

# **Biology**

**Faculty of Agricultural and Environmental Sciences,  
Wageningen University**

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This report was finalized on 4 December 2015



# Report on the bachelor's programme Biology and the master's programme Biology of Wageningen University

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point (19 December 2014).

## Administrative data regarding the programme

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### Bachelor's programme Biology

Name of the programme:	Biology
CROHO number:	56860
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specialisations or tracks:	Cell and Molecular Biology Organismal and Developmental Biology Human and Animal Health Biology Ecology and Biodiversity
Location(s):	Wageningen
Mode(s) of study:	full time
Language of instruction:	Dutch, English
Expiration of accreditation:	26-4-2017

### 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
Specialisations or tracks:	Animal Adaptation and Behavioural Biology Bio-interactions Molecular Ecology Conservation and Systems Ecology Evolution and Biodiversity Health and Disease Marine Biology Molecular Development and Gene Regulation Plant Adaptation
Location(s):	Wageningen
Mode(s) of study:	full time
Language of instruction:	English
Expiration of accreditation:	26-4-2017

The visit of the assessment panel Biology to the Faculty of Agricultural and Environmental Sciences of Wageningen University took place on 17-18 September 2015.

## **Administrative data regarding the institution**

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Name of the institution:	Wageningen University
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive; distinctive feature Internationalisation

## **Composition of the assessment panel**

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The NVAO has approved the composition of the panel on 22 June 2015. The panel that assessed the bachelor's and master's programmes Biology consisted of:

- Prof. dr. Jan Kijne (chair), Professor emeritus of BioScience, Leiden University;
- Prof. dr. Paul Hooykaas, Professor of Molecular Genetics, Leiden University;
- 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;
- Pieter Munster MSc. (student member), policy officer at Leiden University and graduate of the master's programme Cancer, Genomics & Developmental Biology, Utrecht University.

The panel was supported by dr. Kees-Jan van Klaveren, who acted as secretary.

Appendix 1 contains the curricula vitae of the panel members.

## **Working method of the assessment panel**

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The assessment of the bachelor's and master's programmes Biology of Wageningen 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 of 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, VU University 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. 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 Wageningen University. The time table for the visit in Wageningen 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 Wageningen University with the request to report any factual inaccuracies. The comments received from Wageningen University were discussed with the panel's chair. Subsequently, the final report was approved and sent to Wageningen University.

#### *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

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### Bachelor's programme Biology

The bachelor's programme Biology is a broadly oriented programme in biology, offering major specialisations in four fields: Cell & Molecular Biology, Organismal & Developmental Biology, Human & Animal Health Biology and Ecology & Biodiversity.

The panel has established that the intended learning outcomes of the bachelor's programme are in line with (inter)national requirements. The programme shows a clear multidisciplinary and broad profile within the field of the life sciences and has started to reflect on students' engagement with biology as the study of the complete integrated system of biological entities. The panel would welcome a future-directed view on the outcomes, recognizing the central role of understanding the living system within the multi/interdisciplinary area of the life sciences. The panel has identified a strong potential within the programme to develop a distinct profile combining fundamental and applied science.

The curriculum of the programme comprises four elements: a common part (102 EC), a major (30 EC), optional courses (36 EC), and the bachelor thesis (12 EC). The common part of the programme aims at providing students with the basic concepts of biology on a molecular, cellular, organismal, population and ecosystem level. Subsequently, students choose one of four majors meant to deepen their biological knowledge. For the optional courses, students can pick a set of free courses, or follow a minor. The bachelor thesis is a short predefined and structured research project carried out at one of the chair groups in the field of biology.

The panel has established that the bachelor's programme curriculum is well composed in the sense that it allows students to get a good grasp on the full breadth of biology and that it offers them a chance to study one of four themes more in-depth. Through its attention for practicals, the programme also succeeds in training its students in (research) skills, for example needed for the bachelor research project – although extra training in keeping up a lab journal would be preferable.

The panel is pleased with the used mix of teaching methods, performed in a way doing justice to the programme's ambition to offer small scale education. The teaching staff is regularly informed about new trends and innovations in teaching, and modern techniques such as streaming and recording lectures are used to the benefit of students. The programme has some well-qualified study advisors at its disposal, and has taken a number of measures to increase its success rates.

The programme is executed by a teaching staff with a very good to excellent research reputation, and the student-staff ratio is quite favourable. This allows the programme to hold on to small scale teaching methods, even with large cohorts of students. The panel encourages the management to continue their efforts to increase the number of lecturers holding a (senior) teaching qualification, which is still rather low. On the other hand, the panel is convinced that didactic aspects of education are taken seriously. The programme has high quality lab facilities at its disposal for education purposes.

The panel judges positively not only on the quality of the programme's assessment system, but also about the many efforts it has developed to implement new assessment techniques and to increase and control the overall quality of assessment. The involvement of peer review committees is a time-consuming but promising initiative that deserves the support necessary

to maximize efficiency and effect. The quality of assessment and achieved learning outcomes is well safeguarded, not only by a committed Board of Examiners, but also by a number of initiatives such as the ad hoc assessment committee and the team of bachelor thesis evaluators.

Based on the quality of their bachelor theses and their performance at master's level, the panel concludes that graduates of the *bachelor's programme* have demonstrated a good overall level of achieved learning outcomes. All selected theses were adequately graded.

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

*Bachelor's programme Biology*

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

### Master's programme Biology

The master's programme Biology aims to provide students with a broad overview of the latest developments in the academic field, ranging from genes to ecosystems. Students learn to critically discuss and reflect on current scientific developments. They broaden and deepen their knowledge and skills in one of nine specialisations: Animal Adaptation and Behavioural Biology, Bio-interactions, Molecular Ecology, Conservation and Systems Ecology, Evolution and Biodiversity, Health and Disease, Marine Biology, Molecular Development and Gene Regulation, and Plant Adaptation.

The panel has established that the intended learning outcomes of the master's programme are in line with (inter)national requirements. The programme shows a clear multidisciplinary and broad profile within the field of the life sciences and has started to reflect on students' engagement with biology as the study of the complete integrated system of biological entities. The panel would welcome a future-directed view on the outcomes, recognizing the central role of Biology in the multi/interdisciplinary area of the life sciences. The panel has identified a strong potential within the programme to develop a distinct profile combining fundamental and applied science.

The two-years English taught programme kicks off with the compulsory course *Frontiers in Biology*, intended to introduce students to the latest developments in the discipline. Students take two courses in one of nine specialisations and have another 30 EC to spend on either optional courses or a thesis. In the remaining 12 EC of the first year, students have a constrained choice. Students orienting on a PhD position can improve their skills in writing and defending a scientific research proposal in the Research Master Cluster, whilst students aiming for a job at MSc level upon graduation can join the Academic Consultancy Training and two Modular Skills Training courses. The second year consists of three elements. Students do an internship, write a master thesis proposal and complete their studies by writing a master thesis on a research project.

The panel has established that the programme adequately offers students a notable total of nine specialisations, further underpinned by a course offering insight into state-of-the-art research in the broad field of Biology and either the Academic Consultancy Training or the Research Master Cluster. The panel is positive about the fact that the master's programme also offers a compulsory internship, but feels that the programme does not yet benefit from its full potential to further develop the students' potential for applied science.

Apart from teaching methods that are well established for master's programmes in Biology, the programme has recently introduced the 'thesis ring', allowing students to peer review each other's work on their final research project. The panel regards this initiative as a good practice. The programme's success rates are quite acceptable, but have dropped over the past few years. Those rates may be improved if thesis supervisors would take further responsibility and stimulate students to finish their thesis in time.

The programme is executed by a teaching staff with a very good to excellent research reputation, and the student-staff ratio is quite favourable. This allows the programme to effectively execute research-based education. The panel encourages the management to continue their efforts to increase the number of lecturers holding a (senior) teaching qualification, which is still rather low. On the other hand, the panel is convinced that didactic aspects of education are taken seriously. The programme has high quality lab facilities at its disposal for education purposes.

The panel judges positively not only about the quality of the programme's assessment system, but also about the many efforts it has developed to implement new assessment techniques and to increase and control the overall quality of assessment. The involvement of peer review committees is a time-consuming but promising initiative that deserves the support necessary to maximize efficiency and effect. The quality of assessment and achieved learning outcomes is well safeguarded, not only by a committed Board of Examiners, but also by a number of initiatives such as the ad hoc assessment committee and the team of bachelor thesis evaluators.


All of the theses written by graduates of the master's programme the panel has studied demonstrate a high level of achieved learning outcomes. Furthermore, the panel concludes that master graduates are well appreciated on the job market, in as well as outside academia.

*Master's programme Biology*

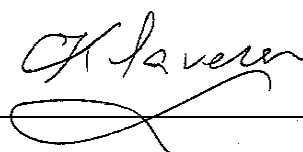
Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	good
Standard 3: Assessment	good
Standard 4: Achieved learning outcomes	good
General conclusion	good

The chair and the secretary of the panel hereby declare that all panel members 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: 4 December 2015



Prof. dr. Jan Kijne, chair



dr. Kees-Jan van Klaveren, secretary

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

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### *Organisation of the degree programmes*

Wageningen University consists of one faculty, the Faculty of Agricultural and Environmental Sciences. Technically, this implies that the university's Rector Magnificus is also Dean of the faculty. The faculty comprises about 90 chair groups, organised in five Science Groups. The degree programmes within the faculty – a total of 19 bachelor's and 26 master's programmes – are the prime responsibility of the Education Institute, in term of content, quality and finances. Its Board consists of four professors and four students and is the governing body of all degree programmes.

Each programme also has a Programme Director and a Programme Committee. In Wageningen, the Programme Committee provides an important contribution to the content and quality of the degree programme, advising the Board of the Education Institute. The Programme Director is responsible for the realisation of the programmes. Courses within the programmes are taught by staff from the chair groups. The Programme Director is in close contact with these chair groups on design, content and quality of the courses provided.

