

Subject module in molecular biology

(English version of the legal Danish subject module curriculum)

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The regulations of these subject module descriptions are issued pursuant to the Curricula for the Bachelor Study Programmes in Natural Sciences, in Hum-Tek, in Humanities, and in Social Science. The regulations of the Curriculum for the Bachelor Study Programme to which the student has been admitted are applicable unless otherwise clearly stated in the regulations of the subject module descriptions.

Purpose

§ 1. The purpose of the subject module in molecular biology is to give students:

- basic knowledge and personal qualifications to identify, define, formulate, and solve complex problems by applying relevant theories and methods within the subject area of molecular biology
- exemplary experience in and knowledge of how molecular biology is related to science, cognition, and society
- knowledge of fundamental scientific theories and methods of molecular biology
- a thorough and exemplary knowledge of the subject areas of molecular biology in specific focusing on key theories and methods of cellular biology, biochemistry and genetics of pro- as well as eukaryotic organisms
- the foundation for a qualified choice in regards to admission to a Master Programme within the subject area of molecular biology/biochemistry.

A further objective of the subject module in molecular biology is to qualify students to enter a Master Programme in Molecular biology or other related Master Programmes.

(2) The subject module in molecular biology is one of two subject modules that form part of the bachelor studies at Roskilde University. The subject module corresponds to 35 ECTS points.

Description of competency

§ 2. The purpose of the subject module in molecular biology is to give students the following knowledge, skills, and qualifications:

Knowledge:

- Knowledge of the key subject areas of molecular biology, i.e. cellular biology, biochemistry, genetics, and bioinformatics.
- Knowledge of fundamental molecular biological theories and their applications.
- Knowledge of central experimental methods and their status in molecular biology.
- Knowledge of selected, fundamental problems in molecular biology.
- Knowledge of aspects of molecular biology related to society and the theory of science.

Skills:

- Skills to identify and apply relevant molecular biological theories and methods for the analysis of a problem.
- Skills to apply relevant experimental and bio-informatics methods.
- Skills to obtain and analyse empirical data.
- Skills to systematically search for molecular biological literature.
- Skills to read and apply original, scientific literature.
- Skills to present and communicate molecular biology correctly and on a scientific basis, orally and in writing, according to academic standards.

Qualifications:

- Qualifications to, independently and in cooperation with others, comprehend, describe, define, and analyse problems by applying molecular biological theories and methods.
- Qualifications to design and carry out relevant molecular biological experiments or bio-informatics analyses.
- Qualifications to reflect on how molecular biological knowledge contributes to and is challenged by the development of society.
- Qualifications to analyse and assess scientific results in biochemistry or genetics in relation to the methods applied.
- Qualifications to study independently and to contribute with fundamental biochemical and genetic knowledge to interdisciplinary projects.
- Qualifications to plan and direct a project complying with self-determined and externally given terms deadlines.

Content and structure

§ 3. The subject module corresponds to 35 ECTS points and consists of the following elements:

- Subject module project in molecular biology (15 ECTS points)
- Subject module course 1: Molecules of life (5 ECTS points).
- Subject module course 2: Biochemistry (5 ECTS points).
- Subject module course 3: Genetics (5 ECTS points)
- Subject module course 4: Methods in molecular biology (5 ECTS points).

(2) Students who combine molecular biology with medicinal biology must attend subject module course 1: “Molecules of life” as part of their first subject module. In their second subject module the students can choose one of the following courses instead of “Molecules of life”:

Subject module courses in chemistry or environmental biology:

Analytic chemistry of ions
 Quantum chemistry and spectroscopy
 Mixtures and separation
 Population biology
 An introduction to Ecosystems

Or

One of the courses BK 4 to BK 8 of the Bachelor Study Programme in Natural Sciences.

Or

Optional course in molecular biology: Research in molecular biology.

Recommended academic requirements

§ 4. Before admission to this subject module students are required to possess knowledge, skills, and qualifications equivalent to the courses ‘Biological chemistry’ and ‘Cellular biology’ which are offered during the basic part of the Bachelor Study Programme in Natural Sciences.

