Assessment plan of the Master's degree programmes 2022-2023:

Biomolecular Sciences

Introduction

This assessment plan is a description of the testing and assessment modes for all study components in the curriculum of the master's degree programme Biomolecular Sciences. The plan is based on the assessment policy of the Faculty of Science and Engineering, as defined in the FSE Quality Assurance Manual- (Chapter 6: Assessment, Appendix B) and the protocol setting out the duties and powers of the Faculty's Board of Examiners (Chapter 6: Assessment, Appendix G)

The assessment plan for the curriculum consists of the following components:

1. The objective(s) of the degree programme
2. The learning outcomes of the degree programme
3. Descriptions of the study components, as set out in the appendices to the Teaching and Examination Regulations 2022-2023 of the degree programme
4. Descriptions of the content of each study component in Ocasys, the online course catalogue. The following elements are relevant in this context:
   - objectives
   - description of content
   - lecturers
   - assessment mode(s) and calculation of final mark
   - mode(s) of instruction
5. An overview of the mentors and examiners (Appendix 1 and 2) and the assessment mode for each study component (Table 1 and Appendix 3). This overview is based on the curriculum approved by the Programme Committee, as set out in the appendices to the Teaching and Examination Regulations 2021-2022 for the degree programme.
6. A matrix showing the relationship between the study components and the learning outcomes for each competence area

Components 3 and 4 are not included in this document. For the descriptions of the study components, see the Appendix to the Teaching and Examination Regulations 2021-2022 for the degree programmes in Biomolecular Sciences. Descriptions of the content of each study component can be obtained from Ocasys (http://www.rug.nl/ocasys/).

1. Objectives of the degree programme

The selective Master degree programme focuses entirely on research to prepare for a career in academia or in research institutes. The study programme therefore mainly consists of research projects, which focus on learning to conduct research by actually doing it. Students will not only independently perform experiments in the laboratory, they will also go through the whole process of conducting science, developing skills such as searching for and studying scientific literature, formulating hypotheses, designing and performing experiments, and interpreting and presenting results.

The students can also follow the specialization Chemical Biology.

Students design their own study programme, tailored to their interests, in consultation with a study mentor (Appendix 1). The board of examiners must approve of each individual programme.

2. Learning outcomes of the degree programme

The taxonomy of Bloom has been adopted as an adequate means to describe the teaching objectives and their level, the teaching and student activities to reach these objectives and the unambiguous assessment of the extent to which the objectives have been reached.

The graduate:

1. a) has acquired in depth knowledge on one or more scientific disciplines within the field of Biomolecular Sciences and can use this knowledge to explain in detail the relevant concepts, using the appropriate terminology
   b) has acquired cross disciplinary knowledge of issues across scientific disciplines within the field of Biomolecular Sciences and can use this knowledge to explain current societal and scientific challenges;

2. can design, and conduct scientific research, and systematically organize his/her work in scientific research;

3. can independently investigate and critically evaluate scientific literature;

4. can identify new developments in the relevant disciplines, and can become familiar with these developments;

5. can formulate realistic, and original solutions to complex problems;

6. can participate in and contribute to a multidisciplinary team;

7. can effectively communicate acquired knowledge, insights and skills to others, both in writing and in oral presentation;

8. can identify societal and ethical implications of scientific research and is able to critically reflect on his/her actions in this context;

9. can independently acquire new knowledge and skills that are relevant for his/her professional career, in science, in policy & management or society.

Curriculum

The major part of the master's degree programme consists of 80 EC of compulsory individual elements (research projects, colloquium, essay; see Table 1) within the domain of biomolecular sciences. These are graded by examiners appointed by the Board of Examiners (Appendix 2).

In addition to the 80 EC individual elements, at most 40 EC of the student's programme is composed of course units. Of these, one course of 5 EC is mandatory and 15 EC have to be chosen from a list of 'obligatory' master courses. In these courses, the student increases her/his domain-specific knowledge and skills.

The student acquires most of the qualifications/learning outcomes (Table 2) during the individual elements. In the courses, the student increases her/his domain-specific knowledge and skills and acquires the qualifications/learning outcomes as indicated in Appendix 3.