### **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 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-subdisciplines 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 Frameworks, 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 bachelor's or 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 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.

According to the critical reflection, the *bachelor's programme* Biology is a broad bachelor in the life sciences with a fundamental and multidisciplinary approach. It aims to equip students with a broad range of theoretical and practical skills, thus delivering basic academic professionals who can either enter a master's programme in biology or a related area, or find a starting position on the job market.

The programme has translated those aims into nine intended learning outcomes. In the critical reflection, a table was provided that relates those learning outcomes to the Dublin descriptors at bachelor level. The learning outcomes have also been reviewed by international peers, who concluded that the learning outcomes do reflect what may be expected of a bachelor graduate in the field of Biology. Finally, the aim and content of the Biology programmes are discussed with its professional field committee. For the bachelor's programme, this committee has emphasised the importance of multidisciplinary and basic experience with research.

In Wageningen, graduates of the bachelor's programme Biology have unconditional access to a total of six master's programmes. Although broadly oriented, the programme allows for some specialisation in one of four fields: Cell & Molecular Biology, Organismal & Developmental Biology, Human & Animal Health Biology and Ecology & Biodiversity.

The panel has studied the programme's intended learning outcomes and it has compared them to the Framework of Reference. It concludes that the intended learning outcomes cover all of the Framework's general requirements and therefore are also in line with the Dublin descriptors. During the site visit, the panel discussed the profiling of the bachelor's programme with programme management, staff and students. Recurring themes in those discussions were the hands-on mentality of Wageningen graduates, their ability to come up with concrete solutions for complex problems, and their strong analytical skills. The panel recognises the broadness and multidisciplinary approach of the programme within the spectrum of the life sciences, but it also identified the programme's dimension of applied science as a key potential. Research at Wageningen University has a strong reputation for social relevance which, according to the panel, could be better reflected in the programme's learning outcomes and be utilised throughout the curriculum. In other words, the panel stimulates Wageningen University to make its educational vision manifest in the learning outcomes.

The panel found that the programme management is well aware of New Biology and its implications for the composition of the bachelor's programme. It recognizes the importance not only to train students to think in different organisational levels, but also to enable them to think *through* the boundaries of those levels and to understand the quantitative aspects of system dynamics. A full implementation of New Biology, including quantitative dynamics, from the start of the curriculum would require a future revision. The programme is somewhat hesitant to do so as it is not convinced that starting students with limited prior knowledge are able to understand (the implications of) Biology as the study of the complete integrated system of biological entities, apart from organizational implications.

The *master's programme* Biology aims to provide students with a broad overview of the latest developments in the academic field, ranging from genes to ecosystems. Students learn to critically discuss and reflect on current scientific developments. Within their area of specialisation, students broaden and deepen their knowledge and skills.

The programme has translated those aims into ten intended learning outcomes. In the critical reflection, a table was provided that relates those learning outcomes to the Dublin descriptors at master level. The learning outcomes have been reviewed by international peers as well, concluding that the learning outcomes do reflect what can be expected of a master graduate in the field of Biology. As stated above, the aim and content of the Biology programmes are discussed with its professional field committee. For the master's programme, this committee emphasised the value of an analytical and multidisciplinary way of thinking, next to experience in conducting research.

The programme distinguishes nine specialisations:

- Animal Adaptation and Behavioural Biology
- Bio-interactions
- Molecular Ecology
- Conservation and Systems Ecology
- Evolution and Biodiversity
- Health and Disease
- Marine Biology
- Molecular Development and Gene Regulation
- Plant Adaptation

The panel established that the master's programme's intended learning outcomes adhere to the general requirements in the Framework of Reference and consequently to those of the Dublin descriptors. In line with its findings for the bachelor's programme, the panel confirms the multidisciplinary nature of the programme and its broad spectrum of specialisations, but it advises the programme to translate its social responsibility and its potential for applied science into clear learning outcomes.

### **Considerations**

The panel has established that the intended learning outcomes of both programmes are in line with (inter)national requirements. Both programmes show a clear multidisciplinary and broad profile within the field of the life sciences and have started to reflect on students' engagement with biology as the study of the complete integrated system of biological entities. The panel has identified a strong potential within both programmes to develop a distinct profile combining fundamental and applied science, in line with the mission of Wageningen University. It encourages the programmes to translate the typical identity of a Wageningen graduate into the learning outcomes.

### **Conclusion**

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

*Master's programme 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**

### *Design and coherence of the curricula*

The fulltime *bachelor's programme* consists of 180 EC, spread evenly over three years and comprising four elements: a common part (102 EC), a major (30 EC), optional courses (36 EC), and the bachelor thesis (12 EC). The common part of the programme aims at providing students with the basic concepts of biology on a molecular, cellular, organismal, population and ecosystem level. In order to understand those concepts, students also take courses in the underlying chemistry, mathematics, statistics, physics and modelling. Subsequently, students choose one of four majors (cf. Standard 1), aiming at deepening of their biological knowledge.

The common part and the following major together cover the first two years and 12 EC of the third year. The remaining two elements may be followed in interchangeable order. For the optional courses, students can pick a set of free courses, or follow one of 57 minors offered by Wageningen University. According to the critical reflection, students are also encouraged to follow courses at other Dutch or international universities. The optional courses-element needs to form a coherent learning pathway contributing to the programme's learning outcomes. Each individual study programme needs the approval of the Board of Examiners.

The final element of the bachelor's programme is the bachelor thesis, a short predefined and structured research project carried out at one of the 28 chair groups in the field of biology. Organisation and final assessment of the theses is performed by the Biology teaching staff. Students need to write and present their research plan, leading to investigating a biological question. They need to present the results of their research – either experimental research, data analysis or literature studies – both written and orally.

The panel has studied the bachelor curriculum and discussed its composition with programme management, students and teaching staff. It appreciates the fact that students are offered a good and rather complete introduction into the full scope of biology, whilst the major-minor structure also allows students to explore a theme of preference. The common curriculum also adequately prepares students for each of the four majors. In line with its recommendations under standard 1, the panel suggests that in the years to come it might consider to gradually replace the current model of subdisciplinary building blocks by a model introducing the systemic approach from the start.

Furthermore, the panel noticed that the programme has not explicitly formulated learning trajectories. Although the programme has added a table to the critical reflection report showing the interconnectedness of courses, and each individual study path based on choice of major and optional courses is checked for coherence by study advisor and Board of Examiners, especially the training in skills throughout the curriculum might be made more explicit. Most skills are incorporated adequately into the curriculum, but more practice in keeping a lab journal would be helpful for students, for example in writing their bachelor



thesis. Although the panel agrees that it is attractive for students to have a set of optional courses, it emphasizes that the study path chosen should not lead to omissions in the development of academic and research skills.

The fulltime English-taught *master's programme* consists of 120 EC, spread evenly over two years. It kicks off with the compulsory course *Frontiers in Biology* (6 EC), intended to introduce students to the latest developments in the discipline. After that, students take two courses in one of nine specialisations (12 EC; cf. Standard 1) and have another 30 EC to spend on either optional courses or a thesis. In the remaining 12 EC of the first year, students have a constrained choice. Students orientating on a PhD position can improve their skills in writing and defending a scientific research proposal in the Research Master Cluster, whilst students aiming for a job at MSc level upon graduation can join the Academic Consultancy Training and two out of twenty-one Modular Skills Training courses.

The second year consists of three elements. Students do an internship (24 EC), write a master thesis proposal (6 EC) and complete their studies by writing a master thesis on a research project (30 EC). The latter two have been combined into a 36 EC-thesis project from 2015-2016 onwards.

The panel has studied the curricula of the master's programme, while looking at a selection of courses in more detail. It concludes that the curricula allow for adequate specialization in one of the nine profiles offered by the programme. It was pleased with the *Frontiers in Biology* course, which not only acquaints students with the state of the art in research in a number of fields, but also shows the breadth and interdisciplinary skills of Biology students in Wageningen. The panel learned from teaching staff that students with a more mono-disciplinary background often dropped out of the course, as they were not able to adequately summarize research papers so far beyond their own specialisation.

According to the panel, the Internship should gain the prominent position in the curriculum suggested by the amount of EC's rewarded for it and should be considered a genuine end work. This programme component embodies the applied profile of the programme, next to the highly appreciated Academic Consultancy Training. Furthermore, given the high number of international internships, it contributes to the vision of Wageningen University on internationalisation. During the site visit, the panel has read a number of exemplary internship reports as well as some reports that could have benefitted from a stronger emphasis on the importance of the Internship in achieving the learning outcomes.

#### *Teaching methods*

In the *bachelor's programme*, teaching is organised based on small, diverse groups of students in order to stimulate interaction between students and lecturers. The programme makes use of a variety of learning methods, of which a relatively high percentage consists of (computer) practicals. The critical reflection states that practicals are important for students in order to acquire skills required for research. Furthermore, the programme offers tutorials, lectures, group work and field practicals. Most courses use a combination of teaching methods.

The panel appreciates the attention in the curriculum for practicals, and is of the opinion that the programme has developed an adequate mix of teaching methods. Particularly, it compliments the programme for its efforts to combine even the most massive lectures with small scale exercises, for example in the third year Genomics course. Rule of thumb is that in those smaller settings, the student-staff ratio is not higher than 10:1. Students informed the panel that various lectures are recorded, thus allowing students to refresh their memory later

on. The panel also learned that some staff members are adopting new teaching methods such as blended learning and flip-the-classroom, with didactic support from the Education Institute. The programme management encourages staff members to do so by organizing 'education days' on new teaching methods and other topics that may be of shared interest.

The *master's programme* also uses a variety of teaching methods, the most dominant of which is individual supervision (during internship, thesis proposal, and thesis research project). Students participate in practicals, take lectures and tutorials, and occasionally do group work. During research proposal and the thesis research project, students join the chair group of their supervisor.

The panel has studied the course overviews and concludes that the programme's learning methods are appropriate and in line with what may be expected of a master's programme Biology. As especially the progress during international internships is hard to monitor from a distance, the panel encourages the programme to make the local supervisor well aware of the programme's expectations on beforehand, and to keep track of good and bad experiences with hosting institutes and companies.

