BIOENG-430

Selected topics in life sciences

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Cursus	Sem.	Type
Biotechnology minor	H	Opt.
Computational and Quantitative Biology		Opt.
Ing.-chim.	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**2 weekly**
Courses	2 weekly
Number of positions	

Summary

The course presents an overview on how recent advances at the interfaces of biology, biotechnology, engineering, physical sciences, and medicine are 1) shaping the landscape of biomedical research; 2) contributing to improving our quality of life and; 3) addressing global health challenges today.

Content

The lectures will highlight some of the latest breakthroughs in biology, biotechnology, chemical biology, synthetic biology, genomics, neuroengineering, and genetic engineering and illustrate how they are being applied today to advance our understanding of living systems and to develop novel tools and therapies for early diagnosis and treatment of human diseases.
The impact on the biotechnology and biomedical industry and ethical implication of each technology will also be discussed.
The topics will include, but not limited to, genome sequencing technologies, genetic editing (CRISPR), personalized medicine and personalized genomics, induced pluripotent stem cells and regenerative medicine, organoids, phage display technologies and antibody and protein engineering in drug discovery, vaccines, synthetic biology, nucleic acid based therapies, manufacturing of biologic medicine, the microbiome and the gut-brain axis in health and disease.

Keywords

Biotechnology, life sciences, gene sequencing, genetic engineering, synthetic biology, stem cells, microbiome, CRISPR, antibodies, proteins, regenerative medicine, molecular diagnostics, neuroengineering, personalized and precision medicine.

Learning Prerequisites

Required courses

None

Recommended courses

Biology of the Cell, Biochemistry, Biological Chemistry, Organic Chemistry.

Important concepts to start the course

General knowledge about
1) Genome Sequencing
2) The human Genome Project
3) Personalized Medicine

4) Stem Cells and Regenerative Therapy
5) Genetic Engineering
6) Gut Microbiome

Learning Outcomes

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

- Demonstrate an understanding and critical awareness of a range of topics covered during the semester
- Demonstrate an ability to critically assess the challenges that advances in genome sequencing, genetic engineering, synthetic biology and stem cell research present to society today.
- Gain an appreciation and understanding on how advances in biotechnology are transforming biomedical research and revolutionizing healthcare by enabling 1) The development of disease models that reproduce more faithful important aspects of the human disease;2) Creating tools for early detection and monitoring disease progression; 3) Development of effective drugs, antibodies and vaccines; 4) Gene therapy; 5) Regenerative medicine; 6) Treatment of inherited diseases; 7) Tailoring prevention and therapeutic strategies, personalized healthcare; 8) The development of new biotechnology and biomedical industry ;8) Harnessing Natureâ##s own tool box or modifying it to develop new strategies to reengineer and reprogram biological systems, design new functions in cells or to treat human diseases
- Demonstrate awareness of the research activities at the EPFL that are relevant to the topics covered.
- Demonstrate the ability to read, understand and report on new discoveries and their impact on science and society
- Develop and/or improve scientific communication and presentation skills

Transversal skills

- Demonstrate the capacity for critical thinking
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Communicate effectively with professionals from other disciplines.
- Make an oral presentation.

Teaching methods

The course instructor and/or guest experts in the relevant topics will give the lectures. Each lecture will be followed by
1) an in class discussion on the ethical implications and economic and societal impact of the specific technology or scientific advances covered in the lecture
2) discussion on latest related discoveries shaping the headlines this fall
or
3) Student presentations on some of the latest scientific discoveries or breakthroughs and team projects.

Expected student activities

In addition to attending the lectures, students are expected to dedicated three weekly hours of personal time to preparing for the lectures and to complete homework assignments.

Assessment methods

Homework assignments (55%) Students will be given an assignment for each lecture. The assignments will be given each week and are to be handed back prior to the start of the next lecture. The assignments will be basied on the content of the lecture and are designed to make sure that the students capture the main concepts and take home messages of the lecture
Semester Team projects (25%): To be decided based on the student number and background
In class activities and participation (20%): Each student will be requested to make 2 short presentations (5-10 minutes) on very specific topics or questions related to the contents of the lectures.

Supervision

Office hours	Yes
Assistants	Yes

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

Chapters from books available at the EPFL Library and selected articles from scientific journals and the general media will be provided to prepare for the lectures and for in class discussions and debates on specific relevant topics. Additional recommended reading and reference materials will be made available for motivated students.

Moodle Link

- https://go.epfl.ch/BIOENG-430