

Molecular Mechanisms of Disease

**Radboud Institute for Molecular Life Sciences,
Faculty of Medical Sciences,
Radboud University**

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This report was finalized on 8 July 2016.

Report on the master's programme Molecular Mechanisms of Disease of Radboud University

This report takes the NVAO *Assessment Framework for Limited Programme Assessments* (19 December 2014) and the NVAO *Guidelines for assessment of research master's programmes* (23 April 2015) as starting points.

Administrative data regarding the programme

Master's programme Molecular Mechanisms of Disease

Name of the programme:	Molecular Mechanisms of Disease
CROHO number:	60322
Level of the programme:	Research Master
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	-
Location(s):	Nijmegen
Mode(s) of study:	full time
Language of instruction:	English
Expiration of accreditation:	18 April 2017

The visit of the assessment panel Molecular Mechanisms of Disease to the Radboud Institute for Molecular Life Sciences of Radboud University took place on 25-26 April 2016.

Administrative data regarding the institution

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

Composition of the assessment panel

NVAO approved the composition of the panel on 5 January 2016. The panel that assessed the master's programme Molecular Mechanisms of Disease consisted of:

- Prof. Frans Ramaekers, Professor of Molecular Cell Biology and Scientific Director of GROW (School for Oncology and Developmental Biology) at Maastricht University Medical Center;
- Prof. Paul Coffey, Professor of Cell Biology at the Center for Molecular Medicine of the University Medical Center Utrecht;
- Prof. Caroline Kisker, Professor at the Rudolf Virchow Center for Experimental Biomedicine of the University of Würzburg;
- Dr. Dik van Gent, Programme Director of the master's programme Molecular Medicine at the Erasmus Medical Center;

- Anouk Baars, MSc, former student of the research master's programme Medical and Pharmaceutical Drug Innovation at the University of Groningen.

The panel was supported by Adrienne Wieldraaijer-Huijzer, MA, who acted as secretary.

Appendix 1 contains the curricula vitae of the panel members.

Working method of the assessment panel

Preparations

QANU received the critical reflection of the research master's programme Molecular Mechanisms of Disease of Radboud University on 15 March 2016. After having established that the reflection fulfilled the criteria of relevance and completeness, the project manager distributed it along with additional information to the members of the panel. They read the critical reflection and prepared questions, comments and remarks. The project manager collected these questions in a document and arranged them according to panel consultation and the standards of the NVAO *Assessment Framework for Limited Programme Assessments*. Some additional questions were sent to the institution for further clarification.

The panel also read internship reports and master's theses from 15 graduates. The reports and theses were selected by the chair of the panel from a list of graduates from the last two completed academic years. The panel chair ensured that the selection was more or less proportional to the distribution of marks over the entire list of graduates. In addition, the sampling covered the different supervisors and thesis subjects.

Site visit

A preliminary programme of the site visit was prepared by the panel secretary and finalised after consultation with the representatives of the programme at Radboud University, Nijmegen. The timetable for the site visit in Nijmegen is included as Appendix 5.

Prior to the site visit, the panel asked the programme to select representative interview partners. During the site visit, meetings were held with panels representing students and teaching staff, programme management, alumni, the Educational 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 to speak informally to the panel during a consultation hour outside the set interviews. 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 the Radboud University Nijmegen with the request to check for any factual inaccuracies. The comments received were discussed with the panel's chair. Subsequently, the final report was approved and sent to Radboud University, Nijmegen.

Decision rules

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

Generic quality

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

Unsatisfactory

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

Satisfactory

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

Good

The programme systematically surpasses the current generic quality standard.

Excellent

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

Summary judgement

Standard 1

The goal of the MMD programme is ‘to educate excellent future scientists with a broad fundamental knowledge in Molecular Life Sciences and the skills to translate this knowledge to medical experimental research and clinical applications.’ The MMD programme distinguishes itself from other programmes in the field because of its strong focus on academic research training, its broad profile and its ‘translational’ approach. In the panel’s view, the broad profile of the programme is a strong feature. It enables the programme to make optimal use of the available expertise at RIMLS. The panel is very impressed with the ‘translational approach’. This approach is well thought out and even has a clinical edge to it; the programme actively brings students into contact with ‘the patient behind a molecular challenge’. In the panel’s view, the ‘translational approach’ is a unique feature.

The panel studied the final qualifications and concluded that they are of the right level and depth. They clearly display the research orientation of the programme and well-reflect the broad focus and translational approach of the programme. In the panel’s view, the goals of the programme with regard to research training and preparation for a future scientific career are highly ambitious and clearly demonstrable. In its view, the focus and intended learning outcomes of the MMD programme are an international model. Therefore, the panel assesses Standard 1 as ‘excellent’.

Standard 2

The MMD research master’s programme is a two-year programme. Each year includes a number of mandatory courses, several electives and a research-training period. The research-training period in year one takes place under the direct supervision of an RIMLS senior researcher and concludes with an internship report. The research-training period in year two is the apotheosis of the programme. It is often organised at a foreign institute of excellence and concludes with a master’s thesis in the form of a scientific article. During the second research-training period, students can choose to do an internship lasting either 6 (39 EC) or 7 (45 EC) months. A 39 EC internship needs to be combined with a ‘Literature thesis’ of 6 EC.

The panel concluded that the MMD programme enables students to achieve the ambitious final qualifications. The level of the courses is consistent with what can be expected of a research master’s programme, and the research orientation of the programme is evident. The curriculum pays ample attention to academic research training, ethos in science, the development of research skills in the lab, and the latest research developments in the scientific field (through the masterclasses). Furthermore, students are actively involved in many research activities within and outside the RIMLS scientific community. In the panel’s view, this community is of high quality and includes many very good – and some outstanding – researchers. MMD students convinced the panel that they are taken seriously within the RIMLS research community and are treated as full junior members.

The panel is impressed with the intensity and flexibility of the mentor programme in place. At the beginning of the first year, each student is assigned a personal mentor, who is a RIMLS senior scientist. The mentor provides support, coaching and guidance. Students also receive support with their professional career development, e.g. upgrading of their CV and help with developing research proposals for PhD positions. The mentor and the student meet at least seven times during the two-year period. In addition, the mentors have an ‘open-door’ policy and are accessible whenever needed. The panel established that the ‘open-door’ policy really works, partly due to the mentor programme and the fact the number of students that enrol is

limited. The admission policy of the programme is thorough and strict, as it should be for a research master's programme. Its success rates are high. The programme takes quality assurance very seriously.

The panel identified a number of recommendations for further improvement. The programme should revise its three educational themes, make the 'Literature thesis' compulsory for all students, and improve the visibility of the programme for Dutch students from other universities than Radboud University.

In the panel's view, the MMD programme is a very attractive programme for students who want to excel and aspire to a scientific career in Molecular Life Sciences. The teaching-learning environment has many strong and some unique features, including its translational approach, its link to the clinic, its high-quality research environment, its strong research orientation, its intensive mentor programme, its favourable staff-student ratio, and its strict admission policy. In the panel's opinion, Standard 2 easily meets the criteria for the qualification 'good'.

Standard 3

The MMD programme follows the assessment policy of the Faculty of Medical Sciences. The formal assessment rules of MMD are described in the Education and Examination Regulations, and the relation between the intended learning outcomes, course objectives and assessment is set out in an examination programme. The panel concluded that the assessment rules, regulations and policy of the MMD programme are described clearly and are followed by the MMD staff. It studied the examination plan and assessments from a number of courses and established that the forms of assessment in the programme are varied and match the learning objectives of the courses. The assessments are of the right level and cover the course content. The relation between the intended learning outcomes, the course objectives and the assessment is well thought out. Students within the MMD programme have a considerable amount of freedom in the composition of their individual study programme. Therefore, they need to develop a study plan for the whole programme and work plans for their internship periods. The panel examined a couple of study and work plans. It is convinced that they are adequate tools in assuring that all students follow a programme of an adequate level and are sufficiently tested on all intended learning outcomes.

