Modulbeschreibungen des Master-Studiengangs EUCOMOR – soweit von JLU angeboten -

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1. Semester - Pflichtmodul

Basic vertebrate histology (6 ECTS)

Lecturers: Stefan Arnhold, Oksana Raabe (Justus-Liebig University of Giessen, Germany)
Contact hours: 20 e-lectures – 1 e-instruction
Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum

Learning outcomes:

- Knows the terminology related to microscopic anatomy
- Draw and describe the microscopic features of tissues and organs for the main vertebrate species.
- Determine the total magnification of a microscope when given the ocular and objective.
- Describe the different staining techniques for the labelling of different structures (e.g. Von Giesson, PAS, HE, etc) and be familiar with different illuminations (bright field, dark field, phase contrast, fluorescence, electron microscopy, confocal microscopy, electron microscopy).
- Can compare animal species and explain differences in function, based upon the morphology of the microscopical structures concerned (or the other way around)
- Can put a research question related to the explanation of similar or differing morphological structures (between species).

Course contents:
This course covers the description of the microscopic anatomy of the major tissues and organs of the main mammalian species. Special differences in tissues or generally specialities will be highlighted. During the virtual microscopy sessions, students learn to draw and describe the microscopic specimens.

Teaching method:

- e-lectures
- e-instruction (read a paper, summarize and deduce the hypothesis and experimental setting)
- virtual microscopy (including the assignment that each student is to present and critically reflect on a case presented via virtual microscopy to his/her peers which need to comment)

Assessment method:

- Written: open questions
- Assignment (continuous assessment)

Study material
Obligatory: hand-outs
Optional reading: Textbook of Veterinary Histology. By D.A. Samuelson, Saunders (Elsevier, Publ) – Altas of Histology. By C.V. Cotea & I.C. Cotea, Technopress Iasi Romania (Publ) – Funktionelle Histologie der Haussäugetiere. By H.G. Liebig, Schattauer (Publ).

3. Semester - Pflichtmodule, falls JLU als Standort für das 3. Semester gewählt

Cell culture (6 ECTS)

Lecturers: Stefan Arnhold, Oksana Raabe, Carsten Staszyk (Justus-Liebig University Giessen, Germany)
Contact hours: 30 h lectures – 30 h lab sessions
Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum and having completed the first cluster of the master of comparative morphology (basic courses)

Learning outcomes:

- Know the principles of cell culture work.
- Know the components of cell culture protocols and can carry out these protocols according to the state of the art procedures.
- Can establish a primary cell culture.

Course contents:
This course deals with the different methods of cell culture work of cells from different species and tissue origin. Various cell cultures (permanent and immortalized) cells will be demonstrated. It will be demonstrated how cells are isolated, how they are taken into culture and by which media they are going to be fed. Furthermore, it will be taught how to investigate the cell morphology by phase contrast microscopy and how to possibly detect species differences of certain cell types. The students will be made familiar with the sterile working techniques under the clean bench. Cell counting with the cytometer and plating of certain cell numbers is also part of the course. Within the practical part of the course static as well as non-static culture procedures are introduced as well as the interaction of cells with specific scaffold materials.

Teaching method:

- Lectures
- Lab sessions

Assessment method:

- Oral: open questions
- Continuous assessment

Study material
Obligatory: hand-outs
Optional reading: S. Schmitz, Der Experimentator, by S. Schmitz, Spektrum Akademischer Verlag (Publ).
At the Bench: A Laboratory Navigator, By K. Barker, Cold Spring Habour Laboratory Press (Publ)

Stem cells (3 ECTS)

Lecturers: Stefan Arnhold, Oksana Raabe (Justus-Liebig University Giessen, Germany)
Contact hours: 15 h lectures – 10 h lab sessions
Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum and having completed the first cluster of the master of comparative morphology (basic courses)

Learning outcomes:

- Know the characteristics of stem cells and stem cell physiology/biochemistry (protein networks, transcription factors, genetics, epigenetics).
- Know the components of stem cell isolation; cultivation and differentiation protocols and can carry out these protocols according to the state of the art procedures.
- Is familiar with the morphology in the undifferentiated state as well as after differentiation procedures into different lineages.
- Is aware of the national, European and international legislation and guidelines as ethical and scientific arguments regarding the use of stem cells for research and therapeutical purposes.

