

Biology
Medical Biology

**Faculty of Science,
Radboud University Nijmegen**

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This report was finalized on 2 February 2016

Report on the master's programmes **Biology, Medical Biology** of **Radboud University Nijmegen**

This report takes the NVAO's Assessment framework for limited programme assessments as a starting point.

Administrative data regarding the programmes

Master's programme Biology

Name of the programme:	Biology
CROHO number:	66860
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations:	Adaptive Organisms Communities and Ecosystems Water and Environment Science in Society Science, Management and Innovation Science and Education
Joint programmes:	Transnational Water Management (double degree with University Duisberg/Essen)
Location(s):	Nijmegen
Mode(s) of study:	full time
Expiration of accreditation:	9-2-2017

Master's programme Medical Biology

Name of the programme:	Medical Biology
CROHO number:	60610
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations:	Clinical Biology Functional Genomics Neuroscience Science in Society Science, Management and Innovation Science and Education
Location(s):	Nijmegen
Mode(s) of study:	full time
Expiration of accreditation:	9-2-2017

The visit of the assessment panel Biology to the Faculty of Science of Radboud University Nijmegen took place on October 19-20.

Administrative data regarding the institution

Name of the institution:	Radboud University Nijmegen
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

Composition of the assessment panel

The NVAO has approved the composition of the panel on July 6, 2015. The panel that assessed the master's programmes Biology and Medical Biology consisted of:

- Prof. dr. Jan Kijne (chair), Professor emeritus of BioScience, Leiden University;
- Prof. dr. Ton Bisseling, Professor of Molecular Biology, Wageningen University;
- Prof. dr. Marieke van Ham, Professor of Biological Immunology, University of Amsterdam;
- Prof. dr. Herman Verhoef, Professor emeritus of Soil Ecology, VU University Amsterdam;
- Prof. dr. Joost Teixeira de Mattos, Professor of Quantitative Microbial Physiology, University of Amsterdam;
- Jeffrey Verhoeff BSc. (student-member), master's student Biology and Animal Sciences, Wageningen University.

The panel was supported by drs. José van Zwieten, who acted as secretary.

Appendix 1 contains the curricula vitae of the panel members.

Working method of the assessment panel

The assessment of the bachelor's programme Biology and the master's programmes Biology and Medical Biology of Radboud University Nijmegen is part of a cluster assessment. From June 2015 until January 2016, the panel assessed a total of twenty-three programmes at seven universities.

The panel consisted of thirteen members:

- Prof. dr. Jan Kijne (chair), Professor emeritus of BioScience, Leiden University;
- Prof. dr. Ton Bisseling (vice-chair), Professor of Molecular Biology, Wageningen University;
- Prof. dr. Maarten Frens, Professor of Systems Physiology, Erasmus University Rotterdam;
- Prof. dr. Marieke van Ham, Professor of Biological Immunology, University of Amsterdam;
- Prof. dr. Paul Hooykaas, Professor of Molecular Genetics, Leiden University;
- Dr. Andries ter Maat, Research Scientist, Max Planck Institute for Ornithology;
- Dr. Maarten van der Smagt, Associate Professor Experimental Psychology, Utrecht University;
- Prof. dr. Joost Teixeira de Mattos, Professor of Quantitative Microbial Physiology, University of Amsterdam;
- Prof. dr. Herman Verhoef, Professor emeritus of Soil Ecology, Vrije Universiteit Amsterdam;
- Prof. dr. Jos Verhoeven, Professor emeritus of Landscape Ecology, Utrecht University;
- Prof. dr. Rens Voeselek, Professor of Plant Ecophysiology, Utrecht University;
- Pieter Munster MSc. (student member), policy officer at Leiden University and graduate of the master's programme Cancer, Genomics & Developmental Biology, Utrecht University;
- Jeffrey Verhoeff BSc. (student member), master's student Biology and Animal Sciences, Wageningen University.

For every site visit, a (sub)panel was composed, based on the expertise and availability of panel members, thereby preventing possible conflicts of interests. Panels regularly consisted of five or six members. In order to enhance consistency of assessment within the cluster, professor Kijne acted as chair during all seven site visits. Coördinator of the cluster assessment Biology is dr. Kees-Jan van Klaveren, employee of QANU. He acted as secretary of the panel at Wageningen University and Utrecht University. He was also present during the final meetings of the five other site visits and read and commented upon each draft report in order to safeguard consistency of assessment. Drs. José van Zwieten, freelance employee of QANU, acted as secretary of the panel at Leiden University, Radboud University Nijmegen, the University of Groningen, the University of Amsterdam and VU University Amsterdam. In Groningen dr. Fiona Schouten, employee of QANU, acted as second secretary to the panel.

Preparation

The panel held a preliminary meeting on May 22, 2015. During this meeting the panel was instructed about the accreditation framework and the programme of the upcoming assessments. Furthermore, the panel discussed its working methods in preparation to and during the site visits. A vice-chair was appointed and the Domain Specific Frameworks for Biology and Psychobiology were discussed.

To prepare the contents of the site visits, the coordinator first checked the quality and completeness of the critical reflections prepared by the programmes. After establishing that the reports met the demands, they were forwarded to the participating panel members. The panel members read the reports and formulated questions and findings on their contents.

Next to the critical reflections, the panel read a selection of fifteen theses per programme. For the master's programme Biology, the panel read an additional selection of ten theses. The theses were chosen by the chair of the panel from a list of graduates of the last two completed academic years within a range of grades.

Site visit

A preliminary programme of the site visit was made by the coordinator and adapted after consultation of the contact persons at Nijmegen. The time table for the visit in Nijmegen is included as Appendix 5.

Prior to the site visit, the panel asked the programmes to select representative interview partners. During the site visit, meetings were held with panels representing students and teaching staff, institute management, programme management, alumni, the Programme Committee and the Board of Examiners.

During the site visit, the panel examined material it had requested; an overview of this material is given in Appendix 6. The panel provided students and lecturers with the opportunity – outside the set interviews – to speak informally to the panel during a consultation hour. No requests were received for this option.

The panel used the final part of the visit for an internal meeting to discuss its findings. The visit was concluded with a public oral presentation of the preliminary impressions and general observations by the chair of the panel.

Report

Based on the panel's findings, the secretary prepared a draft report. This report was then presented to the panel members involved in the site visit. After implementing their comments and receiving approval, the draft report was sent to Radboud University with the request to report any factual inaccuracies. The comments received from Radboud University were discussed with the panel's chair. Subsequently, the final report was approved and sent to Nijmegen.

Decision rules

In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality

The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory

The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory

The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good

The programme systematically surpasses the current generic quality standard.

Excellent

The programme systematically well surpasses the current generic quality standard and is regarded as an international example.

Summary judgement

Master's programme Biology

The master's programme Biology is a two-year-programme and consists of 120 EC. The programme offers three research specializations: Adaptive Organisms, Communities and Ecosystems and Water and Environment. The panel has established that the intended learning outcomes of the programme are in line with (inter)national requirements. The programme has developed clear profiles for the research specialisations as well as for the society-oriented specialisations. The panel suggests that the profiles of the research specialisations could be reflected more clearly in the intended learning outcomes of the programmes.

The programme starts with an orientation course that introduces students to research topics and research groups related to their specialization. All specializations consist of specialization specific courses, electives, research internships and a literature thesis. Students can choose to participate in their second year of study in one of the society-oriented specializations: Science in Society, Science, Management and Innovation or Science and Education.

The panel has studied the master's programme Biology and established that the curricula of the different research specializations offer students adequate opportunities for academic specialisation. The programme is structured as a balanced combination of orientation courses, compulsory courses, electives and research projects. Being a member of the research group, students are well guided in their development towards independent (junior) researcher. The panel established that students would benefit from an advanced statistics course. According to the panel, there should also be more attention for systems biology. In addition, this programme could also be improved by offering a course that provides students with an overview of advanced research topics in Biology.

