CH-416

Chemical biology of cell imaging

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Cursus	Sem.	Type
Chemistry and Chemical Engineering		Obl.
Chimiste	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	3 weekly
Number of positions	

Summary

This course will introduce basic concepts of fluorescence spectroscopy and microscopy applied to the observation of biological systems. The course will focus on the design, preparation and implementation of small-molecule and protein-based probes.

Content

Principles of fluorescence spectroscopy and microscopy, fluorescent dyes and proteins, chemiluminescence, super-resolution microscopy, and fluorescent sensors.

Keywords

fluorescence, labeling, imaging, cell biology, photophysical properties, proteins, sensors

Learning Prerequisites

Recommended courses

Basic chemistry and biology courses

Important concepts to start the course

Electronic absorption and fluorescence; molecular orbitals; basic concepts of electron donating and accepting funtional groups; structure of proteins, basic understanding of the central dogma of molecular biology, basic cell biology.

Learning Outcomes

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

- Predict the approximate photophysical properties of imaging agents (molecules, proteins) based on their chemical structures and physical environment.
- Classify the main fluorescence imaging modalities based on the samples that they can handle and the information that can be obtained from them.
- Assess / Evaluate the suitability of bioconjugation and tagging strategies for specific imaging agents and biological targets.
- Identify the connections between chemical reactions, supramolecular interactions and photophysical properties in fluorescence sensing.
- Assess / Evaluate research papers that describe bioimaging experiments and explain them orally to a multidisciplinary audience.

Transversal skills

- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Demonstrate the capacity for critical thinking
- Communicate effectively with professionals from other disciplines.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Access and evaluate appropriate sources of information.
- Design and present a poster.
- Make an oral presentation.
- Summarize an article or a technical report.

Teaching methods

In this course, students learn to design efficient fluorescence bioimaging experiments. To achieve this objective, a combination of teaching methods is implemented, including regular lectures, case studies, analysis of recent papers, and design of experiments for “real-world” problems. Constant work in small teams and ungraded weekly quizzes are implemented to help students learn by themselves and manage large amounts of multidisciplinary information throughout the course.

Expected student activities

Lecture attendance, participation in interactive sequences, design and presentation of a poster, participation in weekly online quizzes, participation in a final oral presentatation at the end of the semester, if applicable, participation in instrument demonstrations.

Assessment methods

Oral exam. Oral presentation and weekly quizzes provide additional points.

Supervision

Office hours	No
Assistants	Yes
Forum	No
Others	Although no official office hours are provided, students are always welcome to send their question by e-mail, Moodle, or ask in person before, during and after class.

Resources

Bibliography

J. R. Lakowicz. Principles of Fluorescence Spectroscopy. Kluwer Academic / Plenum Publishers. 2006.

P. J. Walla. Modern Biophysical Chemistry: Detection and Analysis of Biomolecules. Wiley-VCH. 2014.

M. Chalfie; S. R. Kain (Eds.) Green Fluorescent Protein: Properties, Applications, and Protocols. Wiley-Interscience. 2006.

R. W. Sabnis. Handbook of Fluorescent Dyes and Probes. John Wiley & Sons, Inc. 2015.

A. P. Demchenko. Introduction to Fluorescence Sensing. Springer Science. 2009.

Ressources en bibliothèque

- Green fluorescent protein / Chalfie
- Modern biophysical chemistry / Walla
- Handbook of fluorescent dyes and probes / Sabnis
- Principles of fluorescence spectroscopy / Lakowicz
- Introduction to fluorescence sensing / Demcenko

Notes/Handbook

Slides and handouts will be available on Moodle before class.

Moodle Link

- https://moodle.epfl.ch/course/view.php?id=15944