During the site visit, the panel learned about a recent new teaching method used during the final research projects: the 'thesis rings'. Those rings consist of master students performing a research project within the same chair group, supervised by one or more senior staff members. Master students will present their work to each other and perform peer-reviews of (lab) reports. Students and staff are quite positive about this new working method – as is the panel. It holds the opinion that practice in peer review is a valuable addition to the skills set of master students.

#### *Study load and feasibility*

The average number of contact hours throughout the curriculum of the *bachelor's programme* is estimated at 24 hours per week. The dropout rate in the first year is well below 20 percent since 2009, and was as low as 7 percent in 2011. Over the last few years, the programme's success rate after 4 years has raised from 42 per cent (of the cohort starting in 2006) to 73 percent (of the cohort starting in 2010). Over the last few years, a number of measures have been introduced. First, in September 2013 the 'harde knip' has been fully implemented, so that students can no longer enrol for master courses before graduating. Second, since 2014-2015 the bachelor's programme has a binding study advice (BSA), which requires students to obtain at least 36 EC in their first year.

During the first year of the bachelor's programme, students receive information about the Biology programme and Wageningen University at five lunch meetings with the study advisors. After this general introduction, small groups of students are invited to meet with their personal study advisor. Students who may risk receiving a negative BSA, or, in a later stage, are not on track to finish the bachelor's programme in four years, receive extra invitations for consultation with their study advisor.

The panel thinks that especially the BSA will turn out a useful instrument in promoting an active attitude amongst students. Moreover, the programme has developed a dedicated system of student counselling that might support them with any issues that might impede optimal performance. The small scale model of teaching and the approachability of staff are other positive factors in making the programme more feasible. Based on the course material it studied and discussions with students, the panel considers the study load firm but fair. Students nor panel identified any stumbling blocks in the curriculum.

The average number of contact hours throughout the curriculum of the *master's programme* is estimated at 13 hours per week. Not included in those numbers is the fulltime presence of students at their internship location during internships and at the chair group during their thesis proposal and thesis research project. Although the number of students per cohort has grown from 63 in 2009 to 93 in 2014 (with a peak of 104 in 2012), dropout rates have remained low at 2 to 7 percent. The success rate after 3 years has dropped somewhat over the years, from >94 percent of the cohorts 2005-2008 to an average of about 85 percent of the cohorts 2009-2011.

The panel considers the master's programme's high success rates a strong indication of the feasibility of the curriculum. As a significant part of the curriculum takes place in (research) internships, the perceived study load may vary from student to student. However, students did not report any stumbling blocks and did not complain about the study load, even though especially the research projects are quite intensive. Although the current success rate of the programme is quite acceptable, the panel suggests it might increase if more students were to finish their master thesis in time. Although a thesis contract has been introduced, it still seems quite common practice for students to surpass deadlines. The panel feels that supervisors could do more to help students to restrict themselves to realistic research projects and to stick to deadlines.

#### *Staff*

In the critical reflection, separate overviews are provided of staff involved in the bachelor's programme and in the master's programme. The overviews show quite some personal overlap, although a few staff members are only assigned to either the bachelor's or the master's programme. Both programmes have favorable student-staff ratio's. The student-staff ratio of the bachelor's programme is 5:1, that of the master's programme 7:1. The vast majority of staff has obtained a PhD degree (85 and 90 per cent, respectively).

Numbers of lecturers that have acquired a teaching qualification are rather low. In both programmes, about one in five lecturers holds a teaching qualification (*Basiskwalificatie Onderwijs*, BKO or its predecessor *Onderwijskwalificatie*, OWK), and another one in five is currently in the process of obtaining it. Obtaining a BKO is a requirement for new permanent staff and staff in tenure track, whereas experienced staff whose teaching is evaluated positively are exempted from BKO-training. According to the critical reflection, excellence in teaching is encouraged by an annual 'teacher of the year' election. Furthermore, it points out that students evaluate courses positively, and show high appreciation for their lecturers in the National Student Questionnaire (4.2 on a five point scale in 2014).

The panel was pleased to note the good quantity of staff and the very favourable student-staff ratio's, recognizing that staff members regularly contribute to courses taken by students from different programmes. In practice, the actual ratio for both programmes may be closer to 10:1, but those numbers still allow for the small scale teaching methods favoured by the programmes. The panel is pleased with the very good to excellent research reputation of the different chair groups providing teaching staff, which makes them well-equipped to offer high quality programmes in Biology. The low numbers of lecturers holding a teaching qualification is a point of concern. Based on its discussions with programme management, the panel is convinced that measures for improvement have already been taken, such as the obligatory character of the BKO-training for tenure trackers. The panel encourages the management to

continue their efforts to increase the number of lecturers holding a (senior) teaching qualification.

On the other hand, the panel has found many signals showing that didactic aspects of education are taken seriously at Wageningen University: New developments are discussed at the regular 'education days' for teaching staff, as well as during 'education lunches'. Also, lecturers can ask for on-the-job assistance while developing or re-designing a course. Programme management emphasized that the BKO-training currently offered by Wageningen University is a hands-on programme which is quite demanding for lecturers.

#### *Programme-specific facilities*

During the site visit, the panel took a tour along the lab facilities used in the bachelor's and master's programmes. The panel was impressed with the high quality of facilities. It has seen some very good classrooms with modern equipment, allowing the programmes' ambitions to maintain small scale education even in classes with large cohorts.

### **Considerations**

#### *Bachelor's programme:*

The panel has established that the bachelor's programme curriculum is well composed in the sense that it allows students to get a good grasp on the full scope of biology and that it offers them a chance to study one of four themes more in-depth. Through its attention for (computer) practicals, the programme also succeeds in training its students in the (research) skills needed for the bachelor research project – although some extra training in keeping a lab journal would be preferable.

The panel is pleased with the used mix of teaching methods, all performed in a way that does justice to the programme's ambition to offer small scale education. The teaching staff is regularly informed about new trends and innovations in teaching, and modern techniques such as streaming and recording lectures are used to the benefit of students. The programme has some well-qualified study advisors at its disposal, and has taken a number of measures to increase its success rates.

#### *Master's programme:*

The panel has established that the programme adequately offers students an notable total of nine specialisations, further underpinned by a course offering insight into state-of-the-art research in the broad field of Biology and either the Academic Consultancy Training or the Research Master Cluster. The panel is positive about the fact that the master's programme also offers a compulsory internship, but feels that the programme does not yet fully benefit from its potential to further develop the profile of its students in applied science.

Apart from teaching methods that are well established for master's programmes in Biology, the programme has recently introduced the 'thesis ring', allowing students to peer review each other's work on their final research project. The panel regards this initiative as a good practice. The programme's success rates are quite acceptable, but have dropped over the past few years. Those rates may be improved if thesis supervisors would take further responsibility and stimulate students to finish their thesis in time.

#### *Both programmes:*

The panel concludes that both programmes are executed by a teaching staff with a very good to excellent research reputation, and that the student-staff ratio of both programmes is quite

favourable. This allows the programmes to hold on to small scale teaching methods, even with large cohorts of students. The panel encourages the management to continue their efforts to increase the number of lecturers holding a (senior) teaching qualification, which is still rather low. On the other hand, it is convinced that didactic aspects of education are taken seriously in both programmes. Both programmes have high quality lab facilities at their disposal for education purposes.

### **Conclusion**

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

*Master's programme 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**

*The assessment system of the bachelor's and master's programme are identical in many respects. Unless indicated otherwise, the panel's findings reflect on both programmes.*

### *System of assessment*

Assessment at course level is described in the 'assessment strategy' (toetsplan), which is part of the course guide. The assessment strategies clarify how and when the course-specific learning outcomes are assessed, by which examiners, and how examiners establish the final grade. In (digital) appendices to the critical reflection, matrices were provided with an overview of learning outcomes per course and the method and level of assessment of each of those learning outcomes. Furthermore, the matrices show how those learning outcomes relate to the learning outcomes of the programme. The matrices distinguish eight assessment methods, varying from written tests to oral defences and from group assignments to scientific reports. Examiners have developed means to increase the transparency of grading: answer keys, model answers, assessment criteria and rubrics. In 2012, each chair group was asked to organize a peer review of its courses by an external, mostly international committees. About one third of the courses of the bachelor's programme Biology had been peer reviewed at the moment of the site visit, and feedback was provided on content, didactic outline and assessment strategy.

The panel has studied a number of course assessments of both programmes during the site visit, as well as reports written by the peer review committees. Prior to the site visit, it also studied the test matrices of both programmes. It appreciates the overall quality of assessment, concluding that the learning objectives of the courses it has studied are being tested adequately and on a proper level of achievement. Students are well informed about the assessment on beforehand by course manuals and sample exam questions. The panel has encountered well-executed multiple-choice exams. It was somewhat surprised, however, by the fact that the Ethics and Philosophy course in the bachelor's programme also uses multiple-choice questions in its exam. This course has been under scrutiny of the programme committee for some time now, and the panel was informed that the set-up and examination of this course will be re-developed. The panel considers the matrices to be good tools to provide management and the Board of Examiners with a complete overview of the programmes and the function of each of their elements. Surprisingly, the master's programmes' Internship has not been included in the matrix.

The panel has also inquired about experiences so far with the peer review committees. Members of the teaching staff explained that the Executive Board has asked each chair group to implement this practice. Staff members whose courses have been peer reviewed, reported positively about the open discussions and the valuable input they received – but they also stated that it would have really helped them if there had been a format to organize the process for staff members and a report template for committee members. Also, they did not have the impression that the Board or Education Institute had that much interest in the results. The panel concludes that the peer reviews are time consuming but promising and

currently are quite unique instruments to maintain and improve quality of courses and assessments, and urges the Executive Board and Education Institute to provide the chair groups with adequate support. On the other hand, the panel does appreciate the support provided by the Education Institute for staff members considering the use of new assessment techniques or looking for help in setting up appropriate assessments for new courses.

