Virtual/Moodle. Students must bring their own lab coat, a waterproof marker and the Laboratory Practice Guide to each laboratory practice class.

**Oral presentations of selected papers**

Students will analyse and discuss in an oral presentation in front of the whole class a selected scientific publication on animal transgenesis, published in a recognized international scientific journal. To this end, students will pair with a fellow classmate. During the process of analysis of the paper's content and preparation of the oral presentation, students will be tutored by researchers with experience in the field of animal transgenesis. Students will have 10 minutes for the oral presentation, equally divided amongst the members of the group, plus 5 minutes for questions (total of 15 minutes). The objective of this evaluating activity is that students get used -under the supervision of a tutor- to the process of searching, reading and understanding of scientific literature, and if necessary, develop a critical view on the figures, tables and results described in the publication. On the other hand, with this activity students will increase their knowledge of the current applications of the animal transgenesis technologies.

**Tutoring**

The oral presentations of selected papers will be tutored. In addition, upon request from the students, individualized tutoring will be available throughout the course. The objective of this sessions will be to help the student resolve doubts and review basic concepts and to provide them with advice on sources of information and the best way to discuss scientific results in public.

**Activities**

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<th>Title</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning outcomes</th>
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<tr>
<td>Oral presentations</td>
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<td>0.2</td>
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### Evaluation

To pass the course, students must achieve a final score of 5 points (over a total of 10 points) and must attend the laboratory practice classes. The evaluation activities are:

1. **Final examination of theoretical classes**
   Accounts for 50% of the final score (5 points out of 10). Assessment will consist of a written examination, under the format of a True or False test, on topics explained during the theoretical classes. A score greater than 2.5 in this examination is required to pass the course.

   There will be a Second Chance/Recovery Exam, under the same format as the original exam.

2. **Examination of Laboratory classes**
   Accounts for 15% of the final score (1.5 points out of 10). Assessment will consist of a written examination, under the format of a True or False test, on topics explained during the practical classes. It will be held at the end of practical classes period.

   To pass the subject, attendance at the practical classes is mandatory.

3. **Self-study exercise**
   Accounts for 10% of the final score (1 point out of 10). Assessment will consist of an exercise that the student will have to develop on their own. Details will be posted online in the "Campus Virtual" at the end of April.

4. **Oral presentations of selected research papers**
   Accounts for 15% of the final score (1.5 points out of 10). Students will be evaluated individually, both on their performance during the oral presentation of the selected paper and on the audio-visual material that they prepared to support their group presentation.

5. **Attendance to the oral presentations of research papers**
   Accounts up to 10% of the final score (1 point out of 10). Both attendance and participation in the scientific discussions of the sessions will be evaluated, following the scale:

   - Attendance 90-100% = 1 point
   - Attendance 80-89% = 0.8 points
   - Attendance 70-79% = 0.7 points
   - Attendance 60-69% = 0.6 points
   - Attendance 50-59% = 0.5 points
   - Attendance 0-49% = 0 points

   Students will be deemed Non-Qualifiable if the number of evaluating activities in which they participate is less than 50% of those proposed in this guide.
Evaluation activities

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Bibliography


Interesting webs:

- [http://www.transtechsociety.org/](http://www.transtechsociety.org/)

- [http://www.knockoutmouse.org/](http://www.knockoutmouse.org/)

- [http://www.emmanet.org/](http://www.emmanet.org/)