The subject module builds on the qualifications acquired during the basic part of the Bachelor Study Programme in Natural Sciences. Students who do not possess these or equivalent qualification must expect to have to study harder in order to carry through the subject module according to the official duration of the subject module.

Description of the elements of the subject module

§ 5.

Title	Subject module project in molecular biology.
Type	Project.
Status	Compulsory.
ETCS	15 ECTS points.
Purpose (assessment criteria)	<u>Literature project:</u> Knowledge: <ul style="list-style-type: none"> • Knowledge of molecular biological concepts, theories, and methods relevant for the chosen problem. • Knowledge of the principles of the experimental methods used in the literature which is central for the problem. Skills: <ul style="list-style-type: none"> • Skills to carry out an adequate search in relevant international literature databases. • Skills to summarize and analyse the original literature on the defined problem. • Skills to present and discuss the project in a clear and well-

	<p>structured way complying with academic requirements and standards.</p> <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications to describe and define a molecular biological problem. • Qualifications to give reasons for and reflect on the selected literature in relation to the problem. • Qualifications to analyse and assess whether the molecular biological data support the models and theories applied. • Qualifications to critically analyse the strengths and weaknesses of the applied models and theories. • Qualifications to plan and direct a project complying with self-determined and externally given terms deadlines. <p><u>Experimental project:</u></p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge of molecular biological concepts, theories, and methods relevant for the chosen problem. • Knowledge of the principles of the experimental methods used in the literature which is central for the problem. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to search relevant international literature databases and to summarize the background literature selected for the chosen problem. • Skills to apply relevant experimental methods or bio-informatics analyses. • Skills to work out adequate and exact procedures for and records of the experimental or bio-informatics work. • Skill to present and discuss the project in a clear and well structured way complying with academic requirements and standards. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications to define a molecular biological problem within a defined subject area and to formulate a testable hypothesis. • Qualifications to design and carry out experiments or bioinformatics analyses for the testing of the hypothesis. • Qualifications to explain the principles of the applied methods and of other methods which could be applied in the solving of the problem. • Qualifications to analyse and interpret the obtained data in relation to simple models and data from the literature. • Qualifications to plan and conduct a project complying with self-determined and externally given terms deadlines.
Overall content	<p>The project must deal with a problem within the key areas of molecular biology. The project report must include an</p>

	<p>overview of the literature on a defined molecular biological subject with the focus on the applied methods of analysis and the interpretation of data. The project work may include students' own experimental work, bio-informatics analyses/studies or the students' independent analyses of available original data.</p> <p>The project work is concluded with the writing of a project report. The project report must be between 20 and 100 pages. A page is a standard page of 2400 characters including spaces and excluding list of content, bibliography, abstract, and enclosures, if any.</p>
Language	Danish or English
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School A level.
Academic requirements	<p>It is recommended that students have passed subject module course 1.</p> <p>It is further recommended that students have passed or at the same time attend at least one of the other courses of the subject module.</p>
Examination	<p>The project is made by a group of 2 to 6 students; cf. Curriculum for the relevant Bachelor Study Programme. The project is assessed at an oral examination. The duration of the examination including the assessment discussion is 30 minutes per student.</p> <p>The examination is a group examination for the students who have written the project report. The basis of the examination is the project report. The examination includes individual presentations on a subject chosen by the examiner and given to the student 3 weekdays before the examination. Each individual presentation including questions asked by the examiners takes 15 minutes. The individual presentations are followed by a joint examination based on the project report. The examination is a conversation between the students, the supervisor(s), and the examiner(s).</p> <p>The project report as the basis of the examination means that questions from the examiners can be asked not only to the entire project report but also to the subject area of the entire project module.</p> <p>The performance of each student is assessed, and the assessment is a joint assessment of the project report and the oral performance.</p>
Marking	7 point scale.
Assessment	External.

Subject module course 1	
Title	Molecules of life.
Type	Course.
Status	Compulsory – cf. § 3, (2).
ETCS	5 ECTS points.

Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge of the central dogma of molecular biology. • Knowledge of fundamental molecular biological terms, concepts, and methods. • Knowledge of the organization of the genetic material of pro and eukaryotic cells. • Knowledge of the structure and the biosynthesis of the macromolecules, DNA, RNA, and protein, of the cell. • Knowledge of fundamental mechanisms for regulation of gene expression. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to explain the biochemical mechanisms of replication, transcription, RNA processing and translation. • Skills to analyse and treat data from simple molecular biological experiments. • Skills to analyse DNA sequences for signals for gene expression. • Skills to explain the principles of some of the methods applied for the characterization of the macromolecules. • Skills to present/disseminate the acquired molecular biological knowledge in a correct and academic way. <p>Qualifications</p> <ul style="list-style-type: none"> • Qualifications to carry out theoretical and experimental project work based on a biological problem and by means of the application of theories and methods of molecular biology. • Qualifications to solve simple practical and/or experimental problems of a molecular biological nature.
Overall content	An introduction to synthesis and function of the informational biopolymers of cells, DNA, RNA, and protein, organization, function and expression of genes, as well as basic methods for characterizing proteins and DNA.
Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School A level.
Academic requirements	None.
Examination	<p>A 3 hour individual, written examination.</p> <p>Aids:</p> <p>First hour of the examination: Calculator and language dictionaries.</p> <p>The last two hours of the examination: Calculator, language dictionaries, textbooks and notes.</p> <p>The examination takes place at the university.</p>
Marking	7 point scale.
Assessment	Internal.

Subject module course 2	
Title	Biochemistry.
Type	Course.
Status	Compulsory
ETCS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge of the fundamental biochemical terms, concepts, theories, and mechanisms. • Knowledge of anabolism (biosynthesis) and catabolism (break down) of macromolecules (proteins, nucleic acids, carbohydrates, and lipids) and their building blocks, and knowledge of the bio-energetics coupling of such metabolic processes. • Knowledge of the biochemical basis of the structure of biological membranes and transport of biological molecules. • Knowledge of the principles of common biochemical methods and their applications. <p>Skills:</p> <ul style="list-style-type: none"> • Skill to apply biochemical terms, concepts, mechanisms, and methods to the solving of biological problems. • Skills to explain key metabolic processes, bioenergetics, membranes, and transport of membranes. • Skills to analyse and treat data from biochemical experiments. • Skills to present biochemical knowledge correctly and academically using biochemical terms and concepts. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications to carry out theoretical and experimental project work on the basis of a biological problem and by means of theories and methods of biochemistry. • Qualifications to solve simple practical and/or experimental problems of a biochemical nature.
Overall content	A theoretical course on the principles of the fundamental metabolic processes of pro- and eukaryotic cells, and on the experimental methods applied in biochemical research.
Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School A level.
Academic requirements	None.
Examination	<p>A 3 hour individual, written examination.</p> <p>Aids: Calculator and language dictionaries.</p> <p>The examination takes place at the university.</p>
Marking	7 point scale.
Assessment	External.

Subject module course 3	
Title	Genetics.
Type	Course.
Status	Compulsory.
ECTS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge of fundamental genetic terms, concepts, theories, mechanisms, and methods. • Knowledge of the mechanisms of replication, mutagenesis, recombination, and DNA repair in living cells. • Knowledge of the principle of common methods of genetic engineering and their applications. • Knowledge of the principles of selected methods and analyses for characterization of genomes (genomics). <p>Skills:</p> <ul style="list-style-type: none"> • Skills to explain the above mentioned genetic terms, concepts, theories, mechanisms, and methods. • Skills to analyse, treat, and interpret data from genetic experiments. • Skills to map genes on the basis of data from simple, classic mapping experiments. • Skills to map and analyse genes on the basis of data from molecular genetic experiments. • Skills to deduce simple gene regulatory mechanisms from genetic and molecular biological data. • Skills to present/disseminate genetic knowledge correctly and academically using genetic terms and concepts. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications to carry out theoretical and experimental project work on the basis of a biological problem and by applying theories and methods of genetics. • Qualifications to solve simple practical and/or experimental problems of a genetic nature.
Overall content	A theoretical course on fundamental theories and principles of common and molecular genetics in both pro- and eukaryotic organisms and an introduction to the experimental methods applied in modern genetic research.
Language	English.
Language skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School A level.
Academic requirements	It is recommended that students have passed subject module course 1, Molecules of life.
Examination	A 3 hour individual, written examination.

