

EE-490(j)

Cell-free synthetic biology

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Withdrawal	Unauthorized
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	4 weekly
TP	4 weekly
Number of positions	
It is not allowed to withdraw from this subject after the registration deadline.	

Remark

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Summary

The cell-free synthetic biology course introduces engineers to the most commonly used techniques required to conduct work in Biotechnology and Bioengineering. Additionally, this course is an experiment in democratizing education and open science by generating useful resources for the local community

Content**Note: registration for this course is limited to a maximum of 16 students**

The hands-on Cell-free synthetic biology laboratory course will introduce engineering students to fundamental methods and techniques commonly used in Biotechnology and Bioengineering. In this course the students will generate a cell-free transcription and translation system called the PURE system, which entails learning and performing polymerase chain reactions (PCRs), protein overexpression, protein purification, and other important molecular biology techniques. The students will then assess the functionality of their PURE systems by quantifying the expression of a green fluorescent protein (GFP).

Cell-free systems are becoming exceedingly powerful and therefore popular tools in biotechnology, bioengineering, and synthetic biology. In one recent example the 2019 EPFL iGEM team who won the iGEM competition that year, developed a cell-free molecular diagnostic kit for the identification and differentiation of two grapevine diseases (see first link below). In addition, we have shown in the past that cell-free systems are ideal tools for education and teaching by providing local high-schools with cell-free educational kits (see second link below). The cell-free synthetic biology course is therefore exploring the possibility to leverage the ample resources available in higher education to generate an additional, synergistic benefit for the population. We are hoping that with this course we will be able to sustainably produce cell-free educational kits for use in local schools.

The cell-free synthetic biology course will consist of a couple of introductory lectures, followed by laboratory experiments. The students will be guided through all the required steps required for each specific method and technique to generate functional cell-free systems (see third link below for a video guided tutorial published by our laboratory describing the steps required to generate a cell-free system). At the end of course, if we succeeded to produce functional cell-free systems we plan to package them into kits together with the students of the class and distribute them to interested local high-schools for their use in their biology curriculum.

Keywords

molecular biology
laboratory techniques and methods
biotechnology
bioengineering

synthetic biology
cell-free synthetic biology
democratizing education
open science

Learning Prerequisites

Required courses

There are no pre-requisite courses.
No prior experience or background in biology is required.

Learning Outcomes

- Analyze experimental outcomes
- Carry out molecular biology techniques
- Conduct molecular biology experiments
- Quantify the functionality of a cell-free system
- Create cell-free systems

Teaching methods

The course will be primarily hands-on experimental work, with real-time instructions and feedback.

Assessment methods

Students will be assessed by their ability to conduct molecular biology experiments, maintain a laboratory notebook, critically assess and report the outcomes of experiments, and work in a team.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Websites

- <https://2019.igem.org/Team:EPFL>
- <https://2017.igem.org/Team:EPFL/HP>
- <https://www.jove.com/t/62625/onepot-pure-cell-free-system>
- <http://lbnc.epfl.ch/index.html>

Moodle Link

- https://go.epfl.ch/EE-490_j