The internship periods are the most important parts of the MMD programme. In the panel's view, the research-training periods provide a solid preparation for a future career in academia. The internship report and master's thesis are adequate tools to assess the final attainment levels of MMD graduates. The panel studied reports and theses from 15 MMD graduates. It concluded that a number of aspects of the assessment and grading of the reports and theses need to be improved. First, the programme has a tendency to give high scores; in many cases, the panel would have given a score at least 0.5 point lower. The Board of Examiners should look into this. Second, the assessment form could be structured in a more transparent way. The panel recommends categorizing the assessment criteria; each category should be graded and weighted. Third, the panel noted that not all reports and theses it studied were assessed with the same amount of accuracy. It urges the Board of Examiners to develop a formal rule explaining to assessors what they should do if mandatory elements are missing in a report/thesis. It also advises the Board to make sure that all assessment forms include written feedback.

The panel studied the minutes from the Board of Examiners and concluded that this Board takes its responsibilities very seriously. Problems are detected early, investigated thoroughly and solved in a satisfactory manner. The panel is confident that the Board of Examiners is in control

and will implement its recommendations in an adequate manner. Therefore, it assesses Standard 3 as 'satisfactory'.

Standard 4

The panel studied the internship reports, master's theses and literature theses (where available) of 15 graduates from the 2012-2014 and 2013-2015 cohorts. In its view, they demonstrate that MMD graduates are capable of performing scientific research on a high level. It is convinced that the graduates achieve the ambitious intended learning outcomes of the programme.

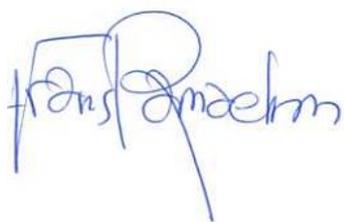
The high level of MMD graduates is also demonstrated by the fact that many of them have published their research in peer-reviewed journals. Their employment record is also impressive: 82% of MMD graduates find a PhD position either shortly before or directly after graduation. In the panel's view, the achieved learning outcomes of the programme clearly surpass the generic quality standards.

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

Standard 1: Intended learning outcomes	excellent
Standard 2: Teaching-learning environment	good
Standard 3: Assessment	satisfactory
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 it. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 8 July 2016.



Prof. Frans Ramaekers
Chair



Adrienne Wieldraaijer-Huijzer, MA
Secretary

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

The research master's programme Molecular Mechanisms of Disease (MMD) is a two-year programme of 120 EC. It is offered by the Faculty of Medical Sciences of Radboud University and forms part of the Graduate School of the Radboud Institute for Molecular Life Sciences (RIMLS). RIMLS is one of three research institutes of the Radboud university medical center. Its mission is 'to achieve greater insights into the molecular basis of disease [...] by integrating molecular and medical research to obtain multifaceted knowledge of normal and pathological processes.'

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

Mission, profile and objectives

The MMD programme is designed for highly talented and ambitious students with a strong motivation to conduct research. The goal of the programme is 'to educate excellent future scientists with a broad fundamental knowledge in Molecular Life Sciences and the skills to translate this knowledge to medical experimental research and clinical applications.'

According to the critical reflection, the MMD programme distinguishes itself from other master's programmes in the field because of its breadth. Instead of being directed towards only one or a few specific areas in Molecular Life Sciences, the MMD programme covers the full range of research activities at RIMLS. The idea is that this broad orientation provides students with more opportunities to acquire cross-disciplinary knowledge and helps them to make well-argued choices for their future scientific profile. The panel agrees with the programme management that the ability to go beyond one's own discipline and obtain cross-disciplinary knowledge is of great importance to future scientists in Molecular Life Sciences. Therefore, it endorses the programme management's choice to connect to the research at RIMLS and to offer students a broad educational programme (also see Standard 2).

Another distinctive feature of the programme is its 'translational approach', that is, its focus on the translation of fundamental insights into new diagnostic and therapeutic approaches. During the site visit, the panel asked the programme management to explain this approach further and, in light of this, to elaborate on its choice to separate 'core fundamental courses' from 'translational courses' in the programme. The programme management explained that it is aware that the fundamental and the translational aspects need to be addressed in close relation to one another. However, experience has taught them that students are better prepared for the translational courses if they are provided with a solid fundamental background first. This is why the programme starts off with fundamental courses. The programme management clarified that in practice the separation between the fundamental and the translational aspects is not that strict.

From the discussion with the students and the examination of the course materials, the panel learned that the translational approach of the programme goes beyond diagnostics, therapies and drugs. The programme actively exploits its position within the Radboud university medical center by bringing students into contact with ‘the patient behind a molecular challenge’. Students highly appreciate this ‘clinical edge’ to the programme. The panel shares their enthusiasm. In its view the ‘translational approach’ is a unique feature of the programme.

Intended learning outcomes, orientation and level

The final qualifications of the programme are listed in Appendix 2.

The panel studied the final qualifications and concluded that they are suitable for a master’s programme in the field of Molecular Life Sciences. They clearly reflect the distinctive features and the ambitious character of the MMD programme. Final qualification A mirrors the emphasis of the programme on obtaining a broad fundamental knowledge basis, while final qualification B focuses on acquiring ‘translational’ knowledge and skills.

The MMD programme is an ambitious research master’s programme with an explicit aim to prepare students for entry to a PhD programme or other types of research positions. The panel studied its set of final qualifications and concluded that research training, research ethics and the connection of the programme to PhD tracks have been incorporated explicitly in them. First, final qualifications C and F set minimum standards for graduates with regard to research and research design skills and the capacity to publish articles in international peer-reviewed journals. Second, final qualification F ensures that graduates are familiar with the societal and ethical questions related to scientific research. Third, final qualification G mirrors the aim of the programme to produce future scientists by stating that the graduates of the programme have acquired the ‘proficiency to move into an international PhD programme’.

The panel concludes that the programme has succeeded in formulating intended learning outcomes that reflect the ‘breadth’ and ‘translational approach’ of the programme as well as the level and depth of a research master’s programme. The programme has a strong research orientation and is very dedicated to preparing students for a future scientific career. The research orientation of the programme is not only clear, but also very ambitious, internationally oriented and demonstrable (see Standard 2). The programme is a ‘research master’ in the true sense.

Considerations

The panel established that the final qualifications of the programme are of the right level and depth. They well-reflect the unique characteristics and the research orientation of the programme. In the panel’s view, the programme’s goals with regard to research training and preparation for a future scientific career (as described in the intended learning outcomes and the critical reflection) are highly ambitious as well as demonstrable. The panel agrees with the choice for a broad profile as the programme is able to make use of the available expertise at RIMLS. Breadth also stimulates students to become interested in cross-disciplinary challenges, which is important for future scientists in Molecular Life Sciences. Last but not least, the panel is impressed by the translational profile and approach of the programme. It highly appreciates the ‘clinical edge’ to the ‘translational’ in the programme. In its view, the focus and intended learning outcomes of the MMD programme are an international model. Therefore, the panel assesses Standard 1 as ‘excellent’.

Conclusion

Master's programme Molecular Mechanisms of Disease: the panel assesses Standard 1 as 'excellent'.

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

2.1 Set-up and content of the programme

The research master's programme Molecular Mechanisms of Disease is a two-year programme. Each year includes of a number of mandatory courses, several electives and a research-training period. An overview of the programme is included in Appendix 3.

Year 1

Year 1 begins with an introductory course of 2.5 EC. In this course students orient themselves in the RIMLS and Radboud university medical center educational and research environments and become familiar with the molecular-oriented research themes there. Subsequently, they select a maximum of four laboratories for the laboratory orientation days at the end of the first month. During these orientation days students visit different laboratories to make a well-informed choice for their first internship period (see below). During the site visit, the panel asked the students if three laboratory orientation days are sufficient to help them make an informed choice for their first research-training period. Students confirmed that this is the case, because they also receive descriptions of all available research-training period projects, attend presentations of second-year students about their research-training periods during a student symposium, and receive help from their personal mentor (see 2.4). In addition, it is possible to visit more labs if a student experiences difficulty to decide upon the lab for the first research-training period.