	<p>Aids: Calculator and language dictionaries.</p> <p>The last two hours of the examination: Calculator, language dictionaries, textbooks and notes.</p> <p>The examination takes place at the university.</p>
Marking	7 point scale.
Assessment	External.

Subject module course 4	
Title	Methods in molecular biology.
Type	Course.
Status	Compulsory.
ETCS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge of common and often applied methods of analyses in molecular biology, genetics, biochemistry, and bioinformatics. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to work safely and securely in a molecular biology laboratory classified for work with genetically modified organisms. • Skills to work with molecular biological methods of analysis according to instruction. • Skills to carry out practical biochemical/genetic laboratory work and to apply molecular biological experimental methods and instruments. • Skills to analyse, treat, and interpret data generated in the students' genetic and biochemical experiments. • Skills to visualize the 3 dimensional structures of proteins and their interaction with ligands. • Skills to search sequence databases on the internet and to apply basic sequence analysis programmes. • Skills to present/disseminate molecular biological test results precisely and academically using correct terms and concepts. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications to plan and carry out experimental project work applying fundamental molecular biological methods. • Qualifications to apply basic bio-informatics tools in the planning and analysis of molecular biological experiments.
Overall content	An experimental course of the central methods of molecular biology with the focus on biochemical, genetic, and bio-informatics analyses.
Language	English.

Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School A level.
Academic requirements	It is recommended that students have passed subject module course 1, Molecules of life.
Examination	Internal examination on the basis of active and satisfactory participation in the course. This means: Presence (a maximum of 25% valid absence such as illness, death, attending another course and the like), approval of reports on laboratory exercises, approval of a written homework in bioinformatics made in the course of one week, and an approved oral presentation of exercise results. A joint assessment is given.
Marking	Passed/Failed.
Assessment	Internal.

Optional course	
Title	Research in molecular biology.
Type	Course.
Status	Optional course, cf. § 3, (2).
ETCS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge of biological regulatory mechanisms within selected areas of molecular biology. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to discuss molecular biological methods, their mode of operation and applications. • Skills to analyse and interpret original scientific work in molecular biology. • Skills to orally present original scientific work and original molecular biological experiments in a precise and academic way by means of a correct use of molecular biological terms and concepts. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications to understand and analyse original scientific work applying common molecular biological methods. • Qualifications to carry out project work dealing with a molecular biological problem and qualifications to apply experimental methods and sound academic practice in the solving of the problem.
Overall content	A theoretical course on selected, more advanced problems of molecular biology. The purpose of the course is to qualify students' reading of original literature and oral presentations of scientific work.

Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School A level.
Academic requirements	It is recommended that students have passed subject module course 1, Molecules of life, and two of the other subject module courses in molecular biology.
Examination	<p>Internal examination on the basis of active and satisfactory participation in the course. This means: Presence (a maximum of 20% valid absence such as illness, death, attending another course and the like), passing of 70% of the spot tests given during the course, approval of oral presentations of original papers and of methods.</p> <p>Re-examination: A 2 hour individual, written examination without aids. A presence of at least 70% is required for taking the re-examination.</p> <p>The examination takes place at the university.</p>
Marking	Passed/Failed.
Assessment	Internal.

Coming into force and transitional rules

§ 6. The description of the subject modules will come into force on 1st September, 2013.

(2) The description of the subject modules apply to all students admitted to a Bachelor Programme as per 1st September 2012 or later.

Adopted by the Board of Studies for *Biology* at a meeting on the 12th November, 2012.

Approved by the Board of Studies for the Bachelor Study Programme in Natural Sciences on the 21st November, 2012.

Approved by the Vice-rector Hanne Leth Andersen on the 5th December, 2012.