

BIOENG-447

Chemical biology - tools and methods

Cursus	Sem.	Type
Bioengineering	MA2, MA4	Opt.
Biomedical technologies minor	E	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	4 weekly
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Remark

pas donné en 2017-18

Summary

Chemical biology is a key discipline in biomedical research for drug discovery, synthetic biology and protein functional annotation. We will give a broad perspective of the field ranging from seminal classical experiments to state-of-the-art approaches to dissect and perturb biological systems.

Content

What is Chemical Biology?

Protein biochemistry and biophysics in chemical biology

Block 1: Small molecules & Proteins:

- Bio-orthogonal conjugation chemistries
- Chemical probes and tool compounds
- Target discovery and validation
- Activity based protein profiling and chemoproteomics
- Bioinformatics resources to aid chemical biology
- Protein post-translational modifications and methodologies
- Drug discovery
- Protein engineering and in vitro evolution
- Protein chemical ligation
- Design of biological sensors

Block 2: Chemical Biology in cells:

- Phenotypic assays
- Chemical genetics
- In situ visualization (labeling and fluorescent sensors/probes)
- Cellular uptake mechanisms

Block 3: Chemical Biology in animal models

- Genetic loss of function vs chemical perturbation
- Chemical probes applied in tissues and living organisms
- In vivo visualization of biological activities

- Crossing the blood-brain barrier to engage targets in the brain

Keywords

Chemical biology, drug discovery, high throughput screening, fluorescence microscopy, imaging, protein biochemistry, protein biophysics, post-translational modifications, cancer, biotechnology, and scientific writing.

Learning Prerequisites

Recommended courses

Biological Chemistry I, II and III

Learning Outcomes

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

- Interpret key experimental strategies to address scientific problems with chemical biology techniques
- Assess / Evaluate chemical biology literature
- Design valid chemical biology experiments to answer biological questions

Transversal skills

- Demonstrate the capacity for critical thinking
- Access and evaluate appropriate sources of information.
- Make an oral presentation.
- Write a scientific or technical report.
- Summarize an article or a technical report.

Teaching methods

- Lectures
- Presentation and discussion of scientific literature
- Interactive lectures with computer-based exercises
- Exercises

Expected student activities

- Attendance to classes
- Presentation of scientific literature
- Discussion of scientific literature
- Class participation

Assessment methods

- Final Exam (open book) 50%
- Two-page essay 30%

- Journal Club presentation 20%

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

Given the rapid development of this field, there is no single book that covers all the subjects of this course, but selected chapters from:

- Concepts and Case Studies in Chemical Biology - Waldman and Janning
- Chemical Biology: from small molecules to system biology and drug design - Stuart L. Schreiber, Tarun Kapoor, Gunther Wess
- Chemical Biology: Approaches to Drug Discovery and Development to Targeting Disease – Natanya Civjan
- Posttranslational Modification of Proteins: Expanding Nature's Inventory - Christopher T. Walsh

will be used. In addition, original research articles and reviews on the topic covered during the course will be discussed.

Ressources en bibliothèque

- [Concepts and Case Studies in Chemical Biology / Waldmann](#)
- [Chemical biology: from small molecules to systems biology and drug design / Schreiber](#)
- [Chemical Biology: Approaches to Drug Discovery and Development to Targeting Disease / Civjan](#)
- [Posttranslational modification of proteins : expanding nature's inventory / Walsh](#)