BIOENG-518

Methods: from disease models to therapy

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Cursus	Sem.	Type
Life Sciences Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	1 weekly
Practical work	3 weekly
Number of positions	**24**

It is not allowed to withdraw from this subject after the registration deadline.

Summary

This course will describe methods underlying translational approaches from disease modeling and characterization to therapeutic applications. The presented techniques will be complemented by hands-on rotations in the technological platforms of the School of Life Sciences.

Content

The initial part of the course will provide a general description of methods related to the development of relevant disease models (using diseases studied by SV labs as examples). Various techniques used for disease model characterization will be introduced, with a particular focus on different imaging techniques. Approaches used to develop therapeutically focused applications will also be outlined. The presented techniques will be discussed in terms of their rationale, applicability and limitations. During the second part of the course students will take part in hands-on rotations in participating technological platforms allowing them to put the theory into practice inside a laboratory environment.
The followings topics will be covered during the theoretical and practical parts of the course:

Animal models
- Basis of the legal and ethical framework of research with animals in Switzerland
- Generation and phenotyping of mouse models
- In vivo imaging techniques

Histology
- General introduction into diverse techniques used to prepare samples for bright field microscopy
- Procedures for standard histology stains
- Detection of proteins and mRNA, multiplexing, spatial omics
- Data analysis and interpretation

Light-microscopy
- Introduction into light-microscopy
- Types of microscopes used to assess histological samples in a fast and reliable manner
- Image analysis, strategies to classify tissue samples

Transmission and scanning electron microscopy
- Basic principles of electron microscopy
- Sample preparation
- Sample imaging

- Image interpretation

Biomolecular integrative structural biology
- 3D high-resolution characterization of biological macromolecules
- X-Ray crystallography, single-particle Cryo-EM and Bio-NMR
- Visit and data collection at high-end microscopes at the Dubochet Center for Imaging
- Introduction to 3D protein structure software and modeling tools as well as data interpretation

Academic drug discovery
- Description of the early drug discovery process
- Molecular screening assays (from in vitro target-based to cellular phenotypic high throughput and high content screening)
- Introduction to the basics of chemical libraries, medicinal chemistry and illustration of the hits to leads process
- Advanced cellular models (3D formats and organoids generated from patient samples)

Gene therapy
- Principles of gene delivery to adult tissues
- Introduction to vector technologies and production methods
- Introduction to genetic manipulations in the context of gene therapy (functional restoration, RNA interference, gene editing)
- Examples of therapeutic applications

Keywords

- Animal models
- Imaging
- Drug discovery
- Gene therapy

Learning Outcomes

By the end of the course, the student must be able to:

- Choose the appropriate model to study a selected biological question
- Select appropriately histological and imaging technique(s) to design relevant experiments
- Describe the drug discovery process
- Illustrate the possibilities and limitations of gene therapy
- Contextualise theoritical and technical concepts of covered techniques

Transversal skills

- Use a work methodology appropriate to the task.
- Collect data.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.

Teaching methods

This course will be divided into 7 weeks of theoretical lectures followed by 6 weeks of rotations in participating scientific platforms including Histology Core Facility, Biological Electron Microscopy Facility, Protein Production and Structure Core Facility and Biomolecular Screening Facility. For the platform rotations, students will work in small groups (6-8 students per group) and will perform experimental work in two different platforms (platform 1: weeks 8 to 10 and platform 2: weeks 11 to 13). Regarding the selection of platforms for rotations: we will try to accommodate students' preferences. During the last week (week 14) students will visit the animal facility and the phenotyping unit.

Assessment methods

Written reports covering 2 rotations in platforms and written exam during the last week of the semester.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Websites

- https://www.epfl.ch/research/facilities/histology-core-facility/
- https://www.epfl.ch/research/facilities/ptbiop/
- https://www.epfl.ch/research/facilities/biological-electron-microscopy/
- https://www.epfl.ch/research/facilities/ptpsp/
- https://www.epfl.ch/research/facilities/biomolecular-screening/

Moodle Link

- https://go.epfl.ch/BIOENG-518