The three society-oriented specialisations provide students with the complementary knowledge and skills that enable them to use their biological knowledge in business, policy, science communication or education environments.

The programme uses a variety of teaching methods: lectures, case studies, field work, group assignments and individual research projects. According to the panel these are adequate didactic practices for master's programmes in the field of Biology.

The panel established that the programme is feasible. Coherence and feasibility of individual trajectories are monitored in portfolio activities. Although the panel considers the portfolio to be a valuable tool, it concludes that current practice does not provide much added value to the personal and academic growth of students.

The programme is delivered by qualified and highly motivated staff members. According to the panel the student-staff ratio is too high and needs to become more favourable in order to maintain and improve the quality of the programme. The Programme Committee plays a proactive role in the quality assurance of the programmes.

The panel has checked whether the programme has adopted an adequate assessment system. The panel has established that the programme uses diverse assessment methods that are aligned with the learning objectives of each course. The panel is convinced that the programme, and particularly the Board of Examiners and their Assessment Committee, have installed adequate measures to monitor assessment quality. Safeguarding the quality of final

research projects gets attention from examiners and the Board of Examiners. The panel has the opinion that at the start of those projects an additional control procedure is necessary in order to safeguard the academic quality and realistic and feasible planning of research internships.

The Board of Examiners has a proactive attitude. The panel observed that many of the measures have been taken quite recently. It will take some time to make these procedures a routine for the teaching staff. Furthermore, concerted consultation of teachers about assessment (peer review) should be encouraged. Assessment quality profits from 'continuously learning from each other'.

After studying a sample of final reports, the panel establishes that students realise the intended learning outcomes of the master's programme Biology. Although some reports of the programme did not demonstrate an adequate academic depth, the panel has been convinced that these were special cases and that meanwhile adequate measures have been taken to prevent these incidents in the future. Based on the performance of alumni the panel concludes that the programme prepares students well for an academic or business position on the labour market.

The panel assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's programme Biology:

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment	satisfactory
Standard 4: Achieved learning outcomes	satisfactory
General conclusion	satisfactory

Master's programme Medical Biology

The master's programme Medical Biology is a two-year-programme and consists of 120 EC. Students can choose between the specialisations 'Clinical Biology', 'Functional Genomics', and 'Neuroscience'. Students can choose to participate in their second year of study in one of the society-oriented specializations: Science in Society, Science, Management and Innovation or Science and Education. The panel has established that the intended learning outcomes of the programme are in line with (inter)national requirements. The programme has developed clear profiles for the research specialisations as well as for the society-oriented specialisations. The panel suggests that the profiles of the research specialisations could be reflected more clearly in the intended learning outcomes of the programme.

The programme starts with orientation courses and courses focussing on state-of-the-art trends in the biomedical field that introduce students to research topics and research institutes related to their specialization. All specializations consist of specialization specific courses, electives, research internships and a literature thesis. The panel has studied the programme and established that the curricula of the different research specializations offer students adequate opportunities for academic specialisation. The programme is structured in a balanced combination of orientation courses, compulsory courses, electives and research projects. Being a member of the research group, students are well guided in their development into an independent (junior) researcher. The panel established that students would benefit from an advanced statistics course.

The contents of the research specializations in Medical Biology are of good quality. Especially the Neuroscience specialization and the new curriculum of the Medical Epigenomics specialization (that has replaced the Functional Genomics specialization) provide students with specialised knowledge in a dynamic, future-oriented research field. These specializations demonstrate major attention for developments in New Biology. The panel recommends the programme to make systems biology a compulsory part of all specializations, which currently is not the case in the Clinical Biology specialization.

The three society-oriented specialisations provide students with the complementary knowledge and skills that enable them to use their biological knowledge in business, policy, science communication or education environments.

The programmes use a variety of teaching methods: lectures, case studies, field work, group assignments and individual research projects. According to the panel these are adequate didactic practices for master's programmes in the field of Medical Biology.

The panel established that the programme is feasible. The availability of sufficient academic research internships is a point of attention. Coherence and feasibility of individual trajectories are monitored in portfolio activities. Although the panel considers the portfolio to be a valuable tool, it concludes that current practice does not provide much added value to the personal and academic growth of students.

The programme is delivered by qualified and highly motivated staff members. According to the panel the student-staff ratio is too high and needs to become more favourable in order to maintain and improve the quality of the programme. The Programme Committee plays a proactive role in the quality assurance of the programme.

The panel has checked whether the programme has adopted an adequate assessment system. The panel has established that the programme uses diverse assessment methods that are

aligned with the learning objectives of each course. The panel is convinced that the programme, and particularly the Board of Examiners and their Assessment Committee, have installed adequate measures to monitor assessment quality. Safeguarding the quality of final research projects gets attention from examiners and the Board of Examiners. The panel has the opinion that at the start of those projects an additional control procedure is necessary in order to safeguard the academic quality and realistic and feasible planning of research internships.

The Board of Examiners has a proactive attitude. The panel observed that many of the measures have been taken quite recently. It will take some time to make these procedures a routine for the teaching staff. Furthermore, concerted consultation of teachers about assessment (peer review) should be encouraged. Assessment quality profits from 'continuously learning from each other'. In this respect, the programme can profit from *best practices* elsewhere in academia.

After studying a sample of final reports, the panel establishes that students realise the intended learning outcomes of the master's programme Medical Biology. Academic depth of the final works deserves continuous attention. Based on the performance of alumni the panel concludes that the programme prepares students well for an academic or business position on the labour market.

The panel assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's programme Medical Biology:

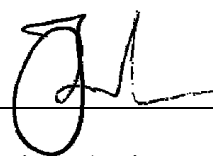
Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	good
Standard 3: Assessment	satisfactory
Standard 4: Achieved learning outcomes	satisfactory
General conclusion	satisfactory

The chair and the secretary of the panel hereby declare that all members of the panel have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 2 February 2016



Prof. dr. Jan Kijne



drs. José van Zwieten

Description of the standards from the Assessment framework for limited programme assessments

Organisation of the education

The master's programmes in Biology and Medical Biology at Radboud University Nijmegen are organised by the Educational Institute Biosciences. Education is provided by the teachers from the research institutes *Institute for Water and Wetland Research (IWWR)*, *Radboud Institute for Molecular Life Sciences (RIMLS)*, *Donders Centre for Neuroscience (DCN)* and the Faculty of Medical Sciences. The Director of Education is responsible for the organisation of the programmes, supported by the Educational Coordinator. The Director of Education reports to the Faculty Board. The bachelor's and master's programmes have a joint Programme Committee (PC) and Board of Examiners (BoE).

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:

As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme. Insofar as is applicable, the intended learning outcomes are in accordance with relevant legislation and regulations.

Findings

The Educational Institute Biosciences of Radboud University Nijmegen offers two master's programmes: Biology and Medical Biology. Both programmes aim to provide students with the knowledge, skills and attitude students require to start a professional career. This can be a career as well prepared experimental researcher with the potential to initiate a PhD project, or as a (medical) biologist transferring or applying existing scientific knowledge in company management and industry strategy development, in governmental and NGO management and decision making, or in education.

Students in both programmes can choose between a research specialisation within each programme or the society-oriented specialisations Science in Society (SiS), Science, Management and Innovation (SMI), Science and Education (SE).

The research specialisations in the Biology programme are 'Adaptive Organisms', 'Communities and Ecosystems', and 'Water and Environment'. The programme focusses on how organisms, communities and ecosystems function in relation to their environment and how they acclimate and adapt to changes in this environment. Students of the Biology programme may also choose the double-degree programme 'Transnational ecosystem-based Water Management' (TWM). This Dutch and German Master's degree is an initiative of Radboud University and the University of Duisberg-Essen. It provides a separate option within the research specialisation 'Water and Environment'.

