Faculty of Science

Prospectus 2007 - 2008

Molecular Life Science

Master

Radboud University Nijmegen

Preface

This is the prospectus for the education program of the master in Molecular Life Science at the Radboud University Nijmegen.
This prospectus is written with care, however the author is not responsible for inaccuracies.
For additional information please contact:

T.T.U. Nguyen (MSc.)

FNWI Toernooiveld 1
room: HG01.062
6525 ED Nijmegen
phone: (024) 365 30 28

e-mail: u.nguyen@science.ru.nl

Contents

1 General Introduction

1.1 Introduction

The Radboud University (RU) in Nijmegen is a general university divided in 9 different faculties. It offers almost all possible academic programs. One of the 9 faculties is the faculty of Natural Sciences (FNWI). This faculty has bachelor and master programs in Biology, Medical Biology, Environmental Sciences, Molecular Life Science, Bioinformatics, Chemistry, Natural Science, Physics, Astronomy, Informatics, and Mathematics.

This guide provides information about the two years Master of Science program in Molecular Life Science (MLW). This program forms the connection between the three years Bachelor of Science program MLW (with teaching in Dutch) and the state-of-the-art research that is being carried out in different departments of the Faculty of Natural Sciences of the RU and the nearby Radboud Medical Center in the field of molecular life sciences. The program is of international standards with teaching in English, and is open for students with a B.Sc. degree in molecular life sciences or related scientific fields. It is therefore of particular appeal to students of any nationality who qualify in terms of their preceeding studies and want to graduate as a Master of Science at the highest standards.

1.2 Admittance

Admittance to the program requires a Bachelor degree in Molecular Life Science obtained from the RU. Students with another bachelor degree in natural or life sciences from a Dutch university or HBO institution are admitted only after completing an individual program of maximally half a year. This linking program contains courses from the MLW Bachelor program. Depending on their background, remission of a part of the Master program may be given to these students, such that the total program can be completed within two years. Admittance of foreign students depends on their pre-education.

1.3 Structure of the masters program

The two years master program consists basically of one year research training in molecular life sciences and one year professional training. Professional training can be in research (O-variant), business and management (MT-variant, Chapter 3.2), communication (C-variant, Chapter 3.3) or education (E-variant, Chapter 3.4). The two years program consists of courses and traineeships with a total size of 120 ec, in which 1 ec corresponds to 28 hours of study, according to the European Credits Transfer System.

The research year consists of an experimental traineeship of 45 ec and master courses in molecular life sciences to a total of 15 ec. The professional year for students in the MT-, C- and E-variant consists of a facultary program specific for each variant with a total size of 60 ec, which includes a professional traineeship outside the university. O-variant students follow a second 45 ec research traineeship, combined with a 15 ec free program (for specific details see chapters 2 and 3).

Research traineeships can be carried out in a large variety of departments at the RU. Traineeships in molecular life sciences at other universities in the Netherlands or abroad require the supervision of a teacher from one of the listed RU groups, who will take the scientific responsibility for such a traineeship. Each research traineeship of 45 ec in total consists of the following components:

- Experimental research including a written master thesis, to a total of 35 ec
- A literature thesis, covering 6 ec
- Theoretical courses given by the department, covering 4 ec

The O-variant program is mainly aimed for students who plan at a career in scientific research after their M.Sc., for example in a university Ph.D. program or in industry. Their program includes two 45 ec research traineeships. For their 15 ec master courses a selection should be made from the list in chapter 3.1. According to university rules, this should include a 3 ec course in Philosophy. Of the 15 ec free programme, 6 ec can be freely implemented with any course at the university level, while at least 9 ec should be covered with courses in natural science.

The MT-, C- and E- variant programs are mainly aimed for the Dutch market. These students follow one 45 ec research traineeship, 12 ec master courses including a 3 ec course in Philosophy, a 6 ec free program on any academic field and 57ec in professional courses (see chapter 3.2-3.4)

1.4 Competences and final qualifications

Professional competences

The Master of Molecular Life Science:

- is capable, based on broad knowledge of molecular action mechanisms of biological and biomedical processes, combined with specialist knowledge and research experience in at least one sub-area of this field, of independently setting up and conducting research designed to acquire new knowledge and insights in this research area.
- is capable of independently identifying, critically reading and comprehending relevant, up-to-date international literature from different disciplines and integrating them in their entirety.
- is capable of formulating new presentations of questions and hypotheses in the field of molecular life sciences and of selecting the correct paths and research methods for resolving them, making allowances for the availability of services and resources.
- is capable of setting up and conducting a scientific experiment independently, including the related controls, as well as interpreting and evaluating the results obtained in terms of well-founded scientific conclusions.
- is capable of describing his or her research results clearly in a written report, in accordance with the standards of an academic article.
- is capable of independent professional practice whereby, depending on the chosen variant, the emphasis is on conducting fundamental scientific research (under supervision), transferring or applying existing scientific knowledge.
- is capable, based on a critical analysis of his or her research results, of breaking new ground in research areas.

