

## Biophysics modules in Biochemistry M.Sc.

Three modules are available to choose:

- 1. 76661 Concepts and Methods in Biophysics (WiSe):**  
Duration 1.5 Semesters. Practical focus.  
Lecture: Biophysics Lecture Series (6 LP)  
Lab: Biophysics - Lab A (9 LP)  
(Participation in this module excludes participation in Special Topics in Biophysics due to partially identical contents)
- 2. 75589 Biophysics Advanced Topics (SoSe+WiSe):**  
Duration 2 Semesters. Lecture focus.  
Lectures: Cellular Biophysics (3 LP), Gene Expression (3 LP), Molecular Motors (3 LP).  
Lab: Biophysics – Lab B (6 LP)  
(Participation in this module excludes participation in Special Topics in Biophysics due to partially identical contents)
- 3. 76660 Special Topics in Biophysics (SoSe):**  
Duration 1.5 Semesters. Practical focus.  
Lectures: Cellular Biophysics (3 LP) and Gene Expression (3 LP)  
Lab: Biophysics - Lab A (9 LP) (Participation in this module excludes both participation in Concepts and Methods in Biophysics and Biophysics Advanced Topics due to partially identical contents)

### Why is Biophysics interesting?

Biophysics aims at providing modern technologies such as single-molecule or super-resolution microscopy methods, which enable novel and unrivalled detailed observations of life processes. Biophysics further aims at carving out the physical laws underlying life processes, to arrive at quantitative, testable models with unprecedented predictive power.

### What do you learn in the Biophysics modules?

After completing a Biophysics module, you will be able to:

- understand the fundamental terms and concepts of Biophysics
- describe life processes with basic physical models
- perform experiments testing life processes at different scales

### Lectures:

#### Cellular Biophysics (SoSe) Kay Gottschalk:

The cell is the smallest living unit in the body. It fulfills a variety of specialized functions and interacts with the environment. Classically, biochemical interactions with the environment by soluble factors like hormones are considered. However, physical parameters like stiffness or shape also play an important role. The goal of the lecture is to highlight these physical triggers of cell function. The main topics are:

- The cell as a composite material: structure and function of the cytoskeleton
- Influence of cell shape on cell function
- Mechanosignalling: Influence of substrate rigidity on cell function and mechanics
- Measurement of cell mechanics: atomic force microscopy and microrheology
- Measurements of cellular forces: traction force microscopy

### Gene Expression (SoSe) Jens Michaelis:

- Molecular basics and structural Biology of gene expression
- RNA polymerase as molecular motor
- FRET studies of transcription dynamics
- Simple model of gene expression I and II
- Gene expression in bacteria- Live single cell experiments
- Gene expression in eukaryotes- Live single cell experiments
- Whole genome analysis – Methods and Applications
- Transcriptome analysis, methods for real time information
- Single cell RNA sequencing
- Introduction to Optogenetics

### Molecular Motors (WiSe) Christof Gebhardt

- Cytoskeletal molecular motors
- Stepping mechanisms
- Coupling of mechanical and chemical cycles
- Force production: Powerstroke vs. Brownian ratchet
- Filament polymerization
- Force production of cytoskeletal filaments
- Length control of cytoskeletal filaments by molecular motors
- Force-induced cooperation of molecular motors
- DNA-based molecular motors
- Models of gene regulation
- Molecular motors and hearing

**Lab:** In the practical labs, you will do several experiments depending on the number of ECTS. Please check our website for detailed information on each experiment.

<https://www.uni-ulm.de/nawi/international-masters-degree-programmes/current-students/biophysics/biophysicslab/>

Experiment overview: Gene expression, bioinformatics, protein labelling, protein crystallization, protein folding, stopped-flow kinetics, single-molecule fluorescence, fluorescence lifetime, ligand binding, FCS, lipid monolayers, ionchannels, live cell imaging, superresolution microscopy, optical tweezers, AFM.

### Organization:

- lecturers: Prof. Michaelis, Prof. Gebhardt, Prof. Gottschalk
- the modules consist of lectures, exercises and practical labs
- **the lectures and exercises take place throughout the term, practical labs can be distributed between SoSe and WiSe**
- grading: written exams (lecture), lab reports and/or oral exam (lab)
- electable for: Master Biochemistry
- ECTS: 15

### More information:

For more information, write an email to: [jens.michaelis@uni-ulm.de](mailto:jens.michaelis@uni-ulm.de) or [carlheinze-roecker@uni-ulm.de](mailto:carlheinze-roecker@uni-ulm.de) (content), [gloria.gessinger@uni-ulm.de](mailto:gloria.gessinger@uni-ulm.de) (organization)