#### *Thesis assessment*

The final assessment of the *bachelor's programme* is a 12 EC thesis project. Students complete a small research project, write a report in the form of a scientific article and give a presentation to their fellow students. The research can consist of a literature study, data analysis or an experiment. For each project, a supervisor is assigned. The assessment of the thesis is performed by the supervisor and a second examiner. The second examiner is member of a team of bachelor thesis 'evaluators', who read all thesis reports and check if they can agree with the supervisor.

An assessment form is used for the evaluation of the bachelor thesis. In order to further enhance transparency, validity and reliability of grading, a rubric for the assessment of bachelor theses has been developed. The grade consists of four elements: research competence (30%), laboratory skills (10%), report (50%), and oral presentation (10%). If the research consisted of a literature study or data analysis, laboratory skills can not be evaluated; its weight is then added to research competence, increasing it to 40%. The grading elements are included in the assessment form as evaluation criteria, where they have been further elaborated in a number of sub-criteria.

The final assessment of the *master's programme* is a thesis of 36 EC (as of 2015-2016, cf. Standard 2). Students join a chair group and perform a research project which contributes to its ongoing research. The assessment of the thesis is performed by the examiner, and the project supervisor designated by the examiner. Examiners are appointed by the Board of Examiners. Generally, one examiner has been appointed within each chair group, so that he/she can safeguard the quality and consistency of all thesis assessments.

An assessment form is used for the evaluation of the master thesis. In order to further enhance transparency, validity and reliability of grading, a rubric for the assessment of master theses has been developed. The Board of Examiners urges chair groups to use this rubric as a guideline for the assessment of the master thesis project; chair groups increasingly do so. The grade consists of four elements: research competence (30-60%), thesis report (30-60%), colloquium (5-10%), and oral defence (5-10%). Within the margins provided above, and on the condition that the sum total of percentages is 100, examiners can determine the relative weight of each of those elements. On the assessment form, each of the four elements is subdivided into a number of sub-criteria.

The panel has assessed the quality of fifteen theses of each of the programmes (see also standard 4) and has studied the accompanying assessment forms. It concludes that the assessment form is a valuable tool in assessing the quality of the thesis, allowing supervisors and examiners to provide consistent and transparent evaluations. Transparency and consistency of assessment are further enhanced by the use of rubrics, a new development which is still rather rare within the field of academic Biology programmes. It appreciates the fact that each bachelor thesis is also assessed by a second examiner belonging to a team of thesis evaluators, thus actively providing calibration of grading between the chair groups.

### *Board of Examiners*

Both programmes fall under the responsibility of the Board of Examiners Life Sciences, which checks whether the individual study paths proposed by students cover all intended learning outcomes. Furthermore, it controls the quality of assessment and achievement of learning outcomes. It does so by appointing examiners for each course and thesis. It has developed documents to support examiners in their task to develop valid, reliable and transparent assessments. Its tasks and procedures can be found in the document 'Rules and Regulations of the Examining Boards of Wageningen University'. In 2011 and 2015, the Board of Examiners has held meetings with the chair groups involved in both programmes in order to verify the quality of assessment in 'their' courses and in the theses written within each group. According to the critical reflection, the Board stays in regular contact with the chair groups about the quality of assessment of courses, and plans additional meetings if concerns are raised for a specific course.

The panel met with the Board of Examiners during the site visit, and was impressed with its pro-active approach in safeguarding assessment quality and the level of achieved learning outcomes. It especially appreciates the regular meeting with the chair groups, as it is of the opinion that critical and open discussion about assessment is the main key to further improve its quality. Furthermore, it learned that an ad hoc assessment committee ('toetscommissie') has performed a spot-check on the quality of assessments of bachelor courses, reporting back to the Board of Examiners. The Board also regularly checks the quality of theses. When asked about the academic level of some of the internship reports in the master's programme, the Board indicated that it already had noticed this issue and addressed the topic with a number of chair groups.

The panel thinks that the level of control of the Board of Examiners over quality of testing and assessment is impressive. It has learned that members of the Board will get some extra time to execute their many tasks (going beyond the safeguarding of the assessment system, and including a number of other degree programmes). The panel still feels that the Board might need some extra support. It suggests to consider delegation of some of its safeguarding tasks to one or more of the other groups and committees already reviewing tests and assessments and/or the quality of theses. This suggestion does not in any way alter the high appreciation the panel holds for the commitment and good work of the Board of Examiners.

### **Considerations**

The panel concludes positively not only about the assessment system of both programmes, but also about the many efforts the programmes have developed to implement new assessment techniques and to increase the overall quality of assessment. The involvement of peer review committees is a promising initiative that deserves the support necessary to maximize efficiency and effect. The quality of assessment and achieved learning outcomes is well safeguarded, not only by a committed Board of Examiners, but also by a number of initiatives like the ad hoc assessment committee and team of bachelor thesis evaluators.

### **Conclusion**

*Bachelor's programme Biology:* the panel assesses Standard 3 as 'good'.

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



#### **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**

#### *Bachelor's programme*

As described under Standard 2, students finish the bachelor's programme with a final thesis project consisting of 12 EC. Being the final element of the programme, and the only element to cover all eight learning outcomes, it is best suited to determine the level achieved by students. In 2013-2014, graduates scored an average of 7.6 for their thesis project, ranging between 6.0 and 9.5. Students can either conduct experimental research, or perform a data analysis or literature study.

Prior to the site visit, the assessment panel has studied fifteen bachelor theses in order to establish the level achieved by graduates. It confirms that all theses are of at least satisfactory quality, and that the average level of achievement is good. All theses were graded accurately. During the thesis writing process, students are embedded in one of the many chair groups in the field of biology, all of which are of very good reputation.

During the site visit, some students reported to the panel that not all chair groups allow bachelor students to conduct experimental research. The panel discussed this topic with members of the teaching staff, who confirmed that a limited number of chair groups hold the opinion that students can not properly conduct meaningful experimental research and report about it in 12 EC. Therefore, a number of staff members would prefer a more substantial bachelor research project. The panel underlines the importance of gaining experience in experimental research and recommends that all chair groups enable students to do so during their bachelor research project. This does in no way demean the quality of theses based on data analysis or literature study that the panel has encountered.

The level achieved by graduates is also demonstrated by their performance upon graduation. Virtually all graduates continue their studies with a master's programme, mostly at Wageningen University. Three out of four continue with a master's programme in Biology, with a success rate (after three years) of about 90 percent.

During the site visit, the panel asked master students whether they felt well-prepared for their current education by the bachelor's programme. They confirmed that the transition was smooth. Members of the teaching staff emphasized the ability of bachelor graduates to oversee the broadness of Biology: in the master course *Frontiers in Biology*, graduates of the bachelor's programme Biology proved far better in discussing topics beyond their specialisation than graduates with other disciplinary backgrounds. The panel concludes that all available indicators of performance upon graduation are very positive.

#### *Master's programme*

As described under Standard 2, students until 2014-2015 finished the master's programme with a final thesis project consisting of 30 EC.

Prior to the site visit, the assessment panel has studied fifteen master theses in order to establish the level achieved by graduates. Its findings are quite similar to those of the

bachelor's programme: all theses are of at least satisfactory quality, and the average level of achievement as shown by the theses is good. Panel members agree with the grades given by the programme. The panel concludes that the very good reputation of the chair groups is reflected in the quality of the theses and their underlying research, and that students profit from the fact that the quality of biological research in Wageningen ranges from very good to excellent according to the QANU Research Review Biology 2012.

During the site visit, the panel also studied nine internship reports, all written by graduates whose theses had been selected. The reading of those reports confirmed its impression that the internship has a strong potential to further enhance the profile of the master's programme in applied science. The majority of the reports showed appropriate qualities of Wageningen's Biology graduates. The panel advises the programme to improve the visibility of the internship by considering it – next to the thesis – as one of the key elements defining the level of achievement reached by its students.

The level achieved by graduates is also demonstrated by their performance upon graduation. In a survey performed by the KLV Wageningen Alumni Network in 2011, graduates of the master's programme Biology indicated that it took them on average 3.5 months to find their first job. Most graduates (64%) start with a research position at a university or research institute. Others work as (policy) advisors, teachers or managers.

The panel was pleased to read that the programme's professional field committee reports positively about Wageningen graduates; its impression that they are highly valued by the job market was further confirmed during its meeting with alumni of the programme. Study association Biologica actively stimulates contact between alumni and students, allowing for networking opportunities. The panel praises those activities, and thinks that further efforts by the programme as a whole might yield even more benefits and career opportunities for current students. The forthcoming establishment of a Career Center at Wageningen University will be of considerable help. Meanwhile, the programme's Academic Consultancy Training course is a good practice in preparing students for the broader job market. For those graduates aiming to pursue a research position, statistics seem quite favorable.

### **Considerations**

The panel concludes that graduates of the *bachelor's programme* have demonstrated a good overall level of achieved learning outcomes, based on the quality of their bachelor theses and their performance at master's level. All theses were adequately graded. This also holds true for the theses written by graduates of the *master's programme* the panel has studied, all of which also demonstrate a high level of achieved learning outcomes. The panel advises the programme to give the internship more prominence by adding the internship reports next to the theses as proof of achieved learning outcomes. Furthermore, the panel concludes that master graduates are well appreciated on the job market, in as well as outside academia.

### **Conclusion**

*Bachelor's programme Biology*: the panel assesses Standard 4 as good

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

## General conclusion

Although the panel holds the opinion that both programmes could make even more of their profiling potential in applied research and societal relevance, it is impressed with the overall quality of the teaching and learning environment. It has identified good practices in both programmes, such as the Frontiers of Biology course in the master's programme and the efforts to maintain small scale education even for large cohorts in the bachelor's programme. Both programmes have a good assessment system in place, the quality of which is well safeguarded by a pro-active Board of Examiners and a committed teaching staff. The achieved learning outcomes of graduates as shown by their theses are of high quality, which is reflected by the fact that bachelor graduates perform well at master's level. Also, the quality of graduates is recognized on the job market, both in and outside academia.

