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

BIO 58004 - Single-Cell Analysis Techniques, 2020 Fall Semester

Instructor Information:

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Level of Course: Doctoral, Master

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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 how to engineer 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. 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 concepts to create genetically encoded biosensors
6. Get the difference between intensiometric and ratiometric biosensors
7. Know the application areas for these biosensors

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)

Exams and Grading

Evaluation Type	Number	Percentage
Presentation	1	70%
Final	1	30%
Total		100%

Lecture Schedule

Weeks	Subject	Pre-Reading
1st Week	Chapter 1: Introduction to Fluorescent Proteins (FPs)	To be defined by the presenter and instructor
2nd Week	Chapter 1: Fluorescent Microscopy Techniques	
3rd Week	Chapter 2: Generating Fluorescent Protein Fusions	
4th Week	Chapter 3: Using Fluorescent Proteins for Localization	
5th Week	Chapter 4: Förster Resonance Energy Transfer (FRET)	
6th Week	Chapter 5: Optogenetics	
7th Week	Chapter 6: Chemogenetics	
8th Week	Chapter 7: Genetically encoded biosensors	
9th Week	Chapter 8: Non-protein fluorophores	
10th Week	Chapter 9: Special application of fluorescent proteins	
11th Week	Chapter 10: Pitfall in the application of Fluorescent proteins	
12th Week	Final Exam	

Final Exam will be three open questions that widely covers the general concepts of the lecture.

LETTER GRADE	BIO58004 GRADING
A	100-85
A-	84-80
B+	79-75
B	74-70
B-	69-65
C+	64-60
C	59-55
C-	54-50
D+	49-45
F	Less than 45