

MSE-212

Biology for engineers

Bastings Maartje

Cursus	Sem.	Type
Materials Science and Engineering	BA4	Obl.

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	Written
Workload	60h
Weeks	14
Hours	2 weekly
Lecture	2 weekly
Number of positions	

Summary

This course consists of an introduction to biology and more particularly to biology as a multidisciplinary field, emphasizing natural examples of materials engineering. It should therefore allow engineering students to find inspiration from biology in future materials research problems.

Content**BLOCK 1: Introduction and engineering with cellular components**

- Lecture 1. Intro to engineering in biology
- Lecture 2. Proteins and protein-based materials
- Lecture 3. DNA and DNA-based materials
- Exercise 1. *Proteins, peptides and DNA*

BLOCK 2: Inter- and intracellular action

- Lecture 4. ECM, adhesion and artificial matrices
- Lecture 5. Virus, antibodies and immune engineering
- Lecture 6. Bacteria and living materials
- Exercise 2. *Nanoparticles and scaffolds*

BLOCK 3: Physics of biological action

- Lecture 7. Multivalency: Receptors and targeting
- Lecture 8. Endocytosis and drug delivery
- Lecture 9. Measuring cell signaling and communication
- Exercise 3. *Engineering Functionality*

- Lecture 10. Revision and conclusion
- Open office. *Questions, discussion, exam prep*

Keywords

Life, Cells, Tissues, Interactions, Natural Materials, Bioengineering, Bioinspired Engineering, Molecular Biology, Structure - Function relationships in Biology

Learning Prerequisites**Important concepts to start the course**

Students should appreciate that many materials engineering problems have been solved by nature. Evolution is always billion years ahead of what we can engineer as humans.

Learning Outcomes

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

- Describe the building blocks of life and how their interactions dictate structure and function in biology
- Identify materials and architectures found in nature
- Realize how cellular communication mechanisms are important in the engineering of biomaterials
- Integrate examples from nature in materials engineering challenges

Teaching methods

Classroom teaching and handouts

Expected student activities

Be present at lectures and actively participate in discussions on the subject.

Assessment methods

Written exam at the end of the semester (exam period)

Supervision

Office hours	Yes
Assistants	Yes
Forum	No
Others	Moodle, 3 exercise sessions, 1 per themed-block to practice the materials and prepare for the exam, guided by TAs

Resources

Bibliography

Materials will be distributed on Moodle

Moodle Link

- <https://go.epfl.ch/MSE-212>

Videos

- <https://tube.switch.ch/channels/b4022068>

Prerequisite for

MSE 471: Biomaterials