The first month of the programme concludes with two courses on research and presentation skills: 'Excellence in communication' (1.5 EC) and 'Scientific Skills' (3 EC). The panel established that the course on Scientific Skills also includes a module on ethics in science and fraudulent behaviour. Even though some students are already familiar with the do's and don'ts in scientific research and there is some overlap, the panel agrees that it is important to make sure that all students have the same level of understanding of this important topic.

After the first month, students pursue three blocks of theoretical courses. Each block represents one of three focus areas of research of RIMLS and consists of two courses. The first course within each block deals with fundamental knowledge about molecular and cellular mechanisms (the 'fundamental courses'); the second course within each block deals with the translation of this knowledge towards applications for diagnosis, treatment and (bio)medical experimental research in theme-related diseases (the 'translational courses'). These 'translational courses' include visits to the clinic and interactions with patients. The three blocks' educational themes are:

1. Cell growth and differentiation / Developmental disorders and malignancies (3.5 + 2 EC).
2. Infection, immunity and regenerative medicine / Immunity-related disorders and immunotherapy (3.5 + 2 EC).
3. Metabolism, transport and motion / Metabolic disorders (3.5 + 2 EC).

The panel studied the three blocks and discussed them with students, alumni and staff members. Although it was rather sceptical at first about the separation between ‘fundamental’ and ‘translational’ courses, students as well as staff members convinced the panel that this set-up really works. Students explained to the panel that they understand the ‘translational’ part better if they receive a solid fundamental background first. As mentioned earlier under Standard 1, the panel is impressed by the fact that the programme has succeeded in linking the curriculum to the clinic and incorporating the patient perspective.

The panel is more critical about the themes of the theoretical courses, and consequently about the coherence and balance between the three blocks. According to the critical reflection these themes were inspired by the RIMLS research themes. During the site visit, the programme management explained that the themes date back to the old structure of RIMLS. The panel advises the programme management to revise the three educational themes.

The second part of the first year is composed of two masterclasses and the first research-training period. The masterclasses are highly interactive courses in which distinguished national and international guest speakers present the latest research developments in their field. Thus, the topics of the masterclasses change every year. Their standard is safeguarded by the masterclass coordinators of the programme. Although the title ‘masterclass’ might not fully cover the aim and content of this course, the panel applauds the programme for including discussion elements about new research topics and challenges.

The first research-training period is directly supervised by a RIMLS senior researcher and concludes with a comprehensive report. In 2015 a formal partnership agreement with the Institute for Research in Biomedicine (IRB) in Barcelona was established. In the context of this agreement, students can also perform their first research training period there. During the first research-training period, students are trained in research design, practical laboratory research, and data analysis and reporting. During the site visit students explained that there are enough internship projects to choose from (around 80 projects for 20 students). The internships at RIMLS are divided among the students in such a way that there is only one student per PI (principal investigator). Sometimes more than one student applies for a project with a specific PI. Staff members, students and alumni convinced the panel that in most cases the programme finds a solution for this problem, for example by admitting students to the lab of their choice but assigning them to a PI from another lab. To guarantee the quality of the first (and second) research-training periods, students write a work plan in consultation with their proposed supervisor. This work plan needs to be approved by the Board of Examiners.

Year 2

The second year of the programme starts again with mandatory courses: Genomics and Statistics (3 EC), Science and Society (1.5 EC) and a third masterclass. Science and Society is a newly revised course that will start from 2016 onwards. The panel looked at the course materials for 2014-2015 and reviewed the intended course set-up for 2016-2017. It concluded that the mandatory 2nd year courses are well designed and of the right level.

During the second year, the students also take electives. These electives may be theoretical courses, courses from PhD programmes and individual courses. The individual courses include writing a full research proposal for the Radboudumc PhD proposal competition. Requirements for elective courses and a list of common elective courses are published in the programme prospectus. The choices of elective courses need to be approved by the Board of Examiners. The panel concludes that the quality control of the electives is in order. The electives allow

students to gain in-depth knowledge in their specific areas of interest, develop their research training skills further and sharpen their individual profile.

The second research-training period is the apotheosis of the programme. During this period students do an internship and write a master thesis in the format of a scientific article for the 'Journal of Cell Biology'. They are guided and strongly encouraged by the programme to choose an international top institute for the internship in this period. During the site visit, students and alumni expressed their appreciation of the extensive contacts of the programme with international top institutes and the support provided in applying to them. The panel agrees with them that the large number of formal contacts with international top institutes, the support that students get in applying for positions there, and the mentoring system in general (see below) are strong features of the programme.

During the site visit, the panel questioned the programme management and the Programme Committee about the quality assurance of the international external lab. They explained that the quality of the international research-training periods is assured through a Work Plan and a traineeship agreement which has to be signed by the student, the host institute and the programme. Most students go to a laboratory that has no formal relations with the RIMLS but where a contact for example through collaboration exists. In all cases, the experiences with the external PIs are carefully documented. If it proves necessary, an external lab is added to the programme's 'black list'. During the external research-training periods, the student and her/his mentor (see below) stay in touch, which helps identify problems early so they can be resolved promptly.

In practice, about 90% of the students in the programme choose an international research-training period. The panel compliments the programme on the large number of students who go abroad for their second internship. MMD students gain some experience with working in an international academic context through their 'international classroom' (65% of all students are non-Dutch, see below), the RIMLS institute and the masterclasses. However, the international internship is an invaluable experience which is of great importance for future scientists. It helps students to develop a truly international orientation and to start building their own international research network. Therefore, the panel encourages the programme to increase the number of students who do their second research-training period abroad.

During the second research-training period, students can choose to go to an institute for either 6 (39 EC) or 7 (45 EC) months. A 39 EC internship has to be combined with a 'Literature thesis' of 6 EC. This 'Literature thesis' can be related to the second research-training period and in this way prepare for it, but it cannot be on the same topic. The panel advises the programme management to make the 'Literature thesis' compulsory for all students in the programme. In the panel's view, analysis of and reporting on existing literature are important skills for future scientists. In addition, the 'Literature thesis' is also ideal to go more deeply into a certain topic. This topic should be different from, but can still be affiliated to, the research topics explored during the internships.

The panel concludes that the programme is organised in a structured manner. There is an adequate balance between theoretical courses and research courses. The level of the courses is consistent with what can be expected of a research master's programme. The programme is challenging and offers students a great preparation for an international career in scientific research: the curriculum pays ample attention to academic research training and the development of research skills in the lab; most students go to an international top institute for their second internship; and students follow masterclasses in which they are informed about the latest research developments in their field.

Additional research activities

An important starting point of the programme is that MMD students are full junior members of the RIMLS scientific community. The panel observed that students are involved in many research activities within and outside this community. For example, they are granted full access to the yearly RIMLS New Frontiers Symposium and are stimulated to attend RIMLS symposia, PhD workshops and international conferences. They can apply for a 'Knowledge transfer' travel fund to attend international conferences. A maximum of 400 euros is available for each student.

In the panel's opinion, the teacher-apprentice relationship between the staff members is at the heart of the research orientation of the programme alongside its research-oriented curriculum and the available additional research opportunities. MMD students are taken seriously within the RIMLS research community, and staff members take sufficient time to support them in their professional development, for example through the mentor programme (see below), checking their CV and giving feedback on research proposals.

2.2 Connection to the intended learning outcomes and the PhD programme

Prior to and during the site visit, the panel studied descriptions provided by the programme of the relation between the final qualifications and the courses, as well as between the course objectives and the final qualifications. It also examined several course manuals (see Appendix 5). The panel concluded that the programme is of the right academic level and adequately enables students to achieve the final qualifications. Part of the MMD programme is obligatory (the mandatory courses) and part is based upon the individual choices of students (electives, research-training periods). To ensure that the intended learning outcomes are achieved and to avoid redundancies, all students need to hand in a 'Study plan' with their individual choices. This 'Study plan' needs to be approved by the Board of Examiners. In the panel's view, this procedure sufficiently ensures that all students achieve the right level of knowledge and skills.

