BIO-110

Bio-organic chemistry

Correia Bruno

Cursus	Sem.	Type
Life Sciences Engineering	BA2	Obl.

Language of teaching	English
Coefficient	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly
Number of positions	

Summary

The aim of the course is to provide a chemical understanding and intuition to decipher and predict chemical processes in living systems.

Content

The course will first introduce fundamentals of organic chemistry, including substance classes, nomenclature, stereochemistry, as well as the fundamental relationships between structure and reactivity. Knowledge of selected compound classes and their most important reaction types such as acid-base reactions, substitutions, additions, eliminations, redox chemistry will be covered using model reactions from classic organic chemistry. Moreover, the course includes projections on natural processes in biological systems, providing a toolbox to understand complex biological processes of life on a molecular level. The course continues with the fundamental principles that enable chemistry inside cells, such as molecular recognition patterns and enzymatic reactions. Throughout the semester, students will gain insights into analytical methods and explore computational tools to facilitate scientific research and discovery. Finally, we will use and combine the learned principles to shine light on key biochemical processes and applications.
Topics

- Structures of organic compounds: The chemical bond (covalent, ionic), dipole moment, atom- and molecular orbital theory, resonance
- Substance classes: Functional groups, nomenclature
- Isomerism: Conformation, Newman projection, ring conformations, molecular symmetry and chirality, stereochemistry
- Acid-base reactions, Hard-soft acid base concept
- Nucleophilic substitution at sp3 hybridized carbon centres: SN1/SN2 reactions
- Electrophilic addition to double bonds
- Eliminations: E1, E2, E1CB
- Redox chemistry: Oxidations / Reductions
- Protein synthesis: Ribosomal, SPPS
- Molecular recognition
- Enzymatic reaction mechanisms

Methodology (Analytical):

- IR
- NMR
- Mass spectrometry
- (column-)Chromatography

Methodology (Computational):

- PyMOL visualization
- ChemDraw visualization
- SMILES representation and RDKit
- Simple Molecular Simulations

Keywords

Classical structure theory; stereochemistry; chemical bonds and bonding; symmetry; nomenclature; organic thermochemistry; conformational analysis; basics of chemical reactions; classification of organic reactions; reactive intermediates: carbocations, carbanions, acids & bases; electrophilic aromatic substitution; electrophilic addition to double bonds; Hard-soft acid base concept; nucleophilic substitution at sp3 hybridized carbon centres (SN1/SN2 reactions); eliminations; oxidations; reductions; enzymatic reactions; molecular recognition.

Learning Prerequisites

Required courses

CH-160 Chimie générale avancée

Important concepts to start the course

Atomistics, Chemical bonding, Chemical quantities, Chemical reactions and stoichiometry, Thermodynamics, Chemical equilibria, Properties of solutions, Proton transfer, Electron transfer, Chemical kinetics

Learning Outcomes

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

- Recognize of chemical structure, properties and nomenclature
- Describe the mechanistic principles of chemical reactions in living systems
- Predict reactivities of organic substances
- Interpret simple spectra for structure elucidation of organic molecules

Transversal skills

- Demonstrate the capacity for critical thinking
- Access and evaluate appropriate sources of information.

Teaching methods

- Lectures
- Exercises
- Computational tutorials

Expected student activities

- Attendance to classes
- Solving and discussing the exercises

Assessment methods

• Written exam, open book.

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

• Soderberg, T. (2019). Organic chemistry with a biological emphasis volume I and II.
• Clayden, J., Greeves, N., & Warren, S. (2012). Organic chemistry.

Ressources en bibliothèque

• Soderberg, T. (2019). Organic chemistry with a biological emphasis volume 1
• Clayden, J., Greeves, N., & Warren, S. (2012). Organic chemistry
• Soderberg, T. (2019). Organic chemistry with a biological emphasis volume 2

Références suggérées par la bibliothèque

• Clayden, Greeves, Warren, Chimie organique, (2013), éd.2, française

Moodle Link

• https://go.epfl.ch/BIO-110