### Conclusion

The panel assesses the *bachelor's programme Biology* as 'good'.

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



# Appendices



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

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**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. Students elected him as a Teacher of the Year in Biology and Life Science & Technology.

**Prof. dr. P.J.J. (Paul) Hooykaas** is Professor of Genetics at Leiden University. Hooykaas studied Chemistry and Biochemistry, and in 1979 obtained his PhD at Leiden University on a genetic approach of the role of plasmid determined functions in the interactions of Rhizobiaceae with plant cells. Hooykaas was appointed Professor of Genetics at Leiden University in 1993, and in the period 1994-2003 also held a chair in Molecular Genetics at Delft University of Technology. From 1999-2008 he acted as Director of the Leiden Institute of Biology and its predecessor, the Institute of Molecular Plant Sciences. In 2009 he was appointed by the Royal Netherlands Academy of Arts and Sciences as Academy Professor. At the Royal Academy, Hooykaas is chairman of the Section Biology and member of the Council for Earth and Life 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.

**P.P. (Pieter) Munster MSc.** is policy officer at the Academic Affairs Directorate of Leiden University and recently graduated from the master's programme Cancer, Genomics & Developmental Biology at Utrecht University. In 2011 he obtained his bachelor's degree in Biology. During the academic year 2011-2012, Munster was chair of the Utrecht biology student association UBV (Utrechtse Biologen Vereniging). In 2013-2014, he acted as student assessor of the Board of the Utrecht Department of Biology.





## Appendix 2: Domain-specific framework of reference

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*Bachelor's programme Biology (in Dutch):*

### **DOMEINSPECIFIEK REFERENTIEKADER BACHELOR BIOLOGIE 2015**

Het domein van de biologie is de levende natuur: een groot geïntegreerd systeem van biologische eenheden waarin regulatie, zelforganisatie, interactie, communicatie, erfelijkheid en evolutie centrale concepten zijn. In elke opleiding Biologie moet de samenhang en vooral ook de dynamiek van al deze aspecten van het leven centraal staan. In de afgelopen jaren heeft de biologische wetenschap zich stormachtig ontwikkeld. Biologie is inmiddels in staat de dynamiek van de bouwstenen van het leven en de mechanismen die ten grondslag liggen aan voor het leven belangrijke functies en structuren te doorgronden. Door integratie met andere vakgebieden zoals wiskunde, natuur- en scheikunde, informatica en aardwetenschappen is biologie uitgegroeid tot een integratieve wetenschap die bovendien een belangrijke rol speelt bij het oplossen van maatschappelijke vraagstukken, zoals duurzame voedselvoorziening, behoud van biodiversiteit en ontwikkeling van groene energie. Biologie speelt in Nederland een sleutelrol bij het behouden en versterken van de sterke internationale positie van de topsectoren.

De stormachtige ontwikkeling van de biologie en de steeds breder wordende waaier van posities waarin biologen gewenst zijn, stellen de opleidingen voor de taak om studenten voor te bereiden op een werkkring in de gebieden van fundamenteel onderzoek, toegepast onderzoek en technologie, educatie, communicatie en beleid, zowel in de biologie als in de grensgebieden met andere wetenschappen. Biologie vereist, meer dan voorheen, de vaardigheid om te gaan met dynamiek en complexiteit op verschillende organisatieniveaus, zoals moleculen, cellen, organismen, populaties en ecosystemen. Studenten dienen tevens goede academische vaardigheden te verwerven, zoals schriftelijk en mondeling rapporteren, kritisch kunnen lezen van de vakliteratuur, en kritische zelfreflectie en het samenwerken in een team.

De opleiding Bachelor Biologie is een driejarige opleiding. De Bachelor opleiding biedt een brede basis, met mogelijkheid tot verdieping in verschillende subdisciplines. Na afronding van de Bachelor Biologie zijn studenten in staat om een biologisch georiënteerde masteropleiding te volgen of een functie op de arbeidsmarkt te verwerven.

#### Eisen van (internationale) vakgenoten en het beroepenveld

Biologie opleidingen kennen wereldwijd een lange traditie als kerndiscipline, waarbij in de loop van de jaren de aandacht verschoven is van het verwerven van zoveel mogelijk feitenkennis over mono-disciplines, naar integratie van verschillende disciplines en organisatieniveaus. De opleiding Biologie beoogt studenten af te leveren die excelleren in hun specifieke vakgebied, maar ook een breed overzicht en brede kennis hebben van algemene concepten en technieken. Uitstroming naar het beroepenveld direct na de Bachelor is tot nu toe in Nederland ongebruikelijk, maar dit zou met het vervallen van de doorstroom Masters kunnen veranderen. Studenten dienen gedurende de Bacheloropleiding voorbereid te worden op de keuze voor een Mastersopleiding, of een mogelijke directe doorstroming naar het beroepenveld.

De Biologie opleidingen in Nederland zijn verbonden in het Overlegorgaan Hoger Onderwijs Biologie (OHOB). In dit verband is overeengekomen dat studenten Bachelor Biologie vrijelijk en zonder aanvullende kosten cursussen kunnen volgen bij de zusteropleidingen (binnen de

hiervoor beschikbare vrije studieruimte). Ook is afgesproken dat afgestudeerde Bachelorstudenten in principe toelaatbaar zijn tot de Masteropleidingen van de zusterinstellingen, mits zij voldoen aan eventuele aanvullende eisen. De Nederlandse Bacheloropleidingen Biologie staan internationaal goed aangeschreven. Studenten met een Nederlands diploma Bachelor Biologie zijn in principe toelaatbaar tot alle internationale biologische Masteropleidingen.

#### Wat mag van een Bachelor Biologie worden verwacht?

Van de afgestudeerde mag worden verwacht dat deze:

#### **1. Beschikt over vakgebonden kennis en vaardigheden.**

##### **De bachelor kan:**

- a. centrale biologische concepten *regulatie, zelforganisatie, interactie, communicatie, erfelijkheid* en *evolutie* herkennen, beschrijven en, afhankelijk van de gekozen specialisatie, toepassen in de context van relevante vakgebieden binnen de biologie
- b. laboratoriumvaardigheden en kwantitatieve onderzoekstechnieken toepassen in biologisch wetenschappelijk onderzoek
- c. zelfstandig, maar onder supervisie, een biologisch onderzoek formuleren, opzetten, uitvoeren en de resultaten analyseren, interpreteren en presenteren

#### **2. Beschikt over academische en leervaardigheden.**

##### **De bachelor is in staat om:**

- a. mondeling en schriftelijk te rapporteren over het bestudeerde vakgebied, zowel voor een publiek van specialisten als voor niet-specialisten
- b. kritisch te reflecteren op eigen en andermans handelen in professionele context en is in staat maatschappelijke en ethische consequenties van biologisch onderzoek te evalueren

## **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

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### *Bachelor's programme Biology*

After successful completion of the bachelor's programme Biology graduates are expected to:

- have advanced knowledge and understanding of the fundamental concepts and mechanisms in biology on the molecular, cellular, organismal, population and ecosystem level;
- be able to apply basic knowledge of physics, mathematics, statistics and chemistry and relate concepts at molecular, cellular, organismal, population and ecosystem level to solve biological problems (under supervision);
- be able to analyse concepts, approaches and methods and reflect upon scientific biological literature;
- be able to gather and interpret relevant data in the of field biology using common research techniques such as microscopy, dissection, determination of organisms, molecular biological techniques, safe microbiological techniques and modelling;
- be able to apply procedural knowledge by writing and carrying out a research plan in the field of biology including the main phases of a scientific research process;
- be capable of doing experiments, collecting data and modelling biological systems/processes (under supervision);
- be able to communicate (verbally and in writing) the outcomes of learning, experiments or project work to both specialist and non-specialist audiences, both in Dutch and in English;
- be able to make judgments based on social and ethical aspects of biological research and are able to recognize and analyse these aspects in concrete situations;
- design and plan own learning path (under supervision) based on continuous evaluation upon personal knowledge, skills and performance.

After successful completion of the master's programme Biology graduates in the Main Variant are expected to:

- be able to critically discuss the latest scientific developments in the biological sciences at molecular, cellular, organismal, population and ecosystem level;
- be able to analyse advanced and complex biological concepts, approaches and methods and reflect upon scientific biological literature;
- have specialized knowledge and understanding of the fundamental concepts and mechanisms in biology in the chosen specialization;
- know how to use and evaluate the use of state of art research techniques in the field of biology;
- be able to write, evaluate and adapt a research plan in the field of biology;
- be able to carry out a research plan in the field of biology by doing experiments and/or collecting (field) data and interpreting the results;
- be able to communicate convincingly project outcomes, methods and underpinning rationale to specialists and non-specialists audiences;
- be able to respond to social, scientific and ethical aspects of biological research that are encountered in work or study in the biology;
- be able to design and plan own learning processes based on continuous reflection upon personal knowledge, skills, attitudes and performance;
- be able to cooperate as a specialist in a multidisciplinary, international team to solve a biological research question or project-based work.

