BIOENG-510

# Trends in chemical biology and drug discovery

Correia Bruno, Thomä Nicolas

| Cursus | Sem. | Type |
|---|---|---|
| Life Sciences Engineering | MA2, MA4 | Opt. |

| | |
|---|---|
| Language of teaching | English |
| Credits | 4 |
| Session | Summer |
| Semester | Spring |
| Exam | Written |
| Workload | 120h |
| Weeks | 14 |
| **Hours** | **4 weekly** |
| Lecture | 2 weekly |
| Exercises | 2 weekly |
| **Number of positions** | |


## Summary

In this course we will cover the scientific basis behind chemical biology approaches for drug development.


## Content

In this course we will cover the scientific basis behind chemical biology approaches for drug development. We will feature drug discovery techniques including high-throughput screening approaches comprising genetic or compounds screens, as well as screens for protein designs, and genomics and proteomics strategies for finding drugs. A special emphasis will be on proteins that are difficult to drug with conventional means. In the undruggable space we will cover new and fast-growing drug modalities that rely on protein-based drugs (including peptide and antibody-based drugs) and proximity modulating small molecules (molecular glues, Protacs etc.). We will highlight how these diverse drug design approaches are now being informed by modern machine learning approaches. This course will feature a number of invited speakers from industry to share their first-hand knowledge in drug development. We will help students to take the conceptual leap from basic research into thinking about the development of medically useful assets. Biotech companies are important engines for innovation that help bring novel and potentially transformative therapeutics to patients; and towards the end of this course we will try to develop the basic science concepts for the creation of a hypothetical Biotech company based on the material presented.

Target and disease area:

- Drug targets in oncology and beyond
- Leveraging the immune system in therapy
- Membrane proteins and receptors in disease
- Current challenges in drug discovery
- Peptide and antibody-based modalities

Methodology (small molecules):

- Targeted protein degradation (Protac, Molecular Glues)
- Covalent small molecule binders
- DNA-encoded libraries
- AI/ML approaches in small molecule design
- Genomics and proteomic approaches for target deconvolution

Methodology (biologics):

- Protein design and smart biologics
- Antibodies, Nanobodies, Monobodies and other formats
- T-cell engineering

- Genome engineering
- Hit-finding, pharmacological assessments, clinical trials

## Keywords

Chemical biology, machine learning, drug discovery, high throughput screening, imaging, protein biochemistry, protein biophysics, post-translational modifications, biotechnology.

## Learning Prerequisites

### Recommended courses

Organic Chemistry
Biological Chemistry I, II

## Learning Outcomes

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

- Know current techniques to drug proteins by small molecules or biologics
- Understand the workflow from idea to medicine
- Learn about strategies and pitfalls

## Transversal skills

- Demonstrate the capacity for critical thinking
- Access and evaluate appropriate sources of information.

## Teaching methods

- Lectures
- Seminars by expert in the field
- Presentation and discussion of scientific literature

## Expected student activities

- Attendance to classes
- Discussion of scientific literature
- Class participation

## Assessment methods

Final exam in the form of a presentation of a company science plan and a 2-page assay.

## Resources

### Bibliography

Given the rapid development of this field, there is no single book that covers all the subjects for this course.

Original research articles and reviews on the topic covered during the course will be discussed.

**Moodle Link**

- https://go.epfl.ch/BIOENG-510