For Medical Biology the research specialisations are 'Clinical Biology', 'Functional Genomics' (now replaced by the specialization Medical Epigenomics) and 'Neuroscience'. It offers multidisciplinary education at the interface of fundamental biology and medical sciences: students learn how fundamental research is translated into clinical application. The panel has

the opinion that the name of the specialization ‘Clinical Biology’ could give the impression that this specialization is not very fundamental-research oriented, being reminiscent of a programme in Biomedical Sciences at the Faculty of Medicine. The panel suggests that if the programme has the intention to distinguish itself from Biomedical Sciences with its basis in fundamental biology, it could be useful to rename the specialization.

The Consultative Body of Higher Educational Teaching in Biology (‘Overlegorgaan Hoger Onderwijs Biologie’, OHOB), in which all academic degree programmes in the Netherlands are represented, has drawn up the Domain-Specific Frameworks of Reference (hereafter the Frameworks) for academic bachelor’s and master’s programmes in Biology. This document demarcates the domain of Biology, and touches upon the transition towards New Biology. The past focus on mono-disciplines has shifted towards integration of different scientific disciplines and requires the competence to deal with the dynamics and complexity of life as a network, from molecules to ecosystems. The Frameworks provide a set of general requirements for academic bachelor’s and master’s programmes in Biology.

The panel has studied the Framework for master’s programmes, and notes that its general requirements correspond to the internationally accepted Dublin descriptors. In terms of contents, the requirements also encompass what might be expected of an academic master’s programme Biology. The panel appreciates the fact that New Biology has been mentioned in the Frameworks. However, it notes that New Biology and the corresponding scientific attitude have often not yet been translated into concrete requirements for academic degree programmes. The panel expects that in the next revision of the document, the integrative and interdisciplinary nature of Biology will be recognized in the general requirements.

The objectives of the master’s programmes are based on the Framework. The programmes have translated these in final qualifications that are described as professional competences, general academic competences and specific competences for the research specializations, the SMI specialization and the SiS specialization. The intended learning outcomes are presented in appendix 3 of this report.

According to the critical reflection, the intended learning outcomes match the requirements of employers. According to the study ‘Arbeidsmarktonderzoek Biowetenschappen en Biomedische Wetenschappen in Nederland’ (2014, NIBI), organisations that employ life scientists require well-trained and knowledgeable life scientists who can perform independently in a multidisciplinary environment, who exercise good communication skills and can work in a team. These requirements are in line with the intended learning outcomes of the master’s programmes.

The panel has studied the intended learning outcomes of the programme and observed that they are in line with the Frameworks. Thereby, their profile and level match (inter)national requirements. The research specialisations are organised in recognisable profiles. The intended attainment level and competences of the society-oriented specialisations clearly describe the requirements related to the professional field. However, the panel did not observe that the different profiles or a generic ‘Nijmegen-profile’ are reflected in the intended learning outcomes.

Considerations

The panel has established that the intended learning outcomes of the master's programmes are in line with (inter)national requirements. The programmes have developed clear profiles for the research specialisations as well as for the society-oriented specialisations. The panel suggests that these profiles of the research specialisations could be reflected more specifically in the intended learning outcomes of the programmes, in addition to specific characteristics of a Radboud graduate in (Medical) Biology.

Conclusion

Master's programme Biology: the panel assesses Standard 1 as **satisfactory**.

Master's programme Medical Biology: the panel assesses Standard 1 as **satisfactory**.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:

The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

The panel has studied the curriculum of the master's programmes. The panel has read course materials, reports of relevant committees and study information on the digital learning environment Blackboard. This standard starts with the findings concerning the content and structure of the curricula. Next, a short description of the didactic concept of the programmes is presented. Finally some findings on the feasibility, staff, quality assurance and facilities of the programmes are described.

Curricula

The master's programmes in Biology and in Medical Biology are two-year-programmes and consist of 120 EC. Appendix 4 shows an overview of the curricula of each of the specialisations in the programmes.

Biology

The Biology programme offers three research specializations: *Adaptive Organisms, Communities and Ecosystems* and *Water and Environment*. Adaptive Organisms focuses on processes at the organismal level. Students study the acclimation and adaptation to environmental stress. This knowledge is applied in biotechnology, aquaculture, plant and animal breeding programmes and nature management. Communities and Ecosystems is focused on the ecology of units of interacting individuals within an environmental context. Students analyse species composition and their diversity and functionally relate this to hydrology, nutritional status and landscape configuration of the ecosystem. Water and Environment offers insight regarding climate change, flooding, eutrophication, chemical pollution, habitat fragmentation and bio-invasions. Students are equipped with laboratory, field and assessment tools to protect eco-system and human health in a context of multiple environmental pressure.

The first year of all specializations are structured in the following elements:

- Orientation in Biology and Environmental Sciences course (3 EC)
- Specialization specific compulsory courses (12 EC)
- Research internship (36 EC)
- Literature thesis (6EC)
- Electives (3 EC)

The Orientation course addresses current topics in biology and introduces students to the different research groups that are connected to the programme. The compulsory courses give students more in-depth knowledge as a starting point for their research internships. Students mention that some of these courses show overlap with bachelor courses. They understand that this is necessary for students who did not take the bachelor's programme Biology in Nijmegen. The panel advises to critically investigate how deficiencies can be repaired through a pre-master programme and/or dedicated courses outside the regular curricula.

In their second year, students choose a second internship (at least 36 EC), write a literature thesis (12 EC) and take additional elective courses. Students can also opt for one of the society-oriented specialisations in their second year (see: *Both programmes*, later in this section).

Students who have chosen for the double degree programme TWM follow the same courses as regular Water and Environment students in the first quarter of the programme. In the second quarter, they follow specialization-specific courses. During the second and third semester they follow courses and do project work at the University of Duisburg-Essen and perform an internship (16 EC). They write a master thesis (30 EC) in the final semester of the programme. For the quality of courses students take at the University of Duisburg-Essen, and the quality of its teaching staff, the panel relies on ‘ASIIN Akkreditierungsbericht’ (2010) of this university, that includes the TWM programme.

The panel concludes that the programme is well structured in line with what could be expected of a master’s programme. It has a good balance of course work, electives and internships. The panel suggests that a course addressing the state-of-the-art in biological research would be a good addition in the master’s programme in order to provide students with a broader perspective on research in biology before or during their specialization. After all, master students Biology graduate in the first place as biologists, with a professionalizing in-depth specialization. The panel observed that systems biology is not addressed in the compulsory part of the Biology programme. According to the panel, future biologists functioning at a master’s level would all benefit from knowledge of systems biology. Finally, students pointed out that they could well use a statistics course, as most of them need to freshen and extend their statistics knowledge at the start of their research projects. The panel agrees that an advanced statistics course would be a useful addition to the programme.

The course materials that the panel studied are of good quality. The panel observed that most courses combine theoretical knowledge with application of science to environmental issues. The Orientation course and, in particular, the internships give the programme the necessary academic character.

Medical Biology

Master students Medical Biology can choose between the specialisations ‘*Clinical Biology*’, ‘*Functional Genomics*’ (now *Medical Epigenomics*), and ‘*Neuroscience*’. In Clinical Biology, students focus on clinical problems at molecular and cellular levels. Students are trained to carry out research on patient material in themes as cancer development, reconstructive and regenerative medicine, and infectious, inflammatory and mitochondrial diseases. Functional Genomics/Medical Epigenomics focuses on functional, molecular and (epi-)genetic aspects of development and differentiation, stem cell biology and disease. In Neuroscience, students examine the human brain from a molecular, neurophysics or neuroinformatics point of view.

The first year of all specializations are structured in the following elements:

- ‘Trends in Medical Biosciences’ and ‘Trends in Medical Biosciences II’ (6 EC)
- Specialization specific courses (9 EC)
- Literature thesis (6 EC)
- Electives (3 EC)
- Research internship (36 EC)

The ‘Trends’ courses address current developments in medical biosciences from an interdisciplinary point of view and introduce students to the different research institutes that

are connected to the programme. The compulsory courses provide students with more in-depth knowledge as a starting point for their research internships.

The panel concludes that the programme is well-structured in line with what could be expected of a master's programme. It has a good balance of course work, electives and internships.