## Appendix 4: Overview of the curriculum

### *Bachelor's programme Biology*

#### Common part

Course code	Course name	Credits	CS/RO	Year	Period
ORC-13803	Bio-organic Chemistry for Life Sciences	3	CS	1	1
MAT-14803	Mathematics 1	3	RO	1	1
MAT-15303	Statistics 1	3	RO	1	1
NCP-10503	Ecology 1	3	CS	1	1
NCP-20503	Ecology 2	3	CS	1	1
MAT-14903	Mathematics 2	3	CS	1	2
PCC-12803	General Chemistry for the Life Sciences	3	CS	1	2
CBI-10306	Cell Biology	6	CS	1	2
GEN-11806	Fundamentals of Genetics and Molecular Biology	6	CS	1	3
GEN-11306	Evolution and Systematics	6	CS	1	4
PPH-10806	Structure and Function of Plants	6	CS	1	5
EZO-10306	Human and Animal Biology 1	6	CS	1	5
BIS-10306	Biodiversity of The Netherlands	6	CS	1	6
BIP-10803	Physics for Life Sciences	6	CS	1	6
MAT-15003	Mathematics 3	6	CS	1	6
HAP-20306	Human and Animal Biology 2	6	CS	2	1
CLB-10803	Reproduction of Plants	3	CS	2	1
YBI-20303	Orientation on Biology	3	CS	2	1
EZO-23306	Modelling Biological Systems	6	CS	2	2
MIB-10306	Microbiology and Biochemistry	6	CS	2	2
MAT-15403	Statistics 2	3	CS	2	3
MOB-20803	Mechanisms of Development	3	CS	2	3
CPT-10303	Below and Behind Biological Knowledge: Ethics and Philosophy of Science	3	CS	2	5
BHE-20303	Animal Behaviour	3	CS	2	5
EZO-20306	Biology of Invertebrates and Lower Plants	6	CS	2	6
YBI-85812	BSc Thesis Biology	12	CS	3	1/2/3/4/5/6

CS: Compulsory course; RO: Choice dependent on type of mathematics at secondary education. Students who took Mathematics A at VWO need to choose MAT-14803 Mathematics 1; students who took Mathematics B need to choose MAT-15303 Statistics 1.

#### Major A: Cell and Molecular Biology

Course code	Course name	Credits	CS/RO	Year	Period
BIC-10306	Practical Biological Chemistry	6	CS	2	4
MOB-20306	Gene Technology	6	CS	2	5
GEN-30306	Genetic Analysis, Tools and Concepts (GATC)	6	CS	2	6
SSB-20306	Bioinformation Technology	6	CS	3	1
CLB-30306	Cell Biology and Advanced Imaging Technologies	6	CS	3	2

**Major B: Organismal and Developmental Biology**

Course code	Course name	Credits	CS/RO	Year	Period
BIC-10306	Practical Biological Chemistry	6	CS	2	4
EZO-22306	Concepts and Approaches in Developmental Biology	6	CS	2	5
PPH-30806	Plant Plasticity and Adaptation	6	CS	2	6
NEM-21306	Ecophysiology	6	CS	3	1
EZO-31306	Vertebrate Structure and Function	6	CS	3	2

**Major C: Human and Animal Health Biology**

Course code	Course name	Credits	CS/RO	Year	Period
BIC-10306	Practical Biological Chemistry	6	CS	2	4
CBI-20306	Cell Biology and Health	6	CS	2	5
HAP-21806	Behavioural Endocrinology	6	CS	2	6
NEM-20806	Basics of Infectious Diseases	6	CS	3	1
HAP-30306	Nutritional Physiology	6	CS	3	2

**Major D: Ecology and Biodiversity**

Choose at least 6 credits from RO1

Course code	Course name	Credits	CS/RO	Year	Period
CSA-20806	Population and Systems Ecology	6	CS	2	4
GEN-20306	Molecular and Evolutionary Ecology	6	CS	2	5
BIS-21306	Webs of Terrestrial Diversity	6	CS	2	6
REG-31806	Ecological Methods 1	6	CS	3	1
GRS-10306	Introduction Geo-information Science	6	CS	3	2
PSS-20306	Systems Analysis, Simulation and Systems Management	6	CS	3	2



**Common part**

Course code	Course name	Credits	CS/RO	Year	Period
YBI-37806	Frontiers in Biology	6	CS	1	3
YEI-60312	Research Master Cluster: Academic Research Proposal Writing	12	RO1B	1/2	2,3+4,5,6
YMC-60809	Academic Consultancy Training	9	RO1A	1/2	1,2,3+4,5,6
YMC-60300	Modular Skills Training	3	RO1A	1/2	1,2,3,5,6
EZO-32303	Laboratory Animal Science: Design and Ethics in Animal Experimentation	3	RO2	1	4,6
SSB-30806	Systems Biology from Gene to Ecosystem	6	RO3	1/2	2
YBI-37306	Master Biology Thesis Proposal	6	CS	1/2	1,2,3,4,5,6

RO1: RO1 B is most suited for students considering a PhD position. RO1A are intended for students who wish to keep all options open after graduation.

RO1A: YMC-60809 must be combined with YMC-60300.

RO2: EZO-32303 should be followed if students want to obtain a certification to work with laboratory animals.

RO3: this is an optional course, not specifically related to any of the specializations.

**Specialization A - Animal Adaptation and Behavioural Biology**

Course code	Course name	Credits	CS/RO	Year	Period
BHE-30306	Behavioural Ecology	6	CS	1	6
AFI-31306	Life History of Aquatic Organisms	6	RO1	1	1
EZO-30806	Functional Zoology	6	RO1	1	5
HAP-30806	Integrated Neuroendocrinology	6	RO1	1	5
AFI-80430	MSc Thesis Aquaculture and Fisheries	30	RO2	1/2	1,2,3,4,5,6
BHE-80330	MSc Thesis Behavioural Ecology	30	RO2	1/2	1,2,3,4,5,6
ENT-80430	MSc Thesis Entomology	30	RO2	1/2	1,2,3,4,5,6
EZO-80430	MSc Thesis Experimental Zoology	30	RO2	1/2	1,2,3,4,5,6
HAP-80430	MSc Thesis Human and Animal Physiology	30	RO2	1/2	1,2,3,4,5,6
REG-80430	MSc Thesis Resource Ecology	30	RO2	1/2	1,2,3,4,5,6
AFI-70424	MSc Internship Aquaculture and Fisheries	24	RO3	1/2	1,2,3,4,5,6
BHE-70324	MSc Internship Behavioural Ecology	24	RO3	1/2	1,2,3,4,5,6
ENT-70424	MSc Internship Entomology	24	RO3	1/2	1,2,3,4,5,6
EZO-70424	MSc Internship Experimental Zoology	24	RO3	1/2	1,2,3,4,5,6
HAP-70424	MSc Internship Human and Animal Physiology	24	RO3	1/2	1,2,3,4,5,6
REG-70424	MSc Internship Resource Ecology	24	RO3	1/2	

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

### Specialization B – Bio-interactions

Course code	Course name	Credits	CS/RO	Year	Period
ENT-30306	Ecological Aspects of Bio-interactions	6	CS	1	1
PHP-30806	Molecular Aspects of Bio-interactions	6	CS	1	2
CSA-80430	MSc Thesis Crop and Weed Ecology	30	RO1	1/2	1,2,3,4,5,6
ENT-80430	MSc Thesis Entomology	30	RO1	1/2	1,2,3,4,5,6
MOB-80430	MSc Thesis Molecular Biology	30	RO1	1/2	1,2,3,4,5,6
NCP-80430	MSc Thesis Nature Conservation and Plant Ecology	30	RO1	1/2	1,2,3,4,5,6
NEM-80430	MSc Thesis Nematology	30	RO1	1/2	1,2,3,4,5,6
PHP-80430	MSc Thesis Phytopathology	30	RO1	1/2	1,2,3,4,5,6
PPH-80430	MSc Thesis Plant Physiology	30	RO1	1/2	1,2,3,4,5,6
SOQ-81830	MSc Thesis Soil Biology and Biological Soil Quality	30	RO1	1/2	1,2,3,4,5,6
VIR-80430	MSc Thesis Virology	30	RO1	1/2	1,2,3,4,5,6
CSA-70424	MSc Internship Crop and Weed Ecology	24	RO2	1/2	1,2,3,4,5,6
ENT-70424	MSc Internship Entomology	24	RO2	1/2	1,2,3,4,5,6
MOB-70424	MSc Internship Molecular Biology	24	RO2	1/2	1,2,3,4,5,6
NCP-70424	MSc Internship Nature Conservation and Plant Ecology	24	RO2	1/2	1,2,3,4,5,6
NEM-70424	MSc Internship Nematology	24	RO2	1/2	1,2,3,4,5,6
PHP-70424	MSc Internship Phytopathology	24	RO2	1/2	1,2,3,4,5,6
PPH-70424	MSc Internship Plant Physiology	24	RO2	1/2	1,2,3,4,5,6
SOQ-70424	MSc Internship Soil Quality	24	RO2	1/2	1,2,3,4,5,6
VIR-70424	MSc Internship Virology	24	RO2	1/2	1,2,3,4,5,6

RO1: Students need to choose one thesis

RO2: Students need to choose one internship

### Specialization C - Molecular Ecology

Course code	Course name	Credits	CS/RO	Year	Period
MIB-31306	Microbial Ecology	6	RO1	1	1
PHP-30806	Molecular Aspects of Bio-interactions	6	RO1	1	2
GEN-30806	Population and Quantitative Genetics	6	RO1	1	6
PHP-30306	Plant-Microbe Interactions	6	RO1	1	6
ENT-80430	MSc Thesis Entomology	30	RO2	1/2	1,2,3,4,5,6
GEN-80430	MSc Thesis Genetics	30	RO2	1/2	1,2,3,4,5,6
MIB-80430	MSc Thesis Microbiology	30	RO2	1/2	1,2,3,4,5,6
NEM-80430	MSc Thesis Nematology	30	RO2	1/2	1,2,3,4,5,6
PHP-80430	MSc Thesis Phytopathology	30	RO2	1/2	1,2,3,4,5,6
SSB-80330	MSc Thesis Systems and Synthetic Biology	30	RO2	1/2	1,2,3,4,5,6
ENT-70424	MSc Internship Entomology	24	RO3	1/2	1,2,3,4,5,6
GEN-70424	MSc Internship Genetics	24	RO3	1/2	1,2,3,4,5,6
MIB-70424	MSc Internship Microbiology	24	RO3	1/2	1,2,3,4,5,6
NEM-70424	MSc Internship Nematology	24	RO3	1/2	1,2,3,4,5,6
PHP-70424	MSc Internship Phytopathology	24	RO3	1/2	1,2,3,4,5,6
SSB-70324	MSc Internship Systems and Synthetic Biology	24	RO3	1/2	1,2,3,4,5,6

