# QBio303: Metabolism

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| **Module Responsible:**<br>CEPLAS Metabolism Prof | **Version:**<br>02/01/2021 |
| **Module Organizer:**<br>CEPLAS Metabolism Prof | **Type:**<br>Compulsory |

**Lecturer:**
CEPLAS Metabolism Prof, Prof. Dr. Martin Lercher, Jun.-Prof. Dr. Mathias Beller

| **Total Working Time** | **Credit Points** | **Contact Time** | **Self Study** | **Duration** |
|---|---|---|---|---|
| 180 h | 6 CP | 60 h | 120 h | 1 Semester |

| **Course Components** | | **Group Size** | **Frequency** |
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| Lecture: | 3 SWS | P: 40 | Every Winter Semester |
| Exercise: | 1 SWS | P: 20 | |

**Learning Competencies:**
After completing the module, students can explain the concept of metabolism as a network of coupled reactions which hand-over metabolites. Coming from the understanding of the key aspects of important building blocks of metabolism over the generic features of enzymatic reactions they will expand their knowledge to the modus operandi of selected biochemical pathways before they expand to looking at cellular metabolism on a network scale. They will determine key parameters of enzymatic reactions by quantitative analyses and learn methods to estimate the dynamic change of metabolites as well as the optimization of a metabolic network to predict e.g. the accumulation of a certain end product.

**Content:**

- Bulding blocks of metabolism (life)
  - energy and electron transfer
    - ATP
    - NADH
    - FADH
  - sugars
  - amino acids
  - (neutral) lipids
  - Nucleotides
- Proteins
  - Amino Acids
  - Structure
  - Modifications
    - Types
    - Impact (e.g. Activation or Repression)
  - Enzymes
    - Importance for life

        - Ligand, substrate and energy binding
        - Regulation
        - Kinetics
        - Thermodynamic constraints
- Metabolic Pathways
    - Glycolysis
    - TCA Cycle
    - Anaplerotic reactions
    - Pentose Phosphate Pathway
    - Gluconeogenesis
    - Respiration Chain & Oxidative Phosphorylation
    - Fatty acid and neutral lipid metabolic pathways
        - Synthesis of fatty acids and phospholipids, neutral lipids and sterols
        - Storage and Remobilization of neutral lipids
        - Beta-oxidation of fatty acids
    - Amino Acid Metabolism
    - Nucleotide Metabolism
- Cellular Metabolism → The interplay of metabolic pathways
    - Anabolism & Catabolism
    - The importance of compartmentalization and regulation
        - Mitochondria
        - Chloroplasts
        - Peroxisomes
        - ER and lipid droplets
- How to model metabolism
    - Kinetic modelling
        - Ordinary differential equations (ODE) to model enzymatic reactions
        - Kinetics and reaction order considerations
        - Coupled reactions and ODEs
    - Flux-balance-modelling
        - The stochiometric matrix
        - Parameterization
        - Linear modelling / programming
        - Optimization & objective function

**Conditions of Participation:**
Passed Modules QBio102 and QBio202

**Examination:**
Learning portfolio consisting of

- Written Exam (50% of the final grade)
- Exercises (20% of the final grade)

**Prerequisites for Awarding Credits for this Module:**

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

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| **Factor for the Overall Grade:**<br>The grade is weighted according to the credit points (CP) in the overall grade. |
| **Language:**<br>English |
| **Literature:** |
| **Further Information:** |