Bioorganic Chemistry - from Metabolites to Medicines

Title	Bioorganic Chemistry - from Metabolites to Medicines
Semester	F2024
Master programme in	Kemi / Chemical Biology / Molecular Health Science
Type of activity	Course
Teaching language	English
Study regulation	Read about the Master Programme and find the Study Regulations at ruc.dk Læs mere om uddannelsen og find din studieordning på ruc.dk

REGISTRATION AND STUDY ADMINISTRATIVE

Registration	Sign up for study activities at stads selvbetjening within the announced registration period, as you can see on the Studyadministration homepage. When signing up for study activities, please be aware of potential conflicts between study activities or exam dates. The planning of activities at Roskilde University is based on the recommended study programs which do not overlap. However, if you choose optional courses and/or study plans that goes beyond the recommended study programs, an overlap of lectures or exam dates may occur depending on which courses you choose.
Number of participants	The Master Programme/Institute reserves the right to cancel the course if fewer than 8 studentes are registered for the course.
ECTS	5
Responsible for the activity	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)
Head of study	Frederik Diness (diness@ruc.dk)
Teachers	
Study administration	INM Registration & Exams (inm-exams@ruc.dk)
Exam code(s)	U60587

ACADEMIC CONTENT

Overall objective

Biological and medicinal molecules are a source of inspiration for understanding nature and its biosynthetic processes, together with the discovery and development of new medicines.

The objective of the course is to describe and illustrate the structure, chemistry and biogenetic origin of biological molecules and medicines, such as the secondary metabolites. Furthermore, the important role these molecules play in Nature and their pharmacological significance as medicines used in the treatment of human health will be described. Using examples from Nature, the major biosynthetic pathways for the production of secondary metabolites (natural products), such as fatty acids and polyketides, phenylpropanoids, alkaloids, and isoprenoids, will be discussed. Building on an understanding of these pathways, the determination of natural product class and the biogenesis of biological molecules, based on an analysis of the key building blocks used to assemble their structures in Nature, will be described. Finally, a number of case studies will be presented, using current medicines as examples, to describe and illustrate principles of medicinal chemistry, such as common disease targets, and the desired characteristics and properties of medicines.

Detailed description of content

The principal roles of biological molecules, including the primary and secondary metabolites (natural products), and their structural and chemical properties will be described and illustrated. A determination of natural product class and biogenesis of biological molecules, based on an analysis of the key building blocks used to assemble their structures in Nature, will be described.

Biological molecules, with their interesting structures and important biological activity, are a source of inspiration for understanding Nature and its biosynthetic processes, together with the discovery and development of new medicines. The chemistry of biological molecules, such as the primary and secondary metabolites, together with their biogenetic origin and role in Nature will be described and illustrated.

Using examples from Nature, the major biosynthetic pathways for the production of secondary metabolites (natural products), such as fatty acids and polyketides, phenylpropanoids, alkaloids, and isoprenoids, will be discussed. Furthermore, the important role these molecules play in Nature and their pharmacological significance as medicines for humans will be described.

Detailed Teaching Objectives and Learning Outcomes

After successful completion of the course the student will be able to demonstrate and apply:

Knowledge of

- The structure, chemical properties and biogenetic origins of bioorganic molecules, which includes the primary metabolites (amino acids, carbohydrates, and nucleic acids) and secondary metabolites (natural products).
- The activity of biological molecules, including their role in Nature and medicinal applications in human health.

Skills in

- Identifying structural elements and features of bioorganic molecules, together with the biosynthetic pathways and mechanisms leading to their structures.
- Problem-solving, independent learning and the application of methods to solve unfamiliar problems.

Learning outcomes

- Read and understand scientific literature concerning bioorganic molecules.
- Be able to examine and classify a natural product structure, and understand and/or propose how it is constructed in Nature using the basic building blocks of biosynthesis.
- Understand the chemical reactivity of bioorganic molecules.
- Have a basic knowledge of the role and activity of biological molecules.

Course material and Reading list

Textbook:

Organic Chemistry with Biological Applications, 3rd Ed., J. McMurry, Cengage Learning, 2015. Chapters 19-25.

Other recommended reading:

Fox and Whitesell, Organic Chemistry, 3rd Ed., Jones and Bartlett, London, 2004.

Mann, Chemical Aspects of Biosynthesis, ed. Davies, Oxford University Press, Oxford, 1994. Oxford Chemistry Primers No 20.

Hanson, Natural Products: the Secondary Metabolites, ed. Abel, Royal Society of Chemistry, Cambridge, 2003, Tutorial Chemistry Texts No 17.

Overall plan and expected work effort

5 ECTS corresponds to 135 hours of work

The work load for the student:

Preparation time Contact time

- Lectures and workshops: 40 hours

Study and preparation time:

- Reading and self-revision problems: 20 hours
- Theoretical problem preparation: 20 hours
- Reading time: 25 hours
- Revision and exam preparation: 30 hours

Total 135 hours

Format

Evaluation and feedback

The course includes formative evaluation based on dialogue between the students and the teacher(s).

Students are expected to provide constructive critique, feedback and viewpoints during the course if it is needed for the course to have better quality. Every other year at the end of the course, there will also be an evaluation through a questionnaire in SurveyXact. The Study Board will handle all evaluations along with any comments from the course responsible teacher.