The MMD programme prepares students for a future career in science. It was developed as an initiative from the RIMLS Research Institute and is part of the RIMLS Graduate School. Just over 50% of its graduates continue with a PhD programme at RIMLS. During the site visit, the panel and the programme management discussed the connection of the MMD programme to the PhD teaching programme. The panel concluded that the programme management is aware of possible overlaps between them. It recently evaluated this connection and made some adjustments to the PhD training programme. The link between RIMLS and the MMD programme is strengthened by regular meetings of the RIMLS director and scientific manager and the MMD programme director and coordinator.

Although the panel is convinced that the programme enables students to achieve its final qualifications, it also observed that the internal coherence of the programme could be improved. The choices that underlie the three broad educational themes of the programme (described in 2.1) are not always evident. For example, why combine courses on regenerative medicine with immunity and infection, or on genetics with statistics? As explained above, the themes date back to the old structure of RIMLS. In the panel's view, the internal coherence and logic of the programme would benefit significantly from a revision of the three educational themes.

2.3 Admission and feasibility

The MMD programme aims to enrol 24 students each year and has a selective admission policy. On average, 80-90 students apply annually, of which 35% are accepted by the Board of Examiners. About 70% of the accepted students actually enrolls in the programme. In the last three years, an average of 20 students started the programme.

The programme is open to students with grades well above average in Molecular Life Sciences, Medical Biology, Molecular Medicine, Biochemistry, Biotechnology or any biomedical or life sciences education with an emphasis on cell and molecular biology. Students submit a letter of motivation and a transcript of their course grades with their application. In addition, students from outside Radboud University need to submit two letters of recommendation, and students who do not have a Dutch BSc degree need to include the results of an English language test. The minimum score for the language test follows Radboud University guidelines. Each application is assessed by two members of the Board of Examiners (selection coordinators). When a student is considered by them to be a potentially suitable candidate for the programme, s/he is invited for a selection interview by Skype, phone or in person. During the interview, the candidate's motivation, English proficiency and background knowledge are assessed by means of a standardised protocol. The interview is conducted by two experienced RIMLS researchers. The final decision on admission to the programme is based on the student's motivation, the grades from their bachelor's programme and a grade for the interview.

The panel concluded that the admission policy is very thorough. From its discussion with members of the Board of Examiners, it learned that former results and high marks are rendered indicative and are therefore strictly upheld for entry into the MMD programme. The panel appreciates the fact that the programme sticks to all the selection criteria, even if this means that the target of 24 students per year is not met. It is convinced that the admission procedure takes into account all relevant issues and that only the best students are admitted to the programme. The success rates of the programme confirm this. Between 2011 and 2015, 78% graduated within two years and 91% in 2.5 years. In the panel's view, the programme is challenging but feasible.

The panel did note one small point of concern and has two suggestions with regard to intake and admission. First, it noted that there are not many Dutch students in the programme from other universities than Radboud University. It advises the programme management to improve the visibility of the programme and to intensify its marketing to this specific group. The recruitment of students from this group might help the programme to come closer to its target of 24 students per year. Second, the panel thinks that the programme could strengthen its international position and profile by more actively supporting students from developing countries with funding. Third, it believes that the unique molecular/translational/clinical focus of the programme (see Standard 1) might also be interesting for medical students. It advises the university and the programme management to consider options allowing medical students to enrol.

2.4. Study guidance

The MMD programme provides students with intensive tutoring through a mentor programme. At the beginning of the first year, each student is assigned a personal mentor, who is a RIMLS senior scientist. The mentor provides support, coaching and guidance, and stimulates the student to reflect on his/her personal development, choice of electives and research-training periods. The mentor also monitors the student's progress. The mentor and the student meet at least seven times during the two-year programme. In addition, the mentors follow an 'open-door' policy and are accessible whenever needed. Prior to every official meeting

with their mentor, students are expected to write a personal reflection report. Students receive additional guidance from older students and alumni during the first months of their study and in the organisation of their international research period.

Students told the panel that the MMD programme is very small scale. During the first four months students follow an intensive whole-day programme and get to know each other and the staff members well. As a result, the teachers and their mentor are easily approachable, and the 'open-door' policy is not just an empty promise. Students appreciate the fact that the mentor programme is not only about progress and study planning, but also about personal and professional career development. The panel is impressed with the intensity and flexibility of the mentor programme and the programme's dedication to its students.

2.5 Staff and academic context

Nearly all lecturers of the MMD programme are actively involved in research in one of the relevant research areas; 99% of them has an MSc degree and 92%, a PhD degree. Most of the lecturers are affiliated to the RIMLS institute, but some come from the Donders Centre of Neuroscience (DCN) and the Faculty of Science.

In October 2011, RIMLS was assessed by an international review board of senior scholars according to the guidelines of the Standard Evaluation Protocol 2009-2015 for Public Research Organizations (SEP). At that time, RIMLS research was still structured in seven research themes. All of the themes scored 4 to 5 (very good to excellent) on all the assessment points. In 2012, the RIMLS Graduate School was assessed and re-accredited by an accreditation committee for research schools of the Royal Netherlands Academy of Arts and Sciences (KNAW). This accreditation committee concluded that the training and supervision programme as well as the organisation of the RIMLS graduate school are of an excellent level.

The panel endorses the reputation of RIMLS. It studied the CVs of the staff members involved in the programme and concluded that the programme includes many very good researchers – and some outstanding ones – in Molecular Life Sciences or a related domain. Among the core staff there are many who have received nationally and/or internationally acclaimed awards such as the Spinoza Prize, ERC grants and Veni-Vidi-Vici grants. It is clear to the panel that students are part of a high-quality and committed research environment. The favourable staff-student ratio (1:10-12) and the intensive mentor programme allow for individual and personal attention, face-to-face contact, high visibility of the staff, and staff-student interaction. As a result, the MMD students really are part of the RIMLS scientific community.

The general policy of Radboud University is that staff members should have a University Teaching Qualification. The Radboudumc has its own teaching qualification system with theoretical and research training supervision components. According to the critical reflection, 55% of all lecturers and 88% of all core lecturers have obtained a UTQ. English proficiency is actively evaluated, and if necessary staff members are stimulated to follow a course to improve their language skills. During the site visit, some staff members confirmed that they have taken such a course. The quality of the lecturers forms part of every course evaluation. Students generally rate the quality of the lecturers as very high (4.1 on a scale of 1-5, with a standard deviation of 0.4). The panel is convinced of the teaching quality of the core staff. Although it understands that many of the other lecturers have a strong focus on research, it recommends that the programme management encourage them to obtain a UTQ as well.

2.6 Programme-specific quality control

The panel met with the members of the Programme Committee (PC) of MMD and the Student Assessor of the Radboudumc. It learned that the PC of MMD consists of three staff members and three student members (with at least one international student). The Student Assessor advises and informs the PC about issues and decisions within the Radboudumc.

The PC meets every two months. It advises the Dean about the Education and Examination Regulations drawn up by the programme management, assesses course and programme evaluations and raises additional action points to be taken up by the management. During the site visit, members of the PC confirmed that they are taken seriously. Because of the small scale of the programme, communication with the programme management is easy. The PC is consulted about planned innovations in the programme and receives regular feedback about actions taken by the programme management as a result of its recommendations.

The panel observed that the programme is evaluated on a regular basis through course evaluations, an exit questionnaire, an exit interview and midterm reviews. It concludes that the PC and the programme management have a dedicated attitude towards the quality of the programme. The programme-specific quality assurance procedures are geared towards ongoing improvement and the continuous development and adjustment of the programme.

Considerations

The panel established that the MMD programme enables students to achieve the final qualifications. The programme is challenging and offers students a great preparation for an international career in scientific research. The RIMLS research environment is of high quality. The programme includes many very good researchers – and some outstanding ones – in Molecular Life Sciences or a related domain. The research orientation of the programme is evident. Not only is a lot of attention paid to research training in the courses, but students are also involved in many research activities within and outside the RIMLS scientific community. More importantly, MMD students are taken seriously within the RIMLS research community and are actively encouraged to reflect on their professional career development. The panel compliments the programme on the support given to students in this respect, e.g. through the mentor program, by checking CVs, by helping students with their grant applications and by supporting them with the development of research proposals for PhD positions.