Course contents:
This course deals with stem cell handling and the isolation of stem cells from different sources and tissues as well as from different species.
Within the course the various specialties and needs of different stem cells from different sources are taught. This comprises embryonic, fetal and adult stem cells. It will be taught how undifferentiated stem cells can be microscopically differentiated from lineage restricted precursor cells. Using molecular methods and other labeling techniques the percentage of stem cell within a cell population will be evaluated.
In laboratory based practical sections the student learns how to actually work with stem cells under the clean bench and which growth factors to apply for the lineage specific differentiation. During a discussion platform the ethical and legal concerns regarding the use of stem cells are addressed. Students need to organize this discussion platform themselves by preparing presentations themselves and inviting keynote speakers.

Teaching method:

- Lectures
- Lab sessions
- Assignments

Assessment method:

- Oral: open questions
- Continuous assessment

Study material
Obligatory: hand-outs
Optional reading: S. Schmitz, Der Experimentator, by S. Schmitz, Spektrum Akademischer Verlag (Publ).

Experimental embryology / morphology (6 ECTS)

Lecturers: Stefan Arnhold, Oksana Raabe (Justus-Liebig University Giessen, Germany), Poul Hyttel (invited lecturer) (University of Copenhagen, Denmark)
Contact hours: 30 h lectures – 20 h lab sessions and assignments
Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum and having completed the first cluster of the master of comparative morphology (basic courses)

Learning outcomes:

- Know and can illustrate and teach the following terminology: differentiation, commitment, specification and determination.
- Know, can illustrate and carry out experiments showing the molecular control of proliferation (and apoptosis), body axis determination, structural specializations in the embryo, the polarization of the embryo, mesodermal induction and notochord formation.
- Can critically evaluate literature data and protcols related to experimental embryology.
- Demonstrate the ability to study the vertebrate and non-vertebrate embryo and to compose research reports of professional quality.
- Is aware of the national, European and international legislation and guidelines as ethical and scientific arguments regarding the use embryos for research and therapeutical purposes.

Course contents:
During the lectures some principles – taught in other courses – will be shortly repeated (via peer-teaching): ectoderm, mesoderm, and endoderm development, definitions and main properties of embryonic and somatic stem cells as the protocols for the isolation, expansion and differentiation of these cells. The remainder of the course will include lectures and lab sessions during which students obtain more knowledge of cell differentiation, specification (autonomous, syncytial and conditional) cell fate, cellular reprogramming, ageing of cells and tissues, neural tube and nervous system development and the role of morphogens of both the vertebrate and the non-vertebrate embryo. The lab sessions will introduce and train the students in the relevant techniques for gaining the aforementioned knowledge. During the seminars, examples of embryonic and morphological experiments are discussed.

Teaching method:

- Lectures
- Lab sessions
- Assignments

Assessment method:

- Oral: open questions
- Continuous assessment

Study material
Obligatory: hand-outs
Optional reading: S.F. Gilbert, Developmental Biology, Sinnauer Associated (Publ).

Advanced molecular techniques in morphology (6 ECTS)

Lecturers: Mirabella Nicola, Squillacioti Caterina, De Luca Adriana (Universiti degli Studi Napoli Federico II, Italy)
Contact hours: 30 h lectures – 20 h lab sessions
Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum and having completed the first cluster of the master of comparative morphology (basic courses)

Learning outcomes:

- Knows the principles and mechanism of the various molecular techniques that are addressed during the course.
- Can manipulate a microscope.
- Can use the appropriate – for the visualisation technique – procedures for tissue handling and specimen preparation.
- Can apply immunohistochemical techniques
- Can apply in situ hybridization techniques.
- Can apply molecular methods to study protein, RNA and DNA expression i.e. Western blot, RT-PCR and real-time RT-PCR.

Course contents:
The course cluster will cover the following techniques via lectures and lab sessions and seminars during which the use of these techniques in biomedical research is case-based discussed: conventional histological and histochemical techniques; immunohistochemical techniques (PAP, ABC, polymeric methods, immunofluorescence), in situ hybridization techniques, laser capture microdissection, tissue handling and specimen preparation to recovery proteins and nucleic acids from animal tissues Western blot analysis, conventional PCR and RT-PCR, in situ RT-PCR, real-time RT-PCR.

Teaching method:

- Lectures
- Lab sessions
- Assignements

Assessment method:

- Oral: open questions
- Continuous assessment

Study material
Obligatory: hand-outs
Optional reading: Morphology Methods: Cell and Molecular Biology Techniques, By R.V. Lloyd, Humana Press (Publ).

