SABANCI UNIVERSITY, DEPARTMENT OF MOLECULAR BIOLOGY, GENETICS, AND BIOENGINEERING

BIO 58004 - Single-Cell Analysis Techniques, 2022 Spring Semester

Instructor Information:

Instructor: Emrah Eroğlu **Office hours:** check by e-mail

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Level of Course: Doctoral, Master **Office phone:** 9597

Course Description

Cellular signaling networks determine the fate and (dys)function of cells in response to a variety of environmental stimuli. The discovery of genetically encoded fluorescent proteins based biosensors over two decades ago enabled the detection and real-time measurement of cellular dynamics and signal transduction pathways with high spatial and temporal resolution. In this lecture, we will study engineered genetically encoded biosensors and chemogenetic/optogenetic tools and will also discuss many of the molecular designs that can be utilized in their development. We will also study how the high temporal and spatial resolution afforded by fluorescent biosensors can be aided for our understanding of the spatiotemporal regulation of signaling networks at the cellular and subcellular levels using state-of-the-art microscopy techniques. It is also planned to highlight some emerging areas of research in both biosensor design and applications that are at the forefront of biosensor development.

Course Learning Outcomes

At the end of this course, students should be able to:

1. Have a broad perspective on fluorescent proteins, fluorescent microscopy techniques, and important concepts in live-cell imaging
2. Explain the function and structure of fluorescent proteins
3. Explain fluorescent microscopy techniques
4. Describe the FRET mechanism
5. Understand the basics of high-resolution microscopy techniques
6. How to use Fluorescent Proteins for Localization studies
7. Know the basic elements of chemogenetic and optogenetic tools
8. Understand the applications of chemical fluorophores

Resources

Fluorescent Proteins 101: A Desktop Resource, by Addgene, First Edition (August 2017).

Requirements

1. Regular attendance is obligatory.
2. Each attendee is expected to hold a presentation on a selected topic defined by the instructor and a relevant research paper (can be chosen by the attendee)
3. A dedicated TA will support each participants lecture in the preparation. Lectures are ~90 min without discussion.
3. It is obligatory to participate in the discussions (up to 90 min) after each presentation

Course Chapters:

	Chapter	Responsible TA
1st Week	Chapter 1: Introduction to Fluorescent Proteins (FPs)	Melike Seçilmiş
2nd Week	Chapter 1: Fluorescent Microscopy Techniques	Hamza Y. Altun
3rd Week	Chapter 2: Generating Fluorescent Protein Fusions	Gülşah Sevimli
4th Week	Chapter 3: Using Fluorescent Proteins for Localization	Melike Seçilmiş
5th Week	Chapter 4: Förster Resonance Energy Transfer (FRET)	Asal Ghaffari Zaki
6th Week	Chapter 5: Optogenetics	Tuba Akgül Çağlar
7th Week	Chapter 6: Chemogenetics	Asal Ghaffari Zaki
8th Week	Chapter 7: Genetically encoded biosensors	Büşra Nur Ata
9th Week	Chapter 8: Non-protein fluorophores	Gülşah Sevimli
10th Week	Chapter 9: Special application of fluorescent proteins	Hamza Y. Altun
11th Week	Chapter 10: Pitfall in the application of Fluorescent proteins	Büşra Nur Ata
12th Week	Final Exam	

Exams and Grading Evaluation Type	**Number**	**Percentage**
Presentation	1	50%
Participation in discussions		30%
Final	1	20%
Total		100%