The panel finds the course-content of the Clinical Biology adequate and well-structured. There is a fair amount of attention for fundamental knowledge. The course Human Genetics is according to the panel a *best practice*, as the course focusses on state-of-the-art practical training in analysis and interpretation of big data, thus preparing the students for a future in biomedical research in which the concepts of New Biology are becoming increasingly important. The panel notices that there could be more attention for obligatory systems biology (which is an elective course), fundamental immunology and microbiology in the specialization. On the other hand, the panel is very positive about the content of the Neuroscience specialization. The courses give students a coherent and future-oriented foundation in this discipline at a high level.

The Functional Genomics specialization is recently restructured and renamed as Medical Epigenomics. The panel has studied the new courses and is very pleased with the substantial attention for developments in line with New Biology. Systems biology, big data and interdisciplinary research are addressed. In its new outline the specialisation is well oriented towards the future academic work field. The panel also observed that the new content brings more coherence in the specialization.

Based on its analysis of the curricula, the panel members' opinions on data handling in the reviewed theses and following the discussion with students, the panel strongly advises the inclusion of an advanced statistics course in all specializations in Medical Biology. In most research projects students need to use statistical techniques that they did not learn adequately in the bachelor's programme or have been trained insufficiently to apply it later in the master projects.

Both programmes

The research internships form the core of the master's programmes. The panel has observed that students are well integrated in the research groups during their research projects. During their projects, students participate in group activities such as literature discussions, work discussions and lectures by guest researchers. Students present and critically discuss their work in the research group. According to the panel the diversity of the research domains in Nijmegen offers students a stimulating and attractive learning environment.

All master specialisations include portfolio assignments that address personal academic development. This includes a master's plan, a curriculum vitae, analysis of job vacancies, writing job application letters and performing a personal SWOT analysis. The portfolio assignments are spread over the two years of the master's programmes.

The panel appreciates that the programmes make students reflect on their personal development and career options. However, from its conversation with students, the panel concluded that in its current form, the portfolio does not fulfil its objectives. Students point out that they perceive most of the assignments as laborious, they do not get much feedback and it does not play a role in their career orientation. Students who enrolled in the elective

course Career Guidance are very enthusiastic about it and they find that this course does effectively address the objectives that the portfolio currently fails to reach.

As mentioned in Standard 1, students may also choose a society-oriented specialisation. These offer specialised courses that orient on either industry, management & innovation (SMI), society & government (SiS), or education (SE).

The difference between the research specialisations and the specialisations SiS and SMI becomes clear in the second year of the master's programme. These specialisations are organised by the Faculty of Science. Students who have chosen a SiS or SMI specialisation, take a specific set of courses and conduct a project that is relevant for the chosen specialisation.

The SMI specialization trains students to apply science to a societal theme. The courses are aimed at working in the private as well as in the public and non-profit sector. Students take 30 EC of courses in innovation management and policy making as well as theme courses on either 'Climate and Energy' or 'Health'. Their final research project should be on an SMI relevant topic.

SiS students are trained in acting as an intermediary between science and society, in science communication, interdisciplinary research and in science journalism. The 30 EC courses provide them with a broader societal perspective on the natural sciences. In the final research project they apply this perspective to a SiS relevant topic.

The panel perceived that both of the society-oriented specializations have a well-structured curriculum. From its conversations with teaching staff it concluded that the course content is applied to specific themes and cases within the field of natural sciences. Students are enthusiastic about these specializations, they appreciate the opportunity to obtain knowledge and skills relevant for a career outside the university.

The SE specialisation is assessed separately and is beyond the scope of this assessment panel. However, the panel appreciates the responsibility taken by the programme by incorporating educational professionalization into the curriculum and advises the programme to safeguard a research component in this specialisation. Good biology teachers in high school are essential for the success of academic biology programmes.

Teaching methods

The teaching concept of the master's programmes in Nijmegen is based on three pillars:

1. Aim to teach the student knowledge insights and skills in either biology or medical biology.
2. Require from students that they can fathom out (medical) biological subjects at an academic master's level.
3. Teach the student to transfer their knowledge to their peers as well as to the general public.

The programmes offer several teaching formats: lectures, self-study, feedback lectures, discussions, preparation of essays and presentations and group assignments. Internships are the crucial practical components of the programmes. These are offered in the form of a 'Master-apprentice' relationship with the supervisor. During the internship students actively participate in research or project work related to their specialisation, and acquire new knowledge and skills under supervision and through discussion with their supervisor.

The panel concludes that the programmes offer adequate and various teaching formats. It has observed that the teaching formats in the courses prepare students well for their research. Within the C&E specialization of the master's programme Biology, students get acquainted with experimental research by a fair amount of field work.

Feasibility

The percentage of students that obtained their degree within three years varies between 36 in 2007 and 74 in 2010 for Biology, and between 81 in 2006 and 60 in 2011 for Medical Biology. Both programmes have tried to improve their success rates by implementing an orientation course and portfolio activities in the curriculum. These orientation courses and portfolio activities should prepare students for a well-considered choice for one of the specialisations. The panel concludes that the efficiency of the programmes is in line with national performance rates. It has established that the orientation courses are adequate instruments to stimulate students to make motivated choices in their programmes. The panel observed that study guidance from staff members and the study advisor functions well.

Students perceive the programmes as intensive but feasible. As mentioned earlier, students from the Radboud University bachelor's programme Biology perceive some overlap with their bachelor's training in specialization-specific core courses. Most of the study delays are caused by not finishing the research projects in time. Students explain that in most cases this is a conscious choice in order to be able to finalize all aspects of their project, but sometimes supervisors could help them stick to deadlines and delimit the work. In some cases, limited availability of equipment or internship positions cause delays for students. Especially in the master's programme Medical Biology students sometimes need to extend the duration of their studies because it takes time to obtain a research internship.

Staff

Education in the master's programme in Biology is largely provided by the scientific staff of the research institutes *Institute for Water and Wetland Research (IWWR)*, *Radboud Institute for Molecular Life Sciences (RIMLS)* and *Donders Centre for Neuroscience (DCN)*. In the master's programme Medical Biology, staff members from the Faculty of Medical Sciences and the Radboudumc are involved as well. About half of the teaching staff has a BKO/UKO teaching qualification and others are in the process of obtaining it. According to the panel there is complementary and sufficient expertise present to take care of the curricula. From the interviews with students and staff members, the panel concludes that the current staff teaches with great commitment.

The staff-student ratio for the bachelor's and master's programmes combined is 1:32. According to the panel, this ratio is too high. It is unlikely that student numbers will drop in the near future. Therefore, the panel highly recommends that the Faculty Board invests in an enlargement of the staff.

Programme specific quality assurance and facilities

The panel has spoken with the Programme Committee (PC) Biology during the site visit. The conversation revealed that the PC is very involved in the master's programmes. It monitors the quality of education through course evaluations. In addition, the panel notes that the PC also plays a proactive role in the development of the programmes. During the visit several examples have been discussed of initiatives that the PC has taken to improve the programmes or the student support. For example, the PC has advised the programmes about the introduction of course files. The panel is very pleased about this task view of the PC.

During the visit, the panel had a tour along a part of the education facilities. The panel was impressed by the good laboratory facilities and observed that there were good facilities for both the courses and the research internships.

Considerations

The panel has studied the master's programmes Biology and Medical Biology and established that the curricula of the different research specializations offer students adequate opportunities for academic specialisation. Both programmes are structured in a balanced combination of orientation courses, compulsory courses, electives and research projects. Being a member of the research group, students are well guided while developing themselves as independent researcher.

The panel established that in both programmes students would benefit from an advanced statistics course. In the master's programme Biology, there should be more attention for systems biology. This programme could also be improved by adding a course that provides students with an overview of advanced research topics in Biology.