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

### Specialization D – Conservation and Systems Ecology

Course code	Course name	Credits	CS/RO	Year	Period
AEW-30306	Ecology: Classics and Trends	6	CS	1	2
SOQ-32806	Biological Interactions in Soils	6	RO1	1	2
AFI-30806	Fisheries Ecology	6	RO1	1	4
FEM-30306	Advanced Forest Ecology and Forest Management	6	RO1	1	5
NCP-30306	Plant, Vegetation and Systems Ecology	6	RO1	1	6
REG-30306	Animal Ecology	6	RO1	1	6
AEW-80430	MSc Thesis Aquatic Ecology and Water Quality	30	RO2	1/2	1,2,3,4,5,6
AFI-80430	MSc Thesis Aquaculture and Fisheries	30	RO2	1/2	1,2,3,4,5,6
CSA-80430	MSc Thesis Crop and Weed Ecology	30	RO2	1/2	1,2,3,4,5,6
ESA-80430	MSc Thesis Environmental Systems Analysis	30	RO2	1/2	1,2,3,4,5,6
FEM-80430	MSc Thesis Forest Ecology and Forest Management	30	RO2	1/2	1,2,3,4,5,6
NCP-80430	MSc Thesis Nature Conservation and Plant Ecology	30	RO2	1/2	1,2,3,4,5,6
PPS-80430	MSc Thesis Plant Production Systems	30	RO2	1/2	1,2,3,4,5,6
REG-80430	MSc Thesis Resource Ecology	30	RO2	1/2	1,2,3,4,5,6
SOQ-81830	MSc Thesis Soil Biology and Biological Soil Quality	30	RO2	1/2	1,2,3,4,5,6
AEW-70424	MSc Internship Aquatic Ecology and Water Quality	24	RO3	1/2	1,2,3,4,5,6
AFI-70424	MSc Internship Aquaculture and Fisheries	24	RO3	1/2	1,2,3,4,5,6
CSA-70424	MSc Internship Crop and Weed Ecology	24	RO3	1/2	1,2,3,4,5,6
ESA-70424	MSc Internship Environmental Systems Analysis	24	RO3	1/2	1,2,3,4,5,6
FEM-70424	MSc Internship Forest Ecology and Forest Management	24	RO3	1/2	1,2,3,4,5,6
NCP-70424	MSc Internship Nature Conservation and Plant Ecology	24	RO3	1/2	1,2,3,4,5,6
PPS-70424	MSc Internship Plant Production Systems	24	RO3	1/2	1,2,3,4,5,6
REG-70424	MSc Internship Resource Ecology	24	RO3	1/2	1,2,3,4,5,6
SOQ-70424	MSc Internship Soil Quality	24	RO3	1/2	1,2,3,4,5,6

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

### Specialization E – Evolution and Biodiversity

Course code	Course name	Credits	CS/RO	Year	Period
BIS-30306	Advance Biosystematics	6	CS	1	2
GEN-30806	Population and Quantitative Genetics	6	CS	1	6
AEW-80430	MSc Thesis Aquatic Ecology and Water Quality	30	RO1	1/2	1,2,3,4,5,6
BHE-80330	MSc Thesis Behavioural Ecology	30	RO1	1/2	1,2,3,4,5,6
BIS-80430	MSc Thesis Biosystematics	30	RO1	1/2	1,2,3,4,5,6
ESA-80430	MSc Thesis Environmental Systems Analysis	30	RO1	1/2	1,2,3,4,5,6
FEM-80430	MSc Thesis Forest Ecology and Forest Management	30	RO1	1/2	1,2,3,4,5,6

GEN-80430	MSc Thesis Genetics	30	RO1	1/2	1,2,3,4,5,6
NCP-80430	MSc Thesis Nature Conservation and Plant Ecology	30	RO1	1/2	1,2,3,4,5,6
PHP-80430	MSc Thesis Phytopathology	30	RO1	1/2	1,2,3,4,5,6
REG-80430	MSc Thesis Resource Ecology	30	RO1	1/2	1,2,3,4,5,6
SOW-81830	MSc Thesis Soil Biology and Biological Soil Quality	30	RO1	1/2	1,2,3,4,5,6
AEW-70424	MSc Internship Aquatic Ecology and Water Quality	24	RO2	1/2	1,2,3,4,5,6
BHE-70324	MSc Internship Behavioural Ecology	24	RO2	1/2	1,2,3,4,5,6
BIS-70424	MSc Internship Biosystematics	24	RO2	1/2	1,2,3,4,5,6
ESA-70424	MSc Internship Environmental Systems Analysis	24	RO2	1/2	1,2,3,4,5,6
FEM-70424	MSc Internship Forest Ecology and Forest Management	24	RO2	1/2	1,2,3,4,5,6
GEN-70424	MSc Internship Genetics	24	RO2	1/2	1,2,3,4,5,6
NCP-70424	MSc Internship Nature Conservation and Plant Ecology	24	RO2	1/2	1,2,3,4,5,6
PHP-70424	MSc Internship Phytopathology	24	RO2	1/2	1,2,3,4,5,6
REG-70424	MSc Internship Resource Ecology	24	RO2	1/2	1,2,3,4,5,6
SOQ-70424	MSc Internship Soil Quality	24	RO2	1/2	1,2,3,4,5,6

RO1: Students need to choose one thesis

RO2: Students need to choose one internship

### Specialization F – Health and Disease

Course code	Course name	Credits	CS/RO	Year	Period
HAP-31806	Molecular Regulation of Health and Disease	6	CS	1	1
CBI-30306	Human and Veterinary Immunology	6	RO1	1	1
CBI-30806	Immunotechnology	6	RO1	1	5
CBI-80430	MSc Thesis Cell Biology and Immunology	30	RO2	1/2	1,2,3,4,5,6
ESA-80430	MSc Thesis Environmental Systems Analysis	30	RO2	1/2	1,2,3,4,5,6
HAP-80430	MSc Thesis Human and Animal Physiology	30	RO2	1/2	1,2,3,4,5,6
HMI-80330	MSc Thesis Host-Microbe Interactomics	30	RO2	1/2	1,2,3,4,5,6
HNE-82430	MSc Thesis Metabolism and Nutrigenomics	30	RO2	1/2	1,2,3,4,5,6
MIB-80430	MSc Thesis Microbiology	30	RO2	1/2	1,2,3,4,5,6
NEM-80430	MSc Thesis Nematology	30	RO2	1/2	1,2,3,4,5,6
SSB-80330	MSc Thesis Systems and Synthetic Biology	30	RO2	1/2	1,2,3,4,5,6
TOX-80430	MSc Thesis Toxicology	30	RO2	1/2	1,2,3,4,5,6
VIR-80430	MSc Thesis Virology	30	RO2	1/2	1,2,3,4,5,6
CBI-70424	MSc Internship Cell Biology and Immunology	24	RO3	1/2	1,2,3,4,5,6
ESA-70424	MSc Internship Environmental Systems Analysis	24	RO3	1/2	1,2,3,4,5,6
HAP-70424	MSc Internship Human and Animal Physiology	24	RO3	1/2	1,2,3,4,5,6
HMI-70324	MSc Internship Host-Microbe Interactomics	24	RO3	1/2	1,2,3,4,5,6
HNE-72424	MSc Internship Metabolism and Nutrigenomics	24	RO3	1/2	1,2,3,4,5,6

MIB-70424	MSc Internship Microbiology	24	RO3	1/2	1,2,3,4,5,6
NEM-70424	MSc Internship Nematology	24	RO3	1/2	1,2,3,4,5,6
SSB-70324	MSc Internship Systems and Synthetic Biology	24	RO3	1/2	1,2,3,4,5,6
TOX-70424	MSc Internship Toxicology	24	RO3	1/2	1,2,3,4,5,6
VIR-70424	MSc Internship Virology	24	RO3	1/2	1,2,3,4,5,6

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

### Specialization G – Marine Biology

Course code	Course name	Credits	CS/RO	Year	Period
AEW-22806	Marine Systems	6	RO1	1	1
MIB-31306	Microbial Ecology	6	RO1	1	1
AFI-30806	Fisheries Ecology	6	RO1	1	4
TOX-30806	Environmental Toxicology	6	RO1	1	5
AEW-80430	MSc Thesis Aquatic Ecology and Water Quality	30	RO2	1/2	1,2,3,4,5,6
AFI-80430	MSc Thesis Aquaculture and Fisheries	30	RO2	1/2	1,2,3,4,5,6
MIB-80430	MSc Thesis Microbiology	30	RO2	1/2	1,2,3,4,5,6
TOX-80430	MSc Thesis Toxicology	30	RO2	1/2	1,2,3,4,5,6
AEW-70424	MSc Internship Aquatic Ecology and Water Quality	24	RO3	1/2	1,2,3,4,5,6
AFI-70424	MSc Internship Aquaculture and Fisheries	24	RO3	1/2	1,2,3,4,5,6
MIB-70424	MSc Internship Microbiology	24	RO3	1/2	1,2,3,4,5,6
TOX-70424	MSc Internship Toxicology	24	RO3	1/2	1,2,3,4,5,6