Master courses

At most 40 ECTS of the student's programme is composed of courses. Protein and Enzyme Engineering (5 ECTS) is compulsory and 15 ECTS have to be chosen from a list of master courses. The student increases his/her domain-specific knowledge and skills in these courses, all of which may also be chosen as electives (at most 20 ECTS in an individual programme).

1. Advances in Signal Transduction; 5 ECTS
2. Advanced Membrane Biology; 5 ECTS
3. Organelle and Membrane Biogenesis; 5 ECTS
4. Molecular Dynamics and Modelling of Membranes and Proteins; 5 ECTS
5. Electron Microscopy of Biological Macromolecules: 5 ECTS

6. Advanced Protein Crystallography; 5 ECTS
7. Tools and Approaches of Systems Biology; 5 ECTS
8. Transcriptomics: DNA Microarrays and RNAseq; 5 ECTS
9. Advanced Genetic Engineering and Complex Gene Regulatory Circuitries; 5 ECTS

The study load of the electives is ≤ 20 ECTS, which can be used for courses, research- or individual assignments.

Additional requirements for the specialization Chemical Biology
Students in the specialization Chemical Biology have to pass all of the following courses:
1. Advanced Protein Crystallography; 5 ECTS
2. Protein and Enzyme Engineering; 5 ECTS
3. Advances in Chemical Biology; 5 ECTS
4. Synthetic Biology and Systems Chemistry; 5 ECTS

Course coordinators in the master's programmes in Biomolecular Sciences provide yearly updated Course Unit Assessment Overviews (CUAO's) for each of their courses. A CUAO describes the relationship between course content, learning objectives, assessment mode and final qualifications. CUAO's are available for all course units (see table 3 and 4).

Students may also choose electives organized by other programmes of the Faculty of Science and Engineering of the University of Groningen, or elsewhere. These are not included in this assessment plan; they are chosen in consultation with the student's mentor to make sure that the individual programme of the student adheres to all learning outcomes of the programme (Appendix 1, Mentors).

Table 1. Overview of the master's degree programme.

Research:

COURSE UNIT	ECTS	TEACHING FORM	ASSESSMENT
Essay	5	Individual literature study	Written report
Research project	≥ 30	Research	Technical and/or laboratory skills, written report, oral presentation
Research project	≥ 40	Research	Technical and/or laboratory skills, written report, oral presentation
Colloquium	5	Individual literature study	Oral presentation
Protein and Enzyme Engineering	5	Lectures, assignments and practicals	Practical work, oral presentation and assignments
Master courses*	15	Various	Various
Electives	≤20	Various	Various

* From list of 9 compulsory master courses

Chemical Biology:

COURSE UNIT	ECTS	TEACHING FORM	ASSESSMENT
Essay	5	Individual literature study	Written report (in the form of a research proposal or review)
Research project	≥ 30	Research	Technical and/or laboratory skills, written report, oral presentation

Research project	≥ 40	Research	Technical and/or laboratory skills, written report, oral presentation
Colloquium	5	Individual literature study	Oral presentation
Advanced Protein Crystallography	5	Lectures and practical work	Practical work, written exam
Protein and Enzyme Engineering	5	Lectures, assignments and practicals	Practical work, oral presentation and assignments
Advances in Chemical Biology	5	Lectures and assignments	Presentation and written exam
Synthetic Biology and Systems Chemistry	5	Lectures, practical work and seminar	Practical work, presentation and written exam
Electives	≤20	Various	Various

3. Overview of examiners and testing and assessment modes for study components

Table 2 shows the study components for each year of the programme, and the intended examiner(s) and assessment modes. Not all elective course units are part of this table but can be found in the Teaching and Examination Regulations (OERs) and/or Ocasys. This satisfies requirement 3 in the Protocol of Duties and Powers of the Board of Examiners of the Faculty of Science and Engineering.