The content of most research specializations in Medical Biology is of high quality. They are based in good to excellent research groups and facilities. Especially the Neuroscience specialization and the new curriculum of the Medical Epigenomics specialization give students specialised knowledge in a dynamic, future oriented research field. These specializations demonstrate major attention for developments in New Biology. The panel recommends the programme to make systems biology a compulsory part of all specializations.

The three society-oriented specialisations provide students with a good orientation on applied sciences. They obtain complementary knowledge and skills that enable them to use their biological knowledge in business, policy, science communication or education environments.

The programmes use a variety of teaching methods: lectures, case studies, field work, group assignments and individual research projects. According to the panel these are adequate didactic practices for master's programmes.

The panel established that the programmes are feasible. For Medical Biology, the availability of sufficient academic research internships is a point of attention. Coherence and feasibility of individual trajectories are monitored in portfolio activities. Although the panel considers the portfolio to be a valuable tool, it concludes that current practice does not provide much added value to the personal and academic growth of students.

The programmes are delivered by qualified and highly motivated staff members. According to the panel the student-staff ratio is too high and needs further investment. The Programme Committee plays a proactive role in the quality assurance of the programmes.

Conclusion

Master's programme Biology: the panel assesses Standard 2 as **satisfactory**.

Master's programme Medical Biology: the panel assesses Standard 2 as **good**.

Standard 3: Assessment

The programme has an adequate assessment system in place.

Explanation:

The tests and assessments are valid, reliable and transparent to the students. The programme's examining board safeguards the quality of the interim and final tests administered.

Findings

Assessment

An assessment policy has been put in place to establish the methods of testing and assessment of both master's programmes. This is based on the 'RU Plan van Aanpak Toetsing en Beoordeling' (2013) (RU Action Plan Assessment and Evaluation) and Faculty guidelines for examinations. The assessment policy holds a vision which clarifies the way the assessment matches students' learning abilities. An assessment plan was drawn up for the programmes as a whole, in which the relationship between the final requirements and individual courses and assessments is shown. The organisation procedures of preliminary and final exams are described in the Education and Examination Regulations.

Examiners are primarily responsible for the quality and level of exams in Nijmegen. Therefore, in BKO education, extra attention is given to the quality of assessment. Teachers are expected to incorporate the exam, the evaluation criteria, the weighting, and an assessment-matrix in the course file. There is also a collegial check of each exam. Approximately 70 per cent of the compulsory courses consist of a written exam with mainly open questions. Over a quarter of the courses is (also) tested with a report. The panel studied the assessment plan and a number of exams and has established that the selected exams are of sufficient quality. The exams and the assessment forms also match the learning objectives of the courses.

The master thesis is examined independently with standard assessment forms by two staff members. The panel observed in the assessment forms of the reports that it studied that this procedure has not always been followed.

Based on its findings that in the past there have been incidents in which research projects did not allow students to show their achieved learning outcomes at an adequate level (see Standard 4), the panel strongly advises the programmes to install an additional control procedure to ensure the quality of internships on beforehand. The panel considers it necessary that at the beginning of the internship, students make a research plan that should be evaluated by a supervisor or, preferably, by the research group concerned. This supervisor should judge whether the internship has an adequate academic level and the planning is realistic and feasible, both content-wise and time-wise.

Board of Examiners

The Board of Examiners (BoE) is ultimately responsible for the quality of testing and assessment. The responsibilities of the Director of Education, the BoE and the Programme Committee/PC are documented in the Faculty Guidelines. According to the critical reflection, specific tasks of the BoE regarding the programmes are:

- Randomly reviewing documentation regarding the assessment, the completeness of the course file and the rating of the validity of testing and reliability of rating;
- An annual sample of 10% regarding the quality of testing and assessment of the final papers;
- Ensuring the quality of testing and assessment by an assessment of 25% of the exams per year. This is performed with the help of a checklist of the BoE.

The BoE has delegated these activities to an Assessment Committee. This committee consists of four members, including an assessment expert. As of spring 2015, the Assessment Committee has started a new procedure to fulfil the tasks described above. The Assessment Committee meets four times a year: twice to check final papers and twice to check exams. It reports its findings to the daily management of the BoE. The BoE reports the findings of the Assessment Committee to the Director of Education, the PC and the teacher (s) whom it concerns.

For the quality of assessment of the courses TWM students take at the University of Duisburg-Essen, the panel relies on 'ASIIN Akkreditierungsbericht' (2010) of this university, that includes the TWM programme.

The assessment and the achieved learning outcomes of the programme are ensured by the previously described measures. On an individual level, the quality of assessment and the final requirements are monitored by the members of the BoE since they assess and approve each students' range of courses. During the interview, the BoE stressed that it will be necessary to also look at the curricular objectives in the programme, in order to further secure the final requirements.

The panel concludes that with the support of the Assessment Committee, the BoE has taken adequate measures to ensure the assessment quality and the realisation of the programmes' learning outcomes. The panel concludes from the description in the critical reflection and from the interview with the BoE that its legal tasks and responsibilities are carefully elaborated in procedures and documents. The BoE demonstrates a vision for the necessary next steps that it will take in the near future. The panel is under the impression that many of the measures have been taken quite recently (e.g. sampling assessment documentation, use of the assessment forms for internships) and that the teaching staff needs time to incorporate these measures as a routine in its teaching practice.

Considerations

The panel has checked whether the programmes have adopted an adequate assessment system. The panel has established that the programmes use diverse assessment methods that are aligned with the learning objectives of each course. The panel is convinced that the programmes, and particularly the Board of Examiners and their Assessment Committee, have installed adequate measures to monitor assessment quality. Safeguarding the quality of final research projects gets attention from examiners and the Board of Examiners. The panel considers an additional procedure to be necessary at the start of those projects in order to safeguard the academic quality and feasibility of research internships.

The Board of Examiners has a proactive attitude. The panel observed that many of the measures are taken quite recently. It will take some time to make these procedures a routine for the teaching staff. Furthermore, concerted consultation of teachers about assessment should be encouraged.

Conclusion

Master's programme Biology: the panel assesses Standard 3 as **satisfactory**.

Master's programme Medical Biology: the panel assesses Standard 3 as **satisfactory**.

Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Explanation:

The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes.

Findings

The final research internship illustrates the level achieved in the master's programmes. Prior to the site visit, the assessment panel has selected and studied fourteen final reports of the master's programme Biology and fourteen final reports of the master's programme Medical Biology. The selection procedure is described in the paragraph 'Working method of the assessment panel', at page 6 in this report.

Biology

The panel has observed that the final reports generally demonstrate an adequate level and in some cases even an excellent level. However, the panel has identified four cases that for different reasons showed a number of shortcomings. Of these four theses, two did not reflect a satisfactory academic level.

In those two cases, the internships did not offer enough opportunities to perform in-depth academic research. Consequently, the reports do not reflect a satisfactory academic master's level. Both internships were taken at the same external research institute. The panel has discussed those cases with the examiners and with the BoE. They recognized this shortcoming and had already identified this and convinced the panel that appropriate measures have been taken to prevent this situation in future.

The third report demonstrated very poor English language skills with a 4 as a grade. Still, the resulting final grade was a 6 due to the good experimental work. The supervisor of this student explained that this was an exceptional case of a dyslectic student who initially did not write a report, even after a lot of support was offered. Years after his research he wrote the report, in order to obtain his degree. The examiners decided to grade it with a 4. The panel has been reassured that the current assessment procedures do not allow compensation of unsatisfactory reports by good experimental work anymore.

The fourth case was a report of acceptable quality that was highly overrated according to the panel. The over-enthusiasm of the American supervisor had not been redressed by the responsible examiner in Nijmegen. The panel emphasizes that internal examiners must have the final saying, thereby safeguarding reasonable and comparable grading among students.

The panel has studied ten more final reports in order to check whether these problematic cases were incidents or indications for a more structural issue. These reports show a satisfactory academic level. The panel concludes that of the 25 reports it studied, in 23 cases the academic quality was beyond doubt. Combined with the explanations of the examiners, the fact that none of the cases were very recent and that in three cases proper measures had already been taken, the panel concludes that the achieved learning outcomes as shown by the final reports as a whole are acceptable.