The panel is impressed with the intensity and flexibility of the mentor programme in place. It established that the ‘open-door’ policy really works, partly as the result of restricted intake numbers and a favourable staff-student ratio (1:10-12). The admissions policy of the programme is thorough and strict, as it should be for a research master’s programme. In the panel’s view, the programme is challenging but feasible. This is confirmed by its high success rates. Finally, the panel established that the programme takes quality assurance very seriously.

The panel identified a couple of suggestions for further improvement, related to the three educational themes and the influx of Dutch students from outside Radboud University and of students from developing countries. Nevertheless, in the panel’s opinion, Standard 2 easily meets the criteria for the qualification ‘good’. In the panel’s view the MMD programme is a very attractive programme for students who want to excel and aspire to a scientific career in Molecular Life Sciences. The programme has many strong and some unique features, including its translational approach, its link to the clinic, its high-quality research environment, its strong research orientation, its intensive mentor programme, its favourable staff-student ratio, and its strict admission policy.

Conclusion

Master's programme Molecular Mechanisms of Disease: the panel assesses Standard 2 as 'good'.

Standard 3: Assessment

The programme has an adequate assessment system in place.

Explanation:

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

Findings*Assessment policy, coherence and quality of course assessments*

In 2014, the Faculty of Medical Sciences developed an assessment policy. This assessment policy describes a common set of principles for assessment of all its educational programmes. They focus on the coherence between the course objectives and content, the intended learning outcomes and the assessment; the availability of assessment matrices for all courses; the availability of course objectives and the examination policy; peer review of written exams; and clear criteria and guidelines for scoring the results. In addition to the faculty-wide assessment policy, each programme developed an examination programme, covering the relation between the intended learning outcomes and the course objectives on the one hand and assessment and assessment types on the other. The formal assessment rules of MMD are described in the Education and Examination Regulations, which are revised and approved every year. MMD students are also informed about the assessment procedure through the study guide and additional guidelines, such as the ones for developing the study plan and outlining the two internship periods.

The panel studied the Education and Examination Regulations, the examination programme, the study guide, and the available instructions and guidelines. It found that the study guide of the programme includes detailed information about assessments and their weight in each course. All assessments within a course must be graded 6.0 or higher to pass it. The panel also learned that the programme uses different forms of assessment, including written examinations, assignments including the writing and presenting of research proposals, research training reports and oral presentations. In most courses, there is a combination of assessment types which together determine the final judgement. In the panel's view, the assessment types in the MMD programme are consistent with the course objectives.

The panel studied assessment files from a number of courses in the programme (for detailed information, see Appendix 5). It also addressed the process of developing and compiling written exams during the site visit in discussion with staff members. It found that the assessments it examined were of the right level and covered the course content. It also established that the faculty-wide principle of peer review of written exams is followed by the MMD staff. An examiner is appointed for each examination by the Board of Examiners. In most cases this is the course coordinator. Before an exam is finalised, it is checked by a peer. The course coordinator also checks that all course objectives are adequately tested. The panel is convinced that the written exams are carefully compiled and that the faculty-wide principles for quality assurance of assessment are followed.

During the site visit, the panel questioned students and alumni about the transparency of assessment and the feedback they received. The students confirmed that in general they are well-informed about assessments and what is expected from them. They also told the panel that they are happy with the amount of feedback they receive on their work. As a result of the 'open-door' policy and the small scale of the programme, it is easy for them to ask a lecturer for additional comments when necessary. The panel agrees that the 'open-door' policy and the accessibility of the staff are strong features of the programme. It is very useful for students to

receive additional oral feedback on their exams. However, the panel recommends that the programme limit the number of feedback rounds on draft versions of internship reports and master's theses. The amount of feedback that students receive on draft versions of internship reports and theses should also be taken into account more explicitly in determining the final grade (see below). These two measures will guarantee that students are treated equally and graded for the actual work they have put into the internship reports and master's thesis.

The panel established from the examination programme, the study guide and the assessment files that the relation between the intended learning outcomes, the course objectives and the assessments in the programme is clear and well thought out. Students within the MMD programme have a considerable amount of freedom in composing their individual study programme. They need to hand in a 'Study Plan' to ensure that the quality of the individual plans is sufficient and that they all achieve the intended learning outcomes. The individual 'Study Plans' need to be approved by the Board of Examiners. Additionally, students need to hand in a 'Work Plan' for each research-training period in which they specify the intended research question, background, aims, course of action, name of intended supervisor and host laboratory. The panel examined a couple of study and work plans. It is convinced that they are adequate tools in assuring that all students follow a programme of sufficient level and achieve the intended learning outcomes.

Assessment of the research-training periods

The MMD programme comprises two research-training periods in which independent research projects are conducted. In the panel's view, the research-training periods are a great preparation for a future career in academia. The first research-training period takes place under the direct supervision of an RIMLS or Radboudumc senior researcher and concludes with a comprehensive report. It is also possible for students to do their first research-training period in Barcelona. The second research-training period is conducted at an external lab (most of the times a top institute abroad) and concludes with a master's thesis. It is also possible for students to write a Literature thesis and a master's thesis. The final products of the programme (first internship report and master's thesis) are suitable for a research master's programme. However, the panel advises the programme management to make the Literature thesis compulsory for all students (see Standard 2).

Prior to the site visit the panel studied the internship reports (first research-training period), master's theses and, if available, literature theses (second research-training period) of 15 graduates including the assessments by the examiners. From the list of graduates from the last two cohorts, the panel noted that the programme has a general tendency to give high scores for the internship. The 2013-2015 cohort scored an average of almost 8.5 for the internship as a whole; 37% of the grades for the internship as a whole were 9.0 or higher. The panel also established that more than 50% of all students finish the programme with a cum laude degree. During the site visit, it discussed this issue with the management and the Board of Examiners. They explained that the programme has a very strict admission procedure; only the best students are admitted. The panel agrees that strict admission criteria and an ambitious student population will result in higher than average scores. However, in the panel's view several of the reports and theses it studied should have been given a lower grade; the panel members would have given a score at least 0.5 point lower than the assessors of the MMD programme. The programme should take this issue seriously. The panel would like to emphasize that the grading process should not be influenced by the ambitions of students to graduate with a cum laude degree. The assessment process should ensure that the grade given is based solely on the quality of the internship report/master's thesis.

In the panel's view, part of the problem described above can be solved by improving the assessment form for the internship report and the master's thesis. The panel was pleased to find that the Board of Examiners had already concluded that the assessment form needed improvement and had recently adopted revised versions. It studied the revised versions of the assessment form for the internship report and the master's thesis. It concludes that the new forms are very detailed and include all necessary grading criteria. However, further improvements need to be made. In the panel's view, the grading criteria should be categorised more logically, and the programme should include instructions about the weighting of the grading criteria (sets) in the form. For example, the programme could categorize the criteria in four blocks: 1. Presentation, 2. Form and structure, 3. Content and 4. Difficulty of the project and the input given by the supervisor. The final grade should be a weighted final grade based on the averages of the grades for each block. Of course, block 3 (Content) should be the main component weighting into the final grade. It should therefore be assigned a relative higher weight than the other blocks towards obtaining the final grade. With regard to the second internship period, the panel advises that a second assessor should attend and grade the presentation. If it is not possible for a second assessor to attend, then the student should do his/her presentation twice. The presentations should be given a separate grade that, for example, counts 10% towards the final grade.

The panel noted that not all of the reports and theses it studied were assessed with the same level of accuracy. Even though the inclusion of a translational section in the report is obligatory, some reports lacked one but still received a high mark. The amount of feedback on the assessment forms also varied widely. The panel urges the Board of Examiners to develop a formal rule explaining to assessors what they should do if mandatory elements are missing in a report/thesis. It also advises the Board to make sure that all assessment forms include written feedback.