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

### Specialization H – Molecular Development and Gene Regulation

Course code	Course name	Credits	CS/RO	Year	Period
MOB-30306	Control of Cellular Processes and Cell Differentiation	6	CS	1	1
HAP-31806	Molecular Regulation of Health and Disease	6	RO1	1	1
ABG-30306	Genomics	6	RO1	1	2,5
VIR-30806	Fundamental and Applied Virology	6	RO1	1	4
CBI-30806	Immunotechnology	6	RO1	1	5
MOB-30806	Regulation of Plant Development	6	RO1	1	5
EZO-30306	Developmental Biology of Animals	6	RO1	1	6
BIC-80430	MSc Thesis Biochemistry	30	RO2	1/2	1,2,3,4,5,6
CBI-80430	MSc Thesis Cell Biology and Immunology	30	RO2	1/2	1,2,3,4,5,6
CLB-80430	MSc Thesis Cell Biology	30	RO2	1/2	1,2,3,4,5,6
EZO-80430	MSc Thesis Experimental Zoology	30	RO2	1/2	1,2,3,4,5,6
HAP-80430	MSc Thesis Human and Animal Physiology	30	RO2	1/2	1,2,3,4,5,6
HMI-80330	MSc Thesis Host-Microbe Interactomics	30	RO2	1/2	1,2,3,4,5,6
MOB-80430	MSc Thesis Molecular Biology	30	RO2	1/2	1,2,3,4,5,6
PPH-80430	MSc Thesis Plant Physiology	30	RO2	1/2	1,2,3,4,5,6
SSB-80330	MSc Thesis Systems and Synthetic Biology	30	RO2	1/2	1,2,3,4,5,6
TOX-80430	MSc Thesis Toxicology	30	RO2	1/2	1,2,3,4,5,6
VIR-80430	MSc Thesis Virology	30	RO2	1/2	1,2,3,4,5,6

BIC-70424	MSc Internship Biochemistry	24	RO3	1/2	1,2,3,4,5,6
CBI-70424	MSc Internship Cell Biology and Immunology	24	RO3	1/2	1,2,3,4,5,6
CLB-70424	MSc Internship Cell Biology	24	RO3	1/2	1,2,3,4,5,6
EZO-70424	MSc Internship Experimental Zoology	24	RO3	1/2	1,2,3,4,5,6
HAP-70424	MSc Internship Human and Animal Physiology	24	RO3	1/2	1,2,3,4,5,6
HMI-70324	MSc Internship Host-Microbe Interactomics	24	RO3	1/2	1,2,3,4,5,6
MOB-70424	MSc Internship Molecular Biology	24	RO3	1/2	1,2,3,4,5,6
PPH-70424	MSc Internship Plant Physiology	24	RO3	1/2	1,2,3,4,5,6
SSB-70324	MSc Internship Systems and Synthetic Biology	24	RO3	1/2	1,2,3,4,5,6
TOX-70424	MSc Internship Toxicology	24	RO3	1/2	1,2,3,4,5,6
VIR-70424	MSC Internship Virology	24	RO3	1/2	1,2,3,4,5,6

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

### Specialization I – Plant Adaptation

Course code	Course name	Credits	CS/RO	Year	Period
MOB-30806	Regulation of Plant Development	6	CS	1	5
GEN-30306	Genetic Analysis, Tools and Concepts (GATC)	6	RO1	1	1,6
PPH-30806	Plant Plasticity and Adaptation	6	RO1	1	6
CLB-30306	Cell Biology and Advanced Imaging Technologies	6	RO1	1	2
CSA-30306	Advanced Crop Physiology	6	RO1	1	2
BIC-80430	MSc Thesis Biochemistry	30	RO2	1/2	1,2,3,4,5,6
CLB-80430	MSc Thesis Cell Biology	30	RO2	1/2	1,2,3,4,5,6
CSA-80430	MSc Thesis Crop and Weed Ecology	30	RO2	1/2	1,2,3,4,5,6
GEN-80430	MSc Thesis Genetics	30	RO2	1/2	1,2,3,4,5,6
MOB-80430	MSc Thesis Molecular Biology	30	RO2	1/2	1,2,3,4,5,6
PPH-80430	MSc Thesis Plant Physiology	30	RO2	1/2	1,2,3,4,5,6
BIC-70424	MSc Internship Biochemistry	24	RO3	1/2	1,2,3,4,5,6
CLB-70424	MSc Internship Cell Biology	24	RO3	1/2	1,2,3,4,5,6
CSA-70424	MSc Internship Crop and Weed Ecology	24	RO3	1/2	1,2,3,4,5,6
GEN-70424	MSc Internship Genetics	24	RO3	1/2	1,2,3,4,5,6
MOB-70424	MSc Internship Molecular Biology	24	RO3	1/2	1,2,3,4,5,6
PPH-70424	MSc Internship Plant Physiology	24	RO3	1/2	1,2,3,4,5,6

RO1: Students need to choose at least one course that prepares them for their thesis subject.

RO2: Students need to choose one thesis

RO3: Students need to choose one internship

## Appendix 5: Programme of the site visit

17 September 2015

Tijd		Naam	Functie
12.00 - 14.00	Vorbereidend overleg en inzien documenten	Panel	
14.00 - 14.45	Gesprek met inhoudelijk verantwoordelijken	Dr. K.J. (Katja) Teerds Ir. M.V. (Marjolijn) Coppens Prof.dr.ir. M.A.J.S. (Tiny) van Boekel Prof.dr. B.J. (Bas) Zwaan	Chair group Human and Animal Physiology Education manager Biology Director of Education Institute, Dean of Education Professor WU Plant Sciences, Member OWI-board
14.45 - 15.00	Overleg Panel		
15.00 - 15.45	Gesprek met studenten bacheloropleiding Biology	Jaëla Arian, 2nd year Max Snoeijen, 3th year Douwe van der Leest, 3th year Eva Drukker, 4th year Michiel Kasteel, 4th year	Major Ecology and Biodiversity Major Organismal and Development Biology Major Ecology and Biodiversity Major Organismal and Development Biology
15.45 - 16.30	Gesprek met studenten masteropleiding Biology	Mischa Streekstra Sander Weerheim Tessa Visser Rens de Boer Jens van Erp Hanneke Suikerbuijk Rogier Sleijpen Eva Mudde Evelien Keuzenkamp	Specialization Marine Biology & Specialization Molecular Development and Gene Regulation Specialization Bio-interactions Specialization Animal Adaption and Behavioural Biology Specialization Conservation and Systems Ecology Specialization Molecular Development and Gene Regulation Specialization Conservation and Systems Ecology Specialization Marine Biology Specialization Conservation and Systems Ecology & Specialization Marine Biology
16.30 - 17.00	Overleg panel		
17.00 - 17.30	Gesprek met alumni	Margriet Krijn Simone Oostindie Djoeke Langeloo Rozemarijn Noordam Marcel Jaklofsky	Traineeship bij Provincie Friesland Genmab Les HBO daarvoor onderzoek Docent middelbare school Sales specialist Eppendorf Nederland B.V.

18 September 2015

Tijd		Naam	Functie
8.45 – 9.00	Aankomst panel		
9.00 – 9.45	Inzien documenten, voorbereiden gesprekken	Panel	
9.45 – 10.30	Gesprek Docenten	Prof.dr.ir. J. (Jaap) Bakker Dr.ir. D. (Detmer) Sipkema  Dr.ir. S. (Sander) Kranenbarg Dr. D. (Dick) Vreugdenhil  Dr.ir. M.J. (Tjits) Ketelaar Dr. B.M.L (Lidy) van Kemenade Prof.dr. M.M. (Monique) van Oers Prof.dr. M. (Marc) Naguib	Chair group Nematology Chair group Microbiology Chair group Functional Zoology Chair group Plant Physiology Chair group Cell Biology Chair group Cell Biology and Immunology Chair group Virology Chair group Behavioural Ecology
10.30 – 10.45	Overleg Panel		
10.45 – 11.30	Gesprek met leden van de Opleidingscommissie	Dr. K.J. (Katja) Teerds Dr.ir. A.J.M. (Fons) Debets Dr. J. (Jasper) van Ruijven Tis Voortman Tjitske Kooistra Anne Rummenic	Chair Programme Committee Lecturer Programme Committee Lecturer Programme Committee First year master 3 <sup>rd</sup> year bachelor 2 <sup>nd</sup> year master
11.30 – 12.15	Gesprek met leden van de Examencommissie + studieadviseurs	Dr.ir. K. (Klaas) Swart Prof.dr.ir. W. (Willem) Takken Ir. A.J. (Arno) Hoetmer Ing. A. (Annemarie) Teunissen MSc. Dr. P.W. (Peter) de Jong	Secretary examining board (former) Chair examining board Study advisor BSc students Study advisor BSc students Study advisor MSc students
12.15 – 12.45	Lunch		
12.45 – 13.45	Rondleiding onderwijsfaciliteiten		
13.45 – 14.15	Voorbereiden eindgesprek met formeel verantwoordelijken		
14.15 – 14.45	Eindgesprek met formeel verantwoordelijken	Prof.dr.ir. M.A.J.S. (Tiny) van Boekel Prof.dr. B.J. (Bas) Zwaan Dr. K.J. (Katja) Teerds Ir. M.V. (Marjolijn) Coppens	Director of Education Institute, Dean of Education Professor WU Plant Sciences, Member OWI-board Chair group Human and Animal Physiology Education manager Biology
14.45 – 17.00	Opstellen voorlopige bevindingen		
17.00 – 17.15	Mondelinge rapportage voorlopig oordeel		



## Appendix 6: Theses and documents studied by the panel

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

### *Bachelor's programme Biology*

900910159110	920318062040	880527966110
890612498100	910328196050	930324269030
901209603060	920517821080	931201585080
901007965130	900723756010	880906684060
881004485010	830525586020	900530707050

### *Master's programme Biology*

870518333100	890512109110	880705471100
861212291030	890531405010	880324148080
860220153130	840316923030	870126706020
881209432090	900514219020	901203387110
880728306120	900912942020	870927470010

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 Report of the Board of Examiners 2013-2014;
- Proceedings and reports of the Programme Committees, 2013-2014 and 2014-2015;
- Nine internship reports (master's programme).

The panel also studied the course materials (including literature, student manuals and assessment material) of the following selection of courses:

### *Bachelor's programme Biology:*

- Cell biology (year 1)
- Mechanisms of development (year 2)
- Population and Systems Ecology (year 2)
- Bioinformation technology (year 3)
- Ecophysiology (year 3)

### *Master's programme Biology:*

- Systems Biology from Gene to Ecosystem (year 1/2)
- Behavioural Ecology (year 1)
- Microbial Ecology (year 1)
- Genomics (year 1)