Medical Biology

The panel has observed that the final products generally demonstrate an adequate level and in some cases even an excellent level. The grades of the final products given by the examiners generally match the grades of the panel. The panel observed that some reports clearly

suggested that the internship-assignment was not at a truly academic level, these cases being mainly based in the Radboudumc. The panel concludes that, as mentioned earlier in this report, it is necessary to install better procedures to safeguard the academic character of research internships. In general, the panel established that the achieved level of the students as shown by the reports is adequate.

Both programmes

In 2012 and 2013, there were 6 out of 69 Biology graduates and 5 out of 72 Medical Biology graduates, who were awarded the *judicium cum-laude*. The critical reflection contains a list of students who contributed to research publications as author or co-author. The panel observed that this is not an exception.

The level achieved by graduates is also demonstrated by their performance upon graduation. 15 per cent of Biology graduates and 39 per cent of Medical Biology graduates have taken a position as a PhD. The panel considers this percentage for the Biology graduates as being rather low compared to other Dutch universities. According to a NIBI monitor, one year after graduation 25% of the alumni are employed at a university and 33 per cent work in education. Other graduates get jobs in industry, commerce or transport, in communication, in government and in health care. Alumni in Medical Biology also find jobs at research institutes and hospitals (about 24 per cent).

During the site visit, the panel had a conversation with a number of alumni of both programmes. They appear to be very satisfied with their education. Alumni in a research career as well as alumni in a business or educational career are satisfied with the level of the programmes and how these prepared them for a job as a young professional. The panel concludes that the master's programmes are a good preparation for the start of an academic or professional career.

Considerations

After studying a sample of final reports, the panel establishes that students realise the intended learning outcomes of the master's programmes in Biology and Medical Biology. Although some final reports of the Biology programme did not demonstrate an adequate academic level, the panel concludes that these were exceptional cases and that adequate measures have been taken to prevent these incidents in the future. Based on the performance of alumni the panel concludes that the programme prepares students well for an academic or business position on the labour market.

Conclusion

Master's programme Biology: the panel assesses Standard 4 as **satisfactory**

Master's programme Medical Biology: the panel assesses Standard 4 as **satisfactory**

General conclusion

In line with the NVAO decision rules for limited programme assessments, the panel assesses the quality of both programmes as satisfactory.

Conclusion

The panel assesses the *master's programme Biology* as **satisfactory**.

The panel assesses the *master's programme Medical Biology* as **satisfactory**.

Appendices

Appendix 1: Curricula Vitae of the members of the assessment panel

Prof. dr. J.W. (Jan) Kijne is Professor emeritus of BioScience at Leiden University. He studied Biology in Leiden and obtained his PhD in 1979 under supervision of Prof. Ton Quispel. In his dissertation Kijne studied the symbiotic nitrogen-fixing root nodules of the pea, a theme which remained a main focus in his further research. He was Professor of Fytotechnology (in collaboration with TNO, 1994-1997), Plant Physiology (1997-2006) and BioScience (2006-2010) in Leiden, and visiting Professor of Microbiology at the University of Tromsø, Norway (1995-2000). At Leiden University Kijne also acted as programme director Biology (1996-2002), as vice-dean of the Faculty of Science holding the Education Portfolio (2002-2008), and as Academic Director of the Pre-University College (2004-2008). In 2009-2010, Kijne was chair of the panel that assessed nineteen programmes in Biology at five Dutch universities.

Prof. dr. A.H.J. (Ton) Bisseling is Full Professor and head of the Laboratory of Molecular Biology at Wageningen University. He studied Biology in Nijmegen and obtained his PhD at the Department of Molecular Biology of Wageningen University. After holding a number of scientific positions there, he was appointed to his current chair of Molecular Biology in 1998. Bisseling is member of numerous Editorial Boards of international journals, including *Plant Biology* and *Science*. Bisseling is member of the Royal Netherlands Academy of Arts and Sciences, and member of its Council for Earth and Life Sciences.

Prof. dr. S.M. (Marieke) van Ham is Professor of Biological Immunology at the University of Amsterdam and Head of the Department of Immunopathology at Sanquin Blood Supply, Amsterdam. She studied Medical Biology at the University of Amsterdam, where she subsequently obtained a PhD for her research on bacterial vaccine components. After a number of scientific positions at the Imperial Cancer Research Fund in London, the Netherlands Cancer Institute in Amsterdam and VU University Medical Center Amsterdam, she joined Sanquin in 2003. In 2005 she was appointed Head of the Department of Immunopathology, with a staff of about 60 people. She occupies her current chair in Biological Immunology at the University of Amsterdam since 2010. In that capacity, she designs and coordinates immunology curricula for the bachelor's and master's programmes Biomedical Sciences.

Prof. dr. M.J. (Joost) Teixeira de Mattos is Professor of Quantitative Microbial Physiology at the University of Amsterdam and co-founder of Photanol BV. Teixeira de Mattos studied Chemistry at the University of Amsterdam, and obtained his PhD in Chemistry there in 1984. He has held a number of scientific positions before being appointed as Full Professor in 2007. Throughout his career, Teixeira de Mattos has been actively involved in education, teaching subjects in biochemistry, microbiology and biotechnology in programmes ranging from Chemistry to Computer Science. He received the Dupont Award for Higher Education, was chosen by students as Teacher of the Year in Chemistry (twice) and in Biology. Teixeira de Mattos has also been member of the Education Advisory Boards in Chemistry and Biology/Biotechnology and of the Boards of Examiners in Chemistry and Life Sciences.

Prof. dr. H.A. (Herman) Verhoef is Professor emeritus of Soil Ecology at VU University Amsterdam. He holds a master's grade and a PhD in Biology, both obtained at VU University, where he was appointed as Associate Professor Animal Ecophysiology in 1986. In 1992, he changed to an Associate Professorship in Soil Ecology, and was subsequently appointed as Full Professor in this specialisation in 2003. Next to his academic career, Verhoef has held a number of social positions at VU University, chairing the Advisory Board on Higher Education HOVO and the Advisory Board on Internationalisation, and acting as auditing member of several Faculty Audits.

J. (Jeffrey) Verhoeff BSc. is master's student Biology and Animal Sciences at Wageningen University. In 2013, he obtained his bachelor's degree in Biology, also at Wageningen University. Verhoeff has been member of the Dutch national council of Biology students (Landelijk Overleg Biologie Studenten, LOBS) since 2013, and acts as its chair since 2015. He is member of the Board of the Dutch Institute for Biology (Nederlands Instituut voor Biologie, NIBI). Since 2012, Verhoeff has worked as student-assistant at Wageningen University, acting as teaching assistant in a number of courses and as co-organizer of Open Days for prospective students.

Appendix 2: Domain-specific framework of reference

Domain-specific framework of the masters' programme in Biology

The domain of biology concerns life and its environment: the complete integrated system of biological entities in which regulation, interaction, communication, heredity and evolution are the central concepts. The coherence and dynamics of all these entities, therefore, should be the central themes in every Biology programme. Recently (or the last two decades), biological sciences have experienced tempestuous (booming) developments that have led to a more profound understanding of the dynamics of life and the structural and functional mechanisms that lie at its basis. In this process, integration with other disciplines such as mathematics, physics, chemistry, informatics, and earth sciences has shown to be crucial. Moreover, biology has become an integral science indispensable in the practice of resolving societal issues such as sustainable food production, conservation of biodiversity and the development of "green energy" resources. Biology in the Netherlands plays a key role in the preservation and further reinforcement of the strong international position of the top sectors.

The rapid development of the biological sciences and the plethora of positions for which biologists are required, force biological educational programmes to prepare students for jobs in fundamental research, applied research and technology, communication and policy; both in biology as well as in adjacent scientific fields. More than ever, biology demands the competence to deal with the dynamics and complexity at various levels of organization, such as molecules, cells, organisms, populations, communities and ecosystems. Furthermore, students need to achieve excellent academic skills in scientific writing, oral presentation, critical reading of scientific literature, self-reflection and teamwork.

The MSc Biology covers a two-year programme, offering a deepening of knowledge in one or more biological sub disciplines in the fields of research, policy, management, communication or teaching. In each of these specialisations at least one research component is incorporated. After completion of the masters' programme, students are well equipped to follow a biologically oriented PhD trajectory or to obtain other positions of academic level related to biology.

Demands of (international) colleagues and the professional environment

Biological master programmes have a long and world-wide tradition as a central discipline. In the course of time, attention has shifted from capitalizing factual knowledge in mono-disciplines to the integration of the levels of organization and disciplines. The masters' programme aims to provide students with knowledge and skills in their specific domain and with general academic competences that will enable them to perform in an excellent manner in a broad range of professional environments. Students should be able to explain and reflect on his or her choice for a specialized PhD trajectory, or for another position at the labour market within the area of policy/administration, management, education or communication.

The institutions offering a biologically oriented MSc in the Netherlands participate in the 'Overlegorgaan Hoger Onderwijs Biologie' (Consultative Body of Higher Educational Teaching in Biology). Students are allowed to take courses within the elective part of their master programme from other Dutch biology masters' programmes. Dutch masters' programmes in biology have a good international reputation. Students with a Dutch masters' diploma can enter into all relevant international biologically oriented PhD positions.

What can be expected from a MSc Biology?

1. Knowledge and research skills

The graduate:

- a) is able to make use of the conceptual framework of the discipline in which he/she has specialized in order to explain the state of the art of developing theories and to identify the most important research issues;
- b) can systematically solve scientific problems within the context of relevant biological fields;
- c) can develop, apply and optimize research techniques in biological research;
- d) can independently formulate, initiate and execute a biological research project and analyse and interpret the results.

2. Academic and learning skills

The graduate:

- a) can report orally and in writing on the field of study for a specialist and a general audience;
- b) is able to critically reflect on the performance of him/herself and others in the professional context and to evaluate the societal and ethical consequences of biological research;
- c) can communicate effectively within the chosen field of specialisation.

Appendix 3: Intended learning outcomes

Both programmes:

Professional competences

P1

Capable, based on broad and up-to-date knowledge of biological and/or biomedical processes, in combination with specialist knowledge (theories, methods, techniques) and research experience in at least one sub-area of this field, of setting up and conducting research aimed at acquiring new knowledge and insight in this research area

P2

Capable of formulating new questions and hypotheses in the biological/ biomedical field, and familiar with the research methods and state-of-the-art techniques to solve them, taking into account available equipment and resources

P3

Capable of setting up and conducting scientific experiments in an independent manner, including the related controls, of using models and theories to explain the results, and of evaluating the results in terms of well-founded scientific conclusions

P4

Capable of independently identifying, critically reading and comprehending relevant, up-to-date international literature from different disciplines, of discriminating essential from non-essential information, and of integrating new information in his overall view on nature

P5

Capable of using concepts from different organization levels in biology, in combination with those from physics, chemistry and mathematics, to solve a complex biological/ biomedical problem at a specific abstraction level

P6

Capable of writing down the results of a research project in the form of a master thesis, in accordance with the standards of an academic article

P7

Capable of independent professional practice whereby, depending on the chosen variant, the emphasis is put on conducting fundamental scientific research (under supervision), or on transferring or applying existing scientific knowledge, thereby taking into account his own competences

General Academic Competences

A1

Capable of asking adequate questions with a critical and constructive attitude towards analysis and resolving of complex biological and/or biomedical problems

A2

Capable of defending his view and of critically evaluating other views in a scientific discussion

A3

Capable of presenting and discussing the results of a research project in the form of an oral presentation for experts and colleague students

A4

Capable of working in or leading a project team, including the making of plans, the distribution of tasks, the integration of sub-projects and the joint evaluation of results

A5

Capable of integrating ethical aspects in his professional practice, along with the ability to reflect on the potential implications for society

A6

Capable, through self-reflection and conversations with others, of assessing his own performance and possibilities on the labor market

Specific competences of biological/ biomedical master students in the RESEARCH-specialization**R1**

Capable, based on specialized knowledge and research experience in two distinct sub-areas of biological/ biomedical sciences, of setting up and performing experiments in an independent manner, including the design of appropriate checks and evaluation of the results in a given time frame.

R2

Capable of writing down the results of a research project according to the exact format of a scientific journal.

R3

Capable of writing a research proposal according to the criteria of external scientific organizations.

R4

Capable of starting up a PhD research project within his biological/ biomedical field of expertise.

Specific competences of biological/ biomedical master students in the SMI-specialization**M1**

Graduates have gained deep knowledge on their theme, based on, on the one hand, connections made between their own science discipline and other science disciplines, and, on the other, approaches from fields that study society, politics and policy, economics and companies (remember/understand).

M2

With this knowledge, they can analyse specific problems within their theme, are able to name a range of approaches to address the problem, and argue for and select feasible options, taking into account the full width of technological, societal, political and economic perspectives (understand/analyse).

M3

The students are proficient in the use of methods and techniques, including basic financial and economic ones, to substantiate strategies and plans, and are able to effectively use a wide variety of information and communication channels (apply/evaluate).

M4

The students can balance perspectives and interests in the specific context of a company, governmental organisation or international organisation, or in configurations of those and other actors, in order to formulate feasible strategies and plans to implement options to address their thematic challenges (evaluate/create).

M5

The students are capable of clearly communicating their insights and choices to others, both in written and in spoken form (communicate).

M6

The students are capable of working in multidisciplinary teams; they know how to divide tasks based on knowledge and competencies and how to take responsibility, and they respect diverging views.

Specific competences of biological/ biomedical master students in the SIS-specialization

S1

Capable of analysing the role of scientific expertise in societal and political decision making with regard to socio-scientific issues

S2

Capable of designing and conducting independent and methodologically sound social research at the interface of science and society and capable of contributing to academic research

S3

Capable of understanding and designing public and stakeholder participation processes in research and innovation

S4

Capable of analysing, improving and evaluating interdisciplinary collaborations with multiple stakeholders, integrating different perceptions, interests and types of knowledge (experiential, professional and scientific)

S5: Capable of substantiating and communicating the relevance of one's scientific discipline in society

Appendix 4: Overview of the curriculum

Structure of the Master's programmes Biology and Medical Biology

Programme component	Study load	
	Research specialisation	SMI and SiS
Compulsory Master courses	15 ec	15 ec
Research Internship + scientific report	36 ec ¹	33 ec ¹
Literature thesis or field course ²	6 ec	6 ec
Philosophy	3 ec	3 ec
Elective Biology/Medical biology courses	3 ec	3 ec
Research internship + scientific report	36 ec	
2 nd Literature thesis	6 ec	
Compulsory & elective SMI/SiS courses		27 ec
SMI/SiS project		30 ec
Free elective education ³	15 ec	3 ec
Portfolio	Integrated into the programme	Integrated into the programme

¹ Study load of first internship for students in SE 30 ec. Students in the option Transnational ecosystem-based Water Management (research specialisation Water and Environment) follow courses (30 ec) in Germany instead of this internship.

² Option to follow a field course only for Biology students; for students in Neuroscience specialisation this thesis is embedded in the course "Systematic Reviews in Neuroscience".

³ Free elective education can be taken by expanding one of the research internships or by following specialisation-specific courses. The student can freely fill in a maximum of 6 ec as long as the quality of the programme is of a measurable academic level. A number of more general courses is organised by the Faculty of Science and is optional to all Master students. Among these are: Laboratory Animal Sciences, Working with Radionuclides Level 5B, "Beroepsoriëntatie" (Career orientation), Scientific English for Master Students, Research Skills and Project Management.

