QBio403: Developmental Biology

Module Responsible: Prof. Dr. Rüdiger Simon	**Version:** 30/12/2020
Module Organizer: Prof. Dr. Rüdiger Simon	**Type:** Compulsory

Lecturer:
Prof. Dr. Rüdiger Simon, Prof. Dr. Guido Grossmann

Total Working Time	**Credit Points**	**Contact Time**	**Self Study**	**Duration**
180 h	6 CP	60 h	120 h	1 Semester

Course Components		**Group Size**	**Frequency**
Lecture:	3 SWS	P: 40	Every Summer Semester
Exercise:	1 SWS	P: 20	

Learning Competencies:
After completing the module, students can:

- explain the fundamental challenges of multicellular life on the example of various model organisms.
- design an experiment that enables them to perform quantitative analyses of developmental plasticity and robustness.
- perform simulations of patterning events using computer simulations.

Content:
Students will be introduced to the basic principles underlying multicellularity and organismal development, such as cell adhesion, cell-cell communication, cellular and planar polarity, as well as cell differentiation. To understand common strategies and specific solutions during evolution, we will investigate the developmental programs from rather simple and transiently multicellular organisms like the amoeba Dictyostelium discoideum, to plants (Arabidopsis thaliana, Pisum sativum, Brachypodium distachyon, Zea mays) and animals (Drosophila melanogaster, Xenopus laevis, Gallus gallus domesticus, Mus musculus and Homo sapiens).

In a first exercise, the students will conceptualize, plan and perform an experiment with the purpose to follow the development in a model system of their choice, use video documentation and extract quantitative information to investigate phenotypic plasticity and robustness.
In a second exercise, the students will use computer simulations to understand the relative importance of various parameters such as diffusive signaling compounds on the formation of biological patterns.

Specifically, the following topics will be covered:

- Cell Identity
    - Cell Potency
    - Differential Gene Expression and Metabolic Profile
    - Apoptosis

- Cell Differentiation
    - Epigenetic
    - Regeneration
    - Reprogramming: Stem Cell → Soma Cell → Stem Cell
    - Cell Division Control
    - Cell Elongation
- Cell-Cell Communication / Cell Signaling
    - Reception - Transduction - Response
    - Bistability
    - Ultrasensitivity & positive feedback loops
    - Local vs. systemic signaling
    - Hormonal signaling
    - Exemplary signaling pathways
- Pattern Formation
    - Reaction Diffusion System
    - Elastic Instability
    - Turing Pattern
    - Phyllotaxis
- Plant Development
    - Model organisms
    - Patterning of the embryo
    - Meristems
    - Reproduction
    - Differentiation
- Animal Development
    - Model organisms
    - Pattern formation
    - Gastrulation
    - Morphogenesis
    - Reproduction
    - Differentiation

Conditions of Participation:
Passed modules QBio201 and QBio202

Examination:
Learning portfolio consisting of:

- 2 Exercises (15% each of final grade)
- Written Exam (70% of final grade)

Prerequisites for Awarding Credits for this Module:

- Participation in exercises: Minimum 1 of possible 15 pt
- Passing the written exam: Minimum 35 of 70 pt
- Minimum total cumulative points: 50 of 100 pt

Factor for the Overall Grade:
The grade is weighted according to the credit points (CP) in the overall grade.

Language: English
Literature: Barresi, Michael J. & Scott F. Gilbert (2020). Developmental Biology. International Twelfth Edition. New York, Oxford: Sinauer Associates, Oxford University Press.
Further Information: -