Board of Examiners

The MMD programme has its own Board of Examiners. During the site visit, the panel questioned the Board of Examiners about the way in which it fulfils its legal responsibilities. It learned that the Board of Examiners takes the active role expected of it in the quality assurance of assessment of the programme. For example, the Board issues the Rules and Guidelines for Examiners, officially appoints the examiners, assesses the Study and Work Plans of all students in the programme, and reviews and revises the assessment forms for internship reports and master's theses (also addressed below). The Board is supported by the faculty-wide Assessment Service, which reviews three written course examinations of the MMD programme each year and gives feedback to the examiners and the Board. This means that all course examinations are tested at least once during a three-year period. In 2015, the Board evaluated the assessments of three master theses (reports from the second research-training period) to see how the final grades were determined by the research training supervisor in the Netherlands and abroad and by the second assessor from RIMLS. In the panel's view, this is a very small sample. It advises the Board of Examiners to increase its scope in the near future.

The panel studied the minutes of the Board of Examiners. It concluded that the Board of Examiners takes its responsibilities very seriously. Problems are investigated and solved in a satisfactory manner. During the site visit, the panel discussed the assessment form for the internship report and the master's thesis in detail. It was pleased to find that some of the problems with this form had also been identified by the Board. Last year, the Board developed a revised form. The discussion between the panel and the Board of Examiners resulted in concrete ideas for further improvement. The panel is convinced of the professionalism of the Board of Examiners. It is confident that this Board is in control and able to solve the issues

with the grading and the assessment form of the internship report and master's thesis independently.

Considerations

The panel established that the assessment rules, regulations and policy of the MMD programme are described clearly and are followed by the MMD staff. The forms of assessment in the programme are varied and match the learning objectives of the courses. The assessments examined by the panel were of the right level and covered the course content. The relation between the intended learning outcomes, the course objectives and the assessment is well thought out. The panel is convinced that all students are adequately tested on all intended learning outcomes.

The two internship periods prepare students properly for a future career in scientific research, and the internship report and master's thesis are adequate tools to assess the level of graduates of a master's programme in the field of Molecular Life Sciences. In the panel's view, the assessment form needs further improvement, and the Board of Examiners should implement a formal rule explaining to assessors what they should do if mandatory elements are missing in a report/thesis. Furthermore, the Board of Examiners should make sure that all assessment forms include sufficient written feedback.

The Board of Examiners takes its responsibilities very seriously. The panel established that the Board is in control and has the right expertise. It is more than confident that the Board of Examiners will implement the recommendations above in a satisfactory manner. Therefore, it assesses Standard 3 as 'satisfactory'.

Conclusion

Master's programme Molecular Mechanisms of Disease: the panel assesses Standard 3 as 'satisfactory'.

Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Explanation:

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

Findings

The panel studied the internship reports, master's theses and literature theses (where available) of 15 graduates from the 2012-2014 and 2013-2015 cohorts. Although it did not fully agree with the marks given (see Standard 3), it was impressed by the overall level of the reports and theses. In general, the reports and theses were well-constructed and demonstrated a high level of in depth knowledge of the respective topics. Some of the master's theses were based on work that had already been published or submitted in high-ranking peer reviewed journals. The reports and theses demonstrated that MMD graduates are capable of performing scientific research on a high level and of working in international research teams. The panel is convinced that graduates achieve the ambitious intended learning outcomes of the programme.

Another measure of the programme's quality is the employment record of graduates in scientific research. The panel found that this record is very high: 82% of MMD graduates find a PhD position either shortly before or directly after graduation. Just over 50% of the graduates choose to pursue their PhD at Radboud University, 30% choose a PhD abroad, and 18% choose one elsewhere in the Netherlands. Graduates are readily accepted by other PhD programmes at prestigious institutes.

Considerations

Based on the overall level of the internship reports and theses and the performance of graduates, the panel concludes that graduates achieve the ambitious intended learning outcomes of the programme. In its view, the high proportion of MMD students working in scientific research, the number of their publications in peer-reviewed journals, and the fact that many MMD students are accepted as interns at prestigious research institutes are further evidence of the high quality of graduates of the programme. In the panel's view, the achieved learning outcomes of the programme clearly surpass the generic quality standards. Therefore, the panel assesses Standard 4 as 'good'.

Conclusion

Master's programme Molecular Mechanisms of Disease: the panel assesses Standard 4 as 'good'.

Overall judgement

The panel assesses the *Master's programme Molecular Mechanisms of Disease* as 'good'.

Measures for improvement

Revise the three educational themes (Standard 2);

Make the 'Literature thesis' compulsory for all students in the programme (Standard 2);

Improve the visibility of the programme and intensify the marketing of the programme to Dutch students from other universities than Radboud University (Standard 2);

Support students from developing countries more actively with funding and investigate options allowing medical students to enrol (Standard 2);

The Board of Examiners should enlarge the sample of theses it assesses every year (Standard 3);

A second assessor should always attend and grade the presentation of the master's thesis (Standard 3);

The Board of Examiners should develop a formal rule explaining to assessors what they should do if mandatory elements are missing in a report/thesis. It also advises the Board to make sure that all assessment forms include written feedback (Standard 3);

The programme should limit the number of feedback rounds on draft versions of internship reports and master's theses (Standard 3);

The Board of Examiners should revise the thesis assessment form (Standard 3).

Appendices

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

Professor Frans C.S. Ramaekers was trained as a chemist at the University of Nijmegen, specialized in Biochemistry at the University of Nijmegen and Pharmaco-chemistry at Organon, Oss, and graduated in 1977. He received his PhD degree in 1981 from the University of Nijmegen for a thesis on the role of the cytoskeleton in cell differentiation. From 1981 to 1990 he was associate professor at the Department of Pathology of the University Hospital in Nijmegen. In 1989 he received the Bristol-Meyers Oncology Award for this work. In June 1989 he was appointed professor of Molecular Cell Biology at Maastricht University and became chairman of the Department of Molecular Cell Biology & Genetics. He has been president of the European Cytoskeleton Forum, chairman of the Dutch Society for Cell Biology, member of the boards of the Dutch Society for Oncology, of the Federation of Medical Scientific Societies and of the Society of Experimental Biology (UK), and member of the editorial board of several international journals. He founded MUBio Products BV in 1998 and is now CSO at Nordic-MUBio. In March 2010, he was appointed scientific director of GROW - School for Oncology and Developmental Biology at the Maastricht University Medical Centre.

Professor Paul Coffer studied biochemistry at Oxford University and graduated in 1988. He performed his postgraduate work at the Ludwig Institute for Cancer Research (London, UK) and obtained his PhD in 1991. He then moved to the Netherlands for a postdoctoral period at the Hubrecht Institute (Utrecht, The Netherlands). In 1995 he was appointed Assistant Professor and then Associate Professor at the Dept. for Respiratory Medicine (University Medical Center Utrecht) before moving to the Wilhelmina Children's Hospital and being appointed a full Professor of Pediatric Immunology in 2006. From 2011 he moved to the Center for Molecular Medicine as Professor of Cell Biology. In 2015 he was appointed scientific director of the UMC Utrecht Regenerative Medicine Center based at the Hubrecht Institute. He is the coordinator of several UU Master's courses and is currently chair of the Utrecht University Regenerative Medicine PhD program.

Professor Caroline Kisker was trained as a biochemist at the Free University of Berlin and graduated there in 1991. From 1991 to 1994 she pursued her PhD thesis in the laboratory of Prof. Wolfram Saenger at the Free University of Berlin where she solved the structure of the tetracycline repressor in complex with the antibiotic tetracycline. She then moved to the USA and worked in the laboratory of Prof. Douglas C. Rees as a postdoc for 3.5 years where she mainly focused on the analysis of the medically highly relevant enzyme sulphite oxidase. After becoming an independent investigator at Stony Brook University, NY, USA in 1998 she focused on the molecular machinery maintaining genomic integrity and on structure-based drug design projects. In 2000 she became a PEW Scholar in the Biomedical Sciences. In 2001 she became Associate Professor at Stony Brook University and in 2005 she moved to the Rudolf Virchow Center of Experimental Biomedicine at the University of Würzburg where she became chairwoman of Structural Biology. In 2009 she was appointed to be the Dean of the Graduate School of Life Sciences, which is funded through the German Excellence Initiative. Since 2009 she is also the Vice Chair of the Rudolf Virchow Center for Experimental Biomedicine and in 2011 she was elected to become a member of the German National Academy of Sciences Leopoldina.

