QBio301: Cell Bioenergetics

Module Responsible: Prof. Dr. Oliver Ebenhöh	**Version:** 02/01/2021
Module Organizer: Prof. Dr. Oliver Ebenhöh	**Type:** Compulsory

Lecturer:
Prof. Dr. Oliver Ebenhöh, Prof. Dr. Martin Lercher, Jun.-Prof. Dr. Wolfgang Hoyer

Total Working Time	**Credit Points**	**Contact Time**	**Self Study**	**Duration**
180 h	6 CP	75 h	105 h	1 Semester

Course Components		**Group Size**	**Frequency**
Lecture:	4 SWS	P: 40	Every Winter Semester
Exercise:	1 SWS	P: 20	

Learning Competencies:
The students have basic knowledge of thermodynamic principles and understand how to apply the concepts to processes in the life sciences. They understand how to quantitatively describe fundamental biophysical processes in cell and molecular biology. The students can independently analyse and interpret their experimental data. They are able to document data appropriately and to convincingly present their results in written and oral form.
After completing the module, the students are able to

- describe chemical reaction energetics quantitatively
- explain processes that drive energy conversion
- understand the physical basis of fluorescence
- perform experiments to characterise enzyme kinetics and protein folding
- understand cellular growth as a thermodynamic process

Content:
In the third semester, the “Cell Bioenergetics” module takes up content from the modules “Deterministic processes of biology”, in which fundamentals in mathematical modelling of biological systems are taught, and “Biomolecules”, which introduced the chemical foundation of living systems. "Cell Bioenergetics" will complement the picture by explaining the thermodynamic foundation of many fundamental biological processes.
After an introduction of basic thermodynamic concepts (temperature, energy, entropy, thermodynamic potentials, energy converters), these concepts will be applied to a number of central phenomena, including chemical reactions, free energies in chemical bonds, enzyme kinetics, protein folding and aggregation, energy conversion through gradients over biological membranes, and microbial growth.

- Thermodynamics fundamentals
  - Temperature
  - Thermodynamic potentials

- Free energy in chemical bonds, free energy change in chemical reactions, equilibrium
- Entropy
- Laws of Thermodynamics
- Chemical potential
- Reaction kinetics

- Membrane-bound processes
  - Gradients
  - Passive and active transport
  - Energy converters
  - Antiporters and symporters
- Molecular motors
- Crowding
- Enzyme kinetics
- Association/dissociation, binding, protein aggregation, polymerisation
- Fluorescence
  - Physical basis
  - Application as biological measurement technique
- Thermodynamic models of microbial growth
  - Macrochemical equations
  - Black-box models
  - Cells as energy converters

Conditions of Participation:
Passed Modules QBio102 and QBio202

Examination:
Learning portfolio consisting of

- Written exams based on the content of the lectures (60% of the final grade)
- Exercises (30% of the final grade)
- Protocol (10% of the final grade)

Prerequisites for Awarding Credits for this Module:

- Passing Exercises (50 % of Exercise Sheets)
- Passing Written Exam

Factor for the Overall Grade:
The grade is weighted according to the credit points (CP) in the overall grade.

Language:
English

Literature:

Further Information: