

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
<b>Hours</b>	<b>2 weekly</b>
Courses	2 weekly
<b>Number of positions</b>	

**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