Furthermore, students can, in accordance with RUCs 'feel free to state your views' strategy through their representatives at the study board, send evaluations, comments or insights form the course to the study board during or after the course.

Programme	The course is organized around a combination of lectures (powerpoint, boardwork, and discussion; 30 hrs) and problem solving workshops (10 hrs). See study.ruc.dk for a detailed coure schedule, and the course page on Moodle for a schedule, course description and other documents, together with lecture notes and problem solving questions. Each lecture section is followed by a problem solving workshop, organized according to the course schedule on Moodle. Students will find questions associated with a particular lecture section either at the end of the set of lecture notes, or as separate files uploaded to the course Moodle page. Students are expected to complete or attempt the problem solving questions associated with a particular workshop, before it takes place, and be prepared to present their solutions, in whole or in part, during the workshop.

ASSESSMENT

Overall learning outcomes	After successful completion of the course the student will be able to: ● account for the structure, chemical properties and biogenetic origins of bioorganic molecules, which includes the secondary metabolites (natural products) and some primary metabolites (amino acids, carbohydrates, and nucleic acids) ● account for the activity of biological molecules and relate this to their role in nature and medicinal applications in human health ● identify structural elements and features of bioorganic molecules, together with the biosynthetic pathways and mechanisms leading to their structures ● solve unfamiliar problems through the application of skills and strategies in problem-solving and independent learning ● use the scientific literature concerning bioorganic and medicinal molecules in problem solving ● examine and classify a natural product structure, and demonstrate an understanding of, or propose how it is constructed in Nature using the basic building blocks of biosynthesis ● describe the chemical reactivity of bioorganic molecules and medicines ● describe the role and activity of biological molecules and medicines
Form of examination	Individual written invigilated exam The duration of the exam is 3 hours. Permitted support and preparation materials for the exam: Computer without internet access during the exam, pocket calculator, course material and own notes. Assessment: Pass/Fail
Form of Re-examination	Samme som ordinær eksamen / same form as ordinary exam
Type of examination in special cases	

Examination and assessment criteria	The individual written invigilated exam is based on a set of problem solving questions. Assesment criteria: ● account for the structure, chemical properties and biogenetic origins of bioorganic molecules, which includes the primary metabolites (amino acids, carbohydrates, and nucleic acids) and secondary metabolites (natural products) ● account for the activity of biological molecules and relate this to their role in nature and medicinal applications in human health ● identify structural elements and features of bioorganic molecules, together with the biosynthetic pathways and mechanisms leading to their structures ● apply problem based skills and methods to solve unfamiliar problems ● examine and classify a natural product structure, and understand and/or propose how it is constructed in Nature using the basic building blocks of biosynthesis ● relate the chemical reactivity of bioorganic molecules to their chemical structure
Exam code(s)	Exam code(s) : U60587

Course days:

Hold: 1

Bioorganic Chemistry (CB)

time	08-02-2024 12:15 til 08-02-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry (CB)

time	13-02-2024 14:15 til 13-02-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	Frederik Diness (diness@ruc.dk) William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	15-02-2024 12:15 til 15-02-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	Frederik Diness (diness@ruc.dk) William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	20-02-2024 14:15 til 20-02-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry (CB)

time	22-02-2024 12:15 til 22-02-2024 14:00
location	28b.0-01 - store teorirum (30)
Teacher	Frederik Diness (diness@ruc.dk) William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	27-02-2024 14:15 til 27-02-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry (CB)

time	29-02-2024 12:15 til 29-02-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	Frederik Diness (diness@ruc.dk) William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	07-03-2024 12:15 til 07-03-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	12-03-2024 14:15 til 12-03-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	Frederik Diness (diness@ruc.dk) William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	14-03-2024 12:15 til 14-03-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	19-03-2024 14:15 til 19-03-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry (CB)

time	21-03-2024 12:15 til 21-03-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	02-04-2024 14:15 til 02-04-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	04-04-2024 12:15 til 04-04-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	09-04-2024 14:15 til 09-04-2024 16:00
location	12.1-073 - teorilokale i 12.1 (30)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	11-04-2024 12:15 til 11-04-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	16-04-2024 14:15 til 16-04-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	Frederik Diness (diness@ruc.dk) William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	18-04-2024 12:15 til 18-04-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	23-04-2024 14:15 til 23-04-2024 16:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry (CB)

time	25-04-2024 12:15 til 25-04-2024 14:00
location	28b.0-05 - lille teorirum (20)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	30-04-2024 14:15 til 30-04-2024 16:00
location	28b.0-01 - store teorirum (30)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry (CB)

time	02-05-2024 12:15 til 02-05-2024 14:00
location	28b.0-01 - store teorirum (30)
Teacher	William Goldring (goldring@ruc.dk)

Bioorganic Chemistry (CB)

time	07-05-2024 14:15 til 07-05-2024 16:00
location	28b.0-01 - store teorirum (30)
Teacher	William Goldring (goldring@ruc.dk) Frederik Diness (diness@ruc.dk)

Bioorganic Chemistry - Exam (CB)

time	04-06-2024 10:00 til 04-06-2024 13:00
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location	25.3-005 - teorirum 25.3 (80)

Bioorganic Chemistry - Reexam (CB)

time	14-08-2024 10:00 til 14-08-2024 13:00
location	28b.0-05 - lille teorirum (20) / 28b.0-01 - store teorirum (30)