Research internship (9 ECTS)

Lecturers: Local coordinator of the cluster assesses the student and coordinates the research internship
Contact hours: placement for 4 weeks
Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum and having completed the first cluster of the master of comparative morphology (basic courses)

Learning outcomes:

- Can adapt to function in a team.
- Can gather, discuss and reflect on scientific literature within the domain of vertebrate morphology.
- Can set up an experimental protocol.
- Can keep a labjournal.
- Can integrate scientific literature in a research protocol and in the reporting of the results.
- Can conduct research activities under supervision.
- Can listen in an active manner e.g. during labmeetings and is able to debate about research results, animal models and visualizing techniques with fellow researchers.
- Can communicate both verbally and in writing research results.

Course contents:
The student will during 4 weeks participate in an active manner in a research lab oriented according to the elective cluster that was chosen. During these weeks, the students will initially observe certain activities and write them down in a labjournal. Furthermore, the student needs to perform a limited study of literature in order to understand the background of the research. In a second stage, the student will more actively participate in the experiments. All experiments done and the results that are obtained will be written in a labjournal and discussed with the promotor.

Teaching method:

- Placement

Assessment method:

- Continuous assessment
- Assignment (quality of the labjournal and the presentation of the results)

Study material : Labjournal.

4. Semester Thesis Pflichtmodul am Wahlstandort

Dissertation (non-elective - 30 ECTS)

Lecturers: examination board (see cooperation agreement), the examination board appoints a tutor (post-doc) per student

Prerequisites: bachelor in Life Sciences with at least 6 ECTS of cell biology in the bachelor curriculum and having completed the core clusters (basic courses and morphology core courses) and one elective cluster (cell or imaging) of the master of comparative morphology.

Learning outcomes:

- Can select and apply the most suitable technique for certain scientific questions related to comparative morphology.
- Can gather, discuss and reflect on scientific literature about complex scientific matters within the domain of vertebrate morphology.
- Can postulate a complex hypothesis, design an appropriate research plan, analyse the research results with the suitable methods.
- Is able to integrate scientific literature in morphology in a research protocol and in the reporting and discussion of research results.
- Can perform experiments both independently and within a team.
- Can listen actively and is able to debate about research results.
- Can integrate knowledge and skills in order to develop/design and critically analyse new complex animal models and/or in vitro/ex vivo alternatives within biomedical research and education.
- Can report (in writing and verbally) research results.
- Can give convincing advice regarding the value, accuracy and applicability of specific animal models and/or in vitro/ex vivo experimental set-ups.
- Can function in a multidisciplinary team and possesses for this purpose social and leadership competences and a flexible attitude.
- Has a basic knowledge of at least 2 EU-languages.

Course contents:

At the end of the 1st year, students are offered information (research facilities, research topics, literature, etc.) regarding placements for conducting dissertation projects via www.eucomor.net. Research groups involved in the master programme post a multidisciplinary – but nevertheless related to comparative morphology - research topic in which a minimum of 3 and a maximum of 5 students need to be involved. The research topic should deal with the analysis, development and/or design of a new animal model or in vitro/ex vivo alternative. Students register for the placement and indicate a subtopic. The students are allocated to a placement upon a first come, first served basis. During the placement, 3 to 5 students work in a 'multidisciplinary' team. Each of the students is responsible for his/hers subtopic but nevertheless needs to maintain the overview of the whole research topic. As a consequence, students need to be capable to actively listen, to critically reflect

on their own functioning and research results, to be flexible, to function in a team, to fulfil several roles within a team (including leadership) and to integrate the different individual research results. At the beginning of their placement, students need to follow a crash-course in the language of the research position in case they are not proficient in the 'local' language. This is to increase the interaction with the research staff and is taken into consideration for the continuous assessment that is carried out by the supervisor and local staff.
The individual thesis and the associated placement, minimally consist of the following elements: formulate a research hypothesis based upon literature data, work out a research plan and experimental set-up, conduct the research activities and report them using a labjournal, critically discuss the research results in relation to the hypothesis and available literature data, report in writing (min 60 pages). In a separate part of the thesis, and in consequence separate part of the assessment, the student needs to critically discuss and paste the individual research results in the multidisciplinary research domain both in writing (min 10 pages) and verbally, involving the thesis exam commission in which all students involved take part.

Teaching method:

- Assignment
- Placement

Assessment method:

- Continuous assessment (10%)
- Peer assessment (10%)
- Presentation (in writing and verbally) of the research results
- (60 % individual work – 20 % integration of the research results)