Outline of the first year of the curriculum Biology

	Adaptive organisms	Communities and Ecosystems	Water and Environment	
				TWM
Week	Quarter 1			
1-2	Orientation in Biology and Environmental Sciences			
3-4	Quantitative Conservation Biology		Ecological and Environmental Concepts	
5-6	Advanced Adaptation Physiology	Management of Ecosystems		
7-8	Microbiology of Wetland Ecosystems	Microbiology of Wetland Ecosystems <i>or</i> Biodiversity and Ecological Assessment	Biodiversity and Ecological Assessment	
9-10	Molecular Physiology of Plant Stress Adaption	Environmental and Ecological Modelling		
	Quarter 2			
1-10	Research internship / literature thesis		Integrated Water Management	
	The following optional course is scheduled on Fridays: Vegetation monographs		Social Aspects of Water Management	
			Environmental Economics for Water Management	
			Water Governance and Spatial Planning	
	Quarter 3			
	Research internship / literature thesis		Courses at University Duisburg/Essen	
	The following optional courses are scheduled on Fridays: Population Ecology European Vegetation Estuarine Ecology Ecology and Management of Large Rivers			
	Quarter 4			
1-10	Research internship / literature thesis		Courses at University Duisburg/Essen	
	Field courses are scheduled in June/July: Alpine Ecology / Ireland			

Outline of the first year of the curriculum Medical Biology

	Clinical Biology	Functional Genomics	Neuroscience
Week	Quarter 1		
1-2	Trends in Medical Biosciences		
3-4	Molecular and Translational Oncology		Systems Neuroscience
5-6	Human Genetics	Molecular Mechanisms of Novel Therapeutics	Behavioural Neuroscience
7-8	Metabolism, Transport and Motility	Molecular and Cellular Neurobiology	
9-10	Trends in Medical Biosciences II		
	Quarter 2		
1-10	Research internship / literature thesis The following courses are scheduled on Fridays: Apoptosis Oncology		Compulsory course: Methods in Neuroscience (on Fridays)
	Quarter 3		
	Research internship / literature thesis The following courses are scheduled on Fridays: Cellular Imaging in Four Dimensions Principles of System Biology Neurogenomics of Speech, Language and Reading Disorders		Compulsory course: Systematic Reviews in Neuroscience (on Fridays)
	Quarter 4		
1-10	Research internship / literature thesis The following courses are scheduled on Fridays: Advanced Endocrinology Human Fertility Molecular Aspects of Host Defence, Tissue Destruction and Repair Chemical Discovery of Drugs and Design		Compulsory course: Systematic Reviews in Neuroscience (on Fridays)

Outline of the second year of the SMI specialisation.

Theme courses can be chosen in the themes “Climate and Energy” or “Health”.

Science, Management and Innovation				
Quarter 5				
Core theme course (6 ec)		Innovation Management (3 ec)	Policy & Economics (3 ec)	SMI elective (3 ec)
Quarter 6				
Theme course (3 ec)	Theme course (3 ec)	Entrepreneurship (3 ec)	Methods in Societal Research (3 ec)	General elective (3 ec)
Quarter 7 and 8				
SMI research project				

Outline of the second year of the SiS specialisation.

Science in Society				
Quarter 5				
Risk Communication (3 ec)	Science & Societal Interaction (3 ec)	Science & Media (3 ec)	SiS elective (6 ec)	
Quarter 6				
Framing Knowledge (3 ec)	Knowledge Society (3 ec)	Science & Public Policy (3 ec)	Methods of Societal Research (3 ec)	General elective (3 ec)
Quarter 7 and 8				
SiS graduation project				

Appendix 5: Programme of the site visit

Maandag 19 oktober		
11.00	14.00	Voorbereidend overleg en inzien documenten (incl. lunch)
14.00	14.45	Gesprek met inhoudelijk verantwoordelijken - Prof. dr. Gert Flik, onderwijsdirecteur - Dr. Juriaan Metz, opleidingscoördinator Bachelor Biologie - Dr. Wim Scheenen, opleidingscoördinator Master Medical Biology - Dr. Eric Visser, opleidingscoördinator Master Biology
14.45	15.00	Overleg panel
15.00	15.45	Gesprek met bachelorstudenten Biologie - Katarina Radisavljevic - Justin Visser - Constant Swinkels - Brechtje de Haas - Sabine de Man - Jos Smits - Sina Bohm - Nathalie Friese
15.45	16.45	Rondleiding practicumruimtes etc.
16.45	17.30	Gesprek met docenten bachelor Biologie - Peter Klaren - Wilco Verberk - Willem Halfman - Laura van Niftrik - Johan van der Vlag - Sharon Kolk - Hans de Kroon
17.30	18.00	Gesprek met alumni - Daisy van der Heijden - Koen Kole - Nicky Driedonks - Fortuné Elekonawo - Laury Loeffen - Jaap Sniekers
18.30	21.30	diner (voorbereiden tweede dag)
Dinsdag 20 oktober		
8.45	9.00	Aankomst panel
9.00	9.30	Inzien documenten, voorbereiden gesprekken, eventueel spreekuur
9.30	10.00	Gesprek met masterstudenten Biology - Jaqueline Hoppenreijts - Marloes van den Akker - Jannah Boerakker - Juan Bakker - Stijn Berger - Annelien van den Brink
10.00	10.30	Gesprek met masterstudenten Medical Biology - Jorie van Rosmalen - Roosmarijn Minnema - Pelle Hoek - Marloes Michels - Jesse Heckman - Vivianne Alewijns - Laura Miesen

10.30	10.45	Overleg panel
10.45	11.30	Gesprek met docenten masters Biology/Medical Biology - Richard van Wezel - Toine Smits - Sarian Kosten - Eelke Jongejans - Michiel Vermeulen - Helma Pluk - Heleen de Coninck - Riyan van den Born
11.30	12.00	Gesprek met leden van de Opleidingscommissie - Ivo Rieu - Rob Leuven - Colin Logie - Aiko Hendriks - Juul van Leersum - David de Jong
12.00	12.30	Lunch
12.30	13.15	Gesprek met leden van de Examencommissie - Joop van Zoelen - Janny Peters - Mark Huijbregts
13.15	13.45	Voorbereiding eindgesprek
13.45	14.30	Eindgesprek formeel verantwoordelijken - Prof. dr. Stan Gielen, decaan - Prof. dr. Lutgarde Buydens, vice-decaan onderwijs - Prof. dr. Gert Flik, onderwijsdirecteur - Dr. Juriaan Metz, opleidingscoördinator Bachelor Biologie - Dr. Wim Scheenen, opleidingscoördinator Master Medical Biology - Dr. Eric Visser, opleidingscoördinator Master Biology
14.30	17.15	Opstellen voorlopige bevindingen
17.15	17.30	Mondelinge rapportage voorlopig oordeel

Appendix 6: Theses and documents studied by the panel

Prior to the site visit, the panel studied the theses of the students with the following student numbers:

Master's programme Biology:

224375	617776	742082	845329	4172949*
437956	709689	753467	857815	4173996
528137	709913	814253	3013340	4247523
543209	710210	816760	3022552*	
606510	731439	837474	4019474	

Master's programme Medical Biology:

505846*	742104	3001474	4150325	
709751	816701	3011526	4163001	
721913	843199*	3025748		

For student numbers marked with a *, the panel studied two reports.

During the site visit, the panel studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- Annual Programme report 2012-2013 and 2013-2014, (including annual report of the Board of Examiners)
- Minutes and annual report of the Programme Committee 2013-2014
- Literature, course manual, exams and evaluation results of the following courses:
 - Master's programme Biology:*
 - Microbiology of Wetland Ecosystems
 - Biodiversity and Ecological Assessment
 - Environmental and Ecological Modelling
 - Integrated Water Management
 - Master's programme Medical Biology:*
 - Human Genetics
 - Systems Neuroscience
 - Principles of System Biology
 - Advanced Endocrinology
- ASIIN Akkreditierungsbericht' (2010) of the University of Duisburg-Essen, including the TWM programme
- RU Action Plan Assessment and Evaluation
- Assessment overviews of the programmes