Course name	Course code	EC	Coordinator/First examiner	Second supervisor	Mode of assessment
Advanced genetic engineering	WMBS006-05	5	Prof. Dr. T.E.F. Quax	Tba	WE/P/PR
Advanced light microscopy	WMBY016-05	5	Prof. Dr. I.J. van der Klei	Prof. Dr. M. Heinemann	WE/R/P/AST
Advanced Membrane Biology	WMBS007-05	5	Prof. Dr. B. Poolman	Prof. Dr. D.J. Slotboom	WE/PR
Advanced protein crystallography	WMBS008-05	5	Dr. A.M.W.H. Thunnissen	Dr. A. Guskov	OE/WE/PR
Advances in signal transduction	WMBS009-05	5	Prof. Dr. A. Kortholt	Dr. M.H.K. Linskens	R/P/PR
Electron microscopy of biological macromolecules	WMBS011-05	5	Dr. C. Batista Paulino	Dr. M.C.A. Stuart	WE/PR
International Genetically Engineered Machine competition (iGEM)	WMBS013-20	20	Dr. S.K. Billerbeck, PhD	Dr. J.L. Kamenz	R/P
Molecular dynamics	WMBS003-05	5	Prof. Dr. S.J. Marrink	Dr. A.H. de Vries	WE/P/PR
Organelle and Membrane Biogenesis	WMBS012-05	5	Prof. Dr. A.J.M. Driessen	Prof. Dr. I.J. van der Klei	P/PR/AST
Protein and Enzyme Engineering	WMBS004-05	5	Prof. Dr. G. Maglia	Prof. Dr. M.W. Fraaije	P/PR/AST
Tools and approaches of systems biology	WMBS005-05	5	Prof. Dr. M. Heinemann	Dr. Andreas Milias-Argeitis	WE/PR
Transcriptomics: RNAseq	WMBS014-05	5	Dr. A. de Jong	Dr. D. Incarnato	R/P/PR

Advances in Chemical Biology	WMCH014-05	5	Prof. Dr. M.D. Witte / Prof. Dr. M.T.C. Walvoort	WE, P
Synthetic Biology & Systems Chemistry	WMCH021-05	5	Prof. Dr. M. Heinemann / Prof. Dr. S. Otto	WE, P, PR

Assessment abbreviations:

(WE) Written Exam
(MC) Multiple choice
(IT) Interim Test
(OE) Oral Exam
(R) Report
(P) Presentation
(PR) Practical Work
(AST) Assignment

4. Relationship between course units and details of the learning outcomes

Table 3 (individual elements) and table 4 (Master and elective courses) show the relationship between the learning outcomes and the course units of the curriculum.

*Table 3. Relation between learning outcomes of the 80 ECTS compulsory individual elements in the master's degree programme**

	Essay	Research projects	Colloquium
1 Knowledge	+++	+++	+++
2 Research design		+++	
3 Scientific literature	+++	+++	+++
4 New developments	+++	+++	+++
5 Solving complex problems	++	+++	++
6 Team contribution		+++	
7 Communication	+++	+++	+++
8 Reflection	+	++	+
9 Learning abilities	+++	++	+++

*The number of + indicates to what extent the module contributes to the learning outcomes. Numbers correspond to learning outcomes of the master's degree programmes.

Students are allowed to do a research assignment of 5-20 ECTS as an elective. Since these research assignments are individual assignments, their contribution to the degree programme's end terms vary as well.

Table 4: Contribution to the learning outcomes of the course units:

Course name	E1	E2	E3	E4	E5	E6	E7	E8	E9
Advanced genetic engineering	X	X	X	x	x	0	X	x	x
Advanced light microscopy	X	X	0	x	0	0	x	0	X
Advanced Membrane Biology	X	X	X	x	X	X	X	0	0
Advanced protein crystallography	X	X	X	X	X	x	x	x	X
Advances in Chemical Biology*	X	0	0	x	X	x	X	0	0
Advances in signal transduction	X	X	X	x	x	0	X	0	x
Electron microscopy of biological macromolecules	X	x	x	x	0	0	X	0	0
International Genetically Engineered Machine competition (iGEM)	X	X	X	X	X	X	X	X	X
Molecular dynamics	X	x	x	0	x	0	X	0	0
Organelle and Membrane Biogenesis	X	X	X	X	X	X	X	0	X
Protein and Enzyme Engineering	x	X	x	0	x	0	X	0	x
Tools and approaches of systems biology	X	x	X	x	0	0	X	0	x
Transcriptomics: DNA microarrays and RNAseq	X	X	X	X	X	X	X	x	X
Synthetic Biology and Systems Chemistry*	X	0	X	x	x	x	x	0	x