Dr. Dik van Gent was trained as a biologist at Utrecht University with a specialization in chemical biology. He graduated in 1988. He obtained his PhD at the Free University Amsterdam for research conducted at the Netherlands Cancer Institute under supervision of Prof. Ronald Plasterk. After his PhD defense in 1993, he went on to do a postdoctoral research period at the National Institutes of Health (Bethesda, USA) from 1993 to 1996. He studied the

mechanism of V(D)J recombination in the immune system, for which he received the annual prize of the Netherlands Society for Biochemistry and Molecular Biology (NVBMB) in 1997. In 1996 he started his position as assistant professor at the Erasmus University (currently Erasmus MC) in the Department of Genetics (currently Molecular Genetics). He is now Associate Professor and Director of the Research Master 'Molecular Medicine'. Furthermore, he is a board member of the Netherlands Society for Radiobiology (NVRB), organizer of several meetings and editor for the journals 'DNA Repair' and 'Genome Integrity', as well as frequent reviewer for scientific journals and funding agencies.

Anouk Baars, MSc., graduated from the research master 'Medical Pharmaceutical Drug Innovation' (MPDI) at the University of Groningen in 2015. During her studies, she participated in an Honours programme on leadership (2013-2014), chaired the social foundation board (2012-2013), was a member of the Programme Committee of the MPDI (2013-2015) and editor of 'Lifeline' (the magazine of Idun, the study association for Biology and Life Science & Technology at the University of Groningen). Recently, Baars started as consultant in the health practice of IG&H consulting and interim in Utrecht.

Appendix 2: Subject-specific reference framework and final qualifications MSc MMD

Researchers in the field of molecular life sciences and molecular medicine are expected to have in depth integrated knowledge across a broad area of disciplines in molecular life sciences, biology and biomedicine, ranging from chemical biology, cell biology, genetics, immunology to regenerative medicine. MSc MMD graduates need to have the ability to apply and critically assess this knowledge to the design, execution and successful completion of research projects. One development in the molecular life sciences is early specialization, but commonalities between subdisciplines are also essential. Opportunities for students to acquire cross-discipline knowledge, for example “metabolic regulation in cancer and immunity” allows them to see connections which they can use in a future research career.

The final qualifications of the MSc MMD programme are the following:

- a. broad fundamental knowledge on the molecular mechanisms underlying disease processes in the full width of the molecular life sciences;
- b. knowledge about key developments in translational medicine and ability to translate fundamental molecular knowledge into medical experimental research towards new therapies and diagnostics;
- c. ability to autonomously formulate a research problem, design and perform scientific research on a high level, keeping up with international standards;
- d. competence to participate in scientific discussions at an international level and present his/her work in the English language to an international scientific audience;
- e. capacity to write at the level of published articles in international peer-reviewed journals;
- f. ability to integrate the societal and ethical impact of scientific research at relevant moments and in relevant situations in his/her scientific career;
- g. proficiency to move into an international PhD programme or participate in projects at biotechnology companies or the pharmaceutical industry.

Appendix 3: Overview of the curriculum

Week	Year 1	Year 2	
36	Introduction to Molecular Mechanisms of Disease (2.5 EC)	Genomics and statistics (3 EC)	
37			
38	Excellence in communication (1.5 EC)	Science and society (1.5 EC)	
39	Scientific skills (3 EC)	Masterclass (1.5 EC)	
40	Cell growth and differentiation (3.5 EC) & Developmental disorders and malignancies (2 EC)	Electives (9 EC) & Radboudumc PhD proposal	
41			
42			
43			
44	Infection, immunity and regenerative medicine (3.5 EC) & Immunity related disorders and immunotherapy (2 EC)	Research-training period 2 (39/45 EC) or Literature thesis (6 EC)	
45			
46			
47			
48	Metabolism, transport and motion (3.5 EC) & Metabolic disorders (2 EC)	Research-training period 2 (39/45 EC) or Literature thesis (6 EC)	
49			
50			
51			
2	Masterclass (1.5 EC)	Research-training period 2	
3	Research-training period 1 (31.5 EC)		
4			
5			
6			
7			
8			
9			Electives (2 EC) & Scientific skills
10			
11			
12			
13			
14			
15			
16	Masterclass (1.5 EC)		
17	Research-training period 1		
18			
19			
20			
21			
22			Electives & Scientific skills
23			
24			
25			
26			
27			

Appendix 4: Programme of the site visit

Visiting timetable Molecular Mechanisms of Disease Room Titus Brandsmakamer		
Monday 25 April 2016		
	12.00	Arrival - <i>welcome by Roland Brock</i>
12.00	15.00	Preparatory meeting panel Lunch (12.30)
15.00	15.45	Interview with the programme management (<i>short presentation Roland Brock</i>)
15.45	16.00	Internal meeting panel
16.00	16.45	Interview with (2 nd year) students
16.45	17.00	Internal meeting panel
17.00	17.30	Interview with alumni
Tuesday 26 April 2016		
08.45	09.00	Arrival
09.00	09.45	Internal meeting panel
09.45	10.30	Interview with lecturers
10.30	10.45	Internal meeting panel
10.45	11.15	Interview with Education Committee => Programme Committee
11.15	12.00	Interview with Board of Examiners , Assessment Committee, Study Advisor/Coordinator
12.00	13.30	Open office hour (12.30-13.00hrs) / Tour Lunch ; Internal meeting panel
13.30	14.00	Interview with programme management (including dean)
14.00	16.00	Internal meeting panel
16.00	16.15	Presentation of preliminary findings (public) – Hippocrates room, route 77

Programme Management (MMD Educational Management Team (OMT)) – 25 April

Prof. Dr. Roland Brock	Chair OMT; Programme Director MMD
Dr. Wiljan Hendriks	Member
Dr. Helma Pluk	Curriculum coordinator
Dr. Bert van der Reijden	Member
Dr. Ronald van Rij	Member
Ms. Juulke Steuten	Student member

MMD Students (first year students and just graduated students since all 2nd year students are abroad for their second research-training period)

	<i>Nationality</i>	
Mr. Teun van den Brand	Dutch	1st year student
Mr. Aykut Demir	Turkey	1st year student
Ms. Lotte Tholen	Dutch	1st year student
Ms. Valentyna Kryklyva	Ukrainian	1st year student
Ms. Miriam Butler MSc	German	Graduated 2015
Ms. Mireia Coll Tané MSc	Spain	Graduated 2015

Ms. Eva-Leonne Göttgens MSc	Dutch	Graduated 2015
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MMD Alumni

	<i>Nationality</i>	<i>Graduated</i>	<i>Position</i>
Ms. Aysegul Erdem MSc	Turkey	2015	PhD UMC Groningen
Mr. Maxim Baranov MSc	Russia	2014	PhD Tumor Immunology Radboudumc
Ms. Stephanie Cornelis MSc	Dutch	2014	Research Assistant Human Genetics Radboudumc
Mr. Rob van Dalen MSc	Dutch	2014	PhD Utrecht University
Ms. Susan Schuster MSc	Germany	2013	PhD Medical Microbiology Radboudumc
Ms. Rocio Acuna Hidalgo MSc	Spain	2012	PhD fellowship Human Genetics Radboudumc
Mr. Markus Loeven MSc	Germany	2012	PhD fellowship Nephrology Radboudumc

Lecturers

	<i>Department</i>		<i>Role in MMD – see Appendix V report</i>
Dr. Janiella van Alfen van der Velden	Pediatrics	Course coordinator MM2TR	L, C
Prof. Dr. Alessandra Cambi	Cell Biology	Internship Supervisor; Vice-course coordinator MMEC, MM1MC	L, M, I, S, E
Dr. Rob Collin	Human Genetics	Internship Supervisor; Lecturer	L, S, M, I, E
Dr. Wiljan Hendriks	Cell Biology	Course coordinator MM3CF; OMT member	L, C, MT, M, I, E
Prof. Dr. Joost Hoenderop	Physiology	Course coordinator MMIC	L, C, M, I, E
Prof. Dr. Martijn Huijnen	CMBI	Lecturer	L, s, I, M, E
Dr. Bert van der Reijden	Laboratory Medicine	Course coordinator MM1TR; OMT member	L, C, MT, M, I, S, E
Dr. Annemiek van Sriel	Tumor Immunology	Course coordinator MM1MC; Internship Supervisor	L, C, M, I, S, E

Programme Committee (Educational Committee)

Dr. Peter van der Kraan	Chair
Dr. Ineke van der Zee	Member
Dr. Esmeralda Blaney Davidson	Member
Ms. Diede van Ens	Student member
Ms. Marieke Roefs	Student member
Ms. Cansu Yanginlar	Student member
Mr. Ruben van Osch	Student member
Mr. Erwin Beelen	Student assessor Radboudumc (student Medicine)

Board of Examiners and study advisor MMD

Dr. Johan van der Vlag	Chair
Dr. Arjan de Brouwer	Vice-chair; Student selection coordinator Course coordinator MMST
Dr. Merel Adjobo-Hermans	Member; Student selection coordinator
Dr. Rick Wansink	Member
Dr. Colin Logie	Member
Dr. Helma Pluk	Study Advisor MMD

Programme Management (including formal responsible persons) – 26 April

Prof. Dr. Paul Smits	Dean
Prof. Dr. Roland Brock	Programme Director MMD
Dr. Helma Pluk	Curriculum coordinator MMD
Dr. Wiljan Hendriks	Member OMT
Dr. Bert van der Reijden	Member OMT
Ms. Juulke Steuten	Student member OMT

Appendix 5: Theses and documents studied by the panel

Prior to the site visit, the panel studied the internship reports and master's theses of the students with the following student numbers:

4039238	4237242
4337697	3016366
4328140	3008703
4332768	4255909
4330064	3032523
4287444	4264630
4039181	3009734
4326571	

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):

1. Course manual 'Developmental disorders and malignancies' – MM3TR 2015-2016
2. Course manual 'Metabolism, transport and motion' – MM2CF 2015-2016
3. Course manual 'Genomics and statistics' – MMST 2015-2016
4. Course manual 'Science and society' – MMSS 2014-2015; intended course setup for 2016-2017
5. Course manuals and evaluation of MMD masterclasses
 1. Overview evaluation scores
 2. MM2MC 1516 (April 2016): Molecular mechanisms of pain
 3. MM3MC 1516 (January 2016): The cilia Journey
 4. MM1MC 1516 (September 2015): Molecular basis of tumor invasion
 5. MM3MC 1415 (April 2015): Gliomas: targeting metabolism
 6. MM2MC 1415 (January 2015): P-type ATPases
 7. MM1MC 1415 (September 2014): Stem cells in research, regeneration and disease
 8. MM2MC 1314 (January 2014): Oxygen in health and disease
 9. Poster "Masterclasses, kritische succesfactoren en best practices voor een uitdagend stimulerend leertraject": poster contribution to NVMO (Dutch Society for Medical Education) Conference 2013
6. Instructions and materials 'Research-training period 1 and 2'
 1. Instructions sent along with approval letter of Board of Examiners (one example)
 2. Guidelines Research Internships MMD
 3. Handouts of Workshop internship report writing I and II during Scientific Skills course (see also Blackboard course Scientific Skills 2014-2015)
 4. Handouts of 2nd year meeting with instructions for international internships
 5. List of visited places (available for students on Blackboard)
 6. Mid-term assessment form
 7. Assessment forms (plus 7 extra copies)
7. Studyplans of students cohort 2013-2015 (same eight students as for which thesis and assessment forms were provided digitally)
 1. Final approved studyplan
 2. Workplan 1st research-training period
 3. Workplan 2nd research-training period

4. Application Literature Thesis (if applicable)
5. Knowledge Transfer sheet
6. Assessment form research-training period student 4330064
8. Literature theses students 2014-2016 and 2013-2015
 1. Overview
 2. Literature Theses
9. Programme and abstracts RIMLS New Frontiers Symposia 2013, 2014 and 2015
10. Annual reports Molecular Mechanisms of Disease
 - 2014-2015: Annual report Programme Committee & Annual report Board of Examiners
 - 2013-2014: Annual report MMD: Programme Committee Chapter 4.3; Board of Examiners Chapter 5
 - 2012-2013: Annual report MMD: Programme Committee Chapter 4.3; Board of Examiners Chapter 5
 - 2011-2012: Annual report MMD: Programme Committee Chapter 4.3; Board of Examiners Chapter 5
11. Minutes Board of Examiners meetings (February 2016 - September 2013)
12. Minutes Programme Committee Molecular Mechanisms of Disease (February 2016 - October 2013)
13. MMD Examination papers (exam questions, answering model, assessment matrix) of all courses with a written exam; academic year 2015-2016 and 2014-2015.
14. Matrix Final Qualifications MSc MMD versus course objectives / assessment type (A3)
15. Core textbooks MMD programme:
 - Lodish: Molecular Cell Biology, W.H.Freeman & Co Ltd, 7h edition (2012)
 - Parham: The Immune System, Taylor & Francis Inc, 3rd edition (2009)
 - Petrie & Sabin: Medical Statistics at a Glance, John Wiley and Sons Ltd, 3rd edition (2009)
16. Blackboard Digital learning environment:
Access to all courses academic year 2015-2016; Scientific Skills and Science and Society 2014-2015 and UMCN Student Community. The UMCN Student Community contains information for all students about:
 - Programme information
 - Information internships (e.g. guidelines, projects, list of visited places)
 - Study plan forms (and information)
 - Assessment forms
 - Evaluation papers of MMD courses

Blackboard Courses:

Course	Blackboard name
Bioinformatics Introductory Module – optional course in summer before start of the programme	MED-BpM-2015-11-V: 1516 Bioinformatics Introductory Module
Introduction to Molecular Mechanisms of Disease	MED-MMIC-2015-1-V: 1516 Introduction to Molecular Mechanisms of Disease
Excellence in communication	MED-MMEC-2015-1-V: 1516 Excellence in Communication
Scientific skills	MED-MMSK-2015-1-V: 1516 Scientific Skills &

	MED-MMSK-2014-JAAR-V: 1415 MMD Scientific Skills
Cell growth and differentiation	MED-MM3CF-2015-2-V: 1516 Cell Growth and Differentiation - Core Fundamental
Developmental disorders and malignancies	MED-MM3TR-2015-2-V: 1516 Cell Growth and Differentiation - Translational Research
Infection, immunity and regenerative medicine	MED-MM1CF-2015-3-V: 1516 Infection, Immunity & Tissue Repair - Core Fundamental
Immunity related disorders and immunotherapy	MED-MM1TR-2015-3-V: 1516 Infection, Immunity and Tissue Repair - Translational Research
Metabolism, transport and motion	MED-MM2CF-2015-4-V: 1516 Metabolism, Transport and Motion: Core Fundamental
Metabolic disorders	MED-MM2TR-2015-4-V: 1516 Metabolism, Transport and Motion - Translational Research
Masterclass 2	MED-MM2MC-2015-5-V: 1516 Masterclass Metabolism, Transport and Motion
Masterclass 3	MED-MM3MC-2015-5-V: 1516 Masterclass Cell Growth and Differentiation
Research-training period 1	UMCN-MMD-IS-1112: 1112 Internship MMD
Genomics and statistics	MED-MMST-2015-1-V: 1516 Genomics and Statistics
Science and society	MED-MMSS-2014-01M3-V: 1415 Science and Society
Masterclass 1	MED-MM1MC-2015-1-V: 1516 Masterclass Infection, Immunity and Tissue Repair
Research-training period 2	UMCN-MMD-IS-1112: 1112 Internship MMD