*Obligatory Chemistry courses in the Chemical Biology specialization

Appendix 1. Mentors Biomolecular Sciences

Name	Research Group
Prof. Dr. S. El Aidy	Microbial Physiology
Dr. S.K. Billerbeck	Molecular Genetics
Prof. Dr. G van den Bogaart	Molecular Immunology
Prof. Dr. A.J.M. Driessen	Molecular Microbiology
Prof. Dr. M.W. Fraaije	Biotransformation and Biocatalysis
Prof. Dr. M. Heinemann	Molecular Systems Biology
Prof. Dr. I.J. van der Klei	Molecular Cell Biology
Prof. Dr. A. Kortholt	Cell Biochemistry
Prof. Dr. G. Maglia	Chemical Biology
Prof. Dr. B. Poolman	Membrane Enzymology
Prof. Dr. D.J. Scheffers	Molecular Microbiology
Prof. Dr. D.J. Slotboom	Membrane Enzymology
Dr. A.H. de Vries	Molecular Dynamics

Appendix 2. List of examiners

List of appointed examiners

The list presented in this chapter provides names of staff members that are formally appointed as Examiner by the Board of Examiners of Biology. Examiners can be contacted for research projects, essays, colloquia and research assignments.
New Examiners can be appointed during the year by the Board of Examiners. Their names and (other) revisions of the list of Examiners will be published on the Student Portal.
Contact details also are available on Student Portal.

Name	**Field of expertise/ Research Group**
Prof. Dr. S. El Aidy	Microbial Physiology
Dr. C. Batista Paulino	Electron Microscopy
Dr. S.K. Billerbeck	Molecular Microbiology
Prof. Dr. G van den Bogaart	Molecular Immunology
Dr. J. Broos	Molecular Genetic
Prof. Dr. A.J.M. Driessen	Molecular Microbiology
Prof. Dr. M.W. Fraaije	Biotransformation and Biocatalysis
Dr. A. Guskov	Structural Biology
Prof. Dr. M. Heinemann	Molecular Systems Biology
Dr. D. Incarnato	Molecular Genetics
Dr. E. Jurak	Bioproduct Engineering
Dr. J.L. Kamenz	Molecular Systems Biology
Prof. Dr. I.J. van der Klei	Molecular Cell Biology
Prof. Dr. A. Kortholt	Cell Biochemistry
Prof. Dr. O.P. Kuipers	Molecular Genetics
Dr. M.H.K. Linskens	Cell Biochemistry
Prof. Dr. G. Maglia	Chemical Biology
Prof. Dr. S.J. Marrink	Molecular Dynamics
Dr. C. Mayer	Biomolecular chemistry & Catalysis
Dr. A. Milias Argeitis	Molecular Systems Biology
Prof. Dr. Ir. A.J. Minnaard	Chemical Biology
Prof. Dr. E.A.A. Nollen	Molecular Neurobiology of Ageing (ERIBA)
Prof. Dr. B.Poolman	Membrane Enzymology
Prof. Dr. T.E.F. Quax	Molecular Microbiology
Prof. Dr. J.G. Roelfes	Synthetic Organic Chemistry
Prof. Dr. D.J. Scheffers	Molecular Microbiology
Prof. Dr. D.J. Slotboom	Membrane Enzymology
Dr. A.M.W.H. Thunnissen	Protein Crystallography
Dr. K.M. Tych	Chemical Biology
Prof. Dr. L.M.Veenhoff	Cellular Biochemistry (ERIBA)
Dr. A.H. de Vries	Molecular Dynamics
Prof. Dr. M.T.C. Walvoort	Chemical Biology
Dr. M.D. Witte	Chemical Biology