Cognitive and Communicative Competences

The Master of Molecular Life Science:
- is capable of insight and problem-related reflection with a critical attitude towards scientific insights.
- is capable, based in part on an ability to abstract, of analyzing a scientific problem by reducing it to testable sub-problems, in which the analysis distinguishes the essentials from secondary matters.
- is capable of achieving a synthesis from solutions of sub-problems and to place them in a scientific context, thereby contributing to the general development of theories.
- is capable of socially-responsible professional practice, with a view towards the ethical consequences of research in the field of molecular life sciences, along with the ability to reflect on the potential effects on and endurance of society.
- is capable, through self-reflection and conversations with others, of assessing his or her own performance.
- is capable of following general scientific progress in the field of molecular life sciences, particularly within his or her chosen specialization.
- is capable, in addition to his or her current specialization, of working at a specialist level of another branch of molecular life sciences.
- is capable of communicating with professional colleagues working in the same field about his or her scientific knowledge at a specialist level.

1.5 Faculty Students Administration

You have to contact the 'facultaire studentenadministratie (FSA)' in case of:
- Changes in address (personal vacation address; address during study - KISS)
- Termination of study or (temporary) interruption of study
- Change in study direction
- Conformation that the registration of specific study has been extended
- Application for specific examinations (including Bachelor's exam and Master's exam)

Facultaire Studentenadministratie/Examenbureau
Address: Toernooiveld 1
6525 ED Nijmegen
Room: HG00.134
024 3652247/3392

Monday till Thursday from 13.00-16.00 h and Friday from 9.00-12.00 h

Registration for Master's exam
In order to apply for the master's examination it is necessary to also apply to the student administration of the faculty. In addition, you must also be able to show that you have the necessary prerequisites for the master's exam. These consist of: (1) you have obtained your bachelor's degree, (2) you are officially registered as a student and (3) you were registered as a student during all the years that you wrote and passed examinations. It is also necessary to bring identification (passport or ID-card)

Apply before:	Date of examination:
10 september 2007	24 september 2007
15 oktober 2007	29 oktober 2007
12 november 2007	26 november 2007
26 november 2007	10 december 2007
14 januari 2008	28 januari 2008
11 februari 2008	25 februari 2008
17 maart 2008	31 maart 2008
07 april 2008	21 april 2008
09 mei 2008	26 mei 2008
16 juni 2008	30 juni 2008
30 mei 2008	29 augustus 2008

A more precise version of these regulations is available at the FSA.

1.6 Examination Appeals Board

With regard to examination-related matters, students can appeal to the Examination Appeals Board of the Radboud University Nijmegen. The procedure to be followed is described in the Vademecum. In addition to the Examination Appeals Board, there is a Higher Education Appeals Tribunal in The Hague (see Vademecum).

1.7 Student Association Sigma

V.C.M.W. Sigma is the Student Association for chemistry and molecular life sciences students. Its basic goal is providing these students with the opportunity to get to know each other in an informal way. To achieve this Sigma organizes not only study-related activities but also a variety of social activities. For example: lectures, excursions, sports tournaments, the Sigma symposium, a weekend-camp, a playback show, drinking bouts and parties, an exchange with students from the ETH Zurich and also the parents' day where parents of freshmen can be students for a day.

Sigma shares a canteen with other student associations of the Faculty of Science where coffee, tea, candybars and snacks are sold during lunch hours. Sigma also provides students with the opportunity to order books needed for classes. Prices lie way below those which are common in bookstores. Every year Sigma produces an almanac. Sigma also has its own magazine "G-mi" that updates its readers on everything that is happening in Sigma and around the studies chemistry and molecular life sciences. On the internetpage you can find all activities and the names of the committees responsible for the various topics.

Membership is 10 euro for one year and 25 euro for all years of being a student.
Sigma can be found in room HG00.150 from 12:30-13:30 hours on Monday, Tuesday, Thursday and Friday; telephone: 024-3653441)

Internet: www.sigma.science.ru.nl and e-mail sigma@science.ru.nl

1.8 BBB Foundation

This annual career-event helps undergraduate and graduate students scouting the job-market. The event takes place in Spring semester at the Science Faculty.
A great number of companies, organizations as well as follow-up degree programmes present themselves. As BBB has historic ties with chemists, the exhibition is very useful for chemistry students.

Companies are present with a display and give lectures. You can gather information and talk with recruiters. Senior and PhD students can apply on-line around the time of the exhibition and make a chance to be invited by one or more of the companies for an interview. These interviews are organized by BBB a few weeks after the exhibition. The chances to be invited at that moment are much higher as compared to when you send an open application to a company. The exhibition is renowned for its casual atmosphere and for its service to the visitors. Admission is free, no registering is needed and everybody receives the BBB-career guide. Prior to the exhibition, BBB organizes workshops on a variety of topics that are relevant for job-seekers and career-starters, such as: interview training, case studies, but also more light-hearted topics.

Address: Toernooiveld 1, HG00.154
024-3652388
www.bbb-carrierebeurs.nl
e-mail: bbb@science.ru.nl

2 Research Departments

2.1 Central Hematology Laboratory

Scientific staff: Dr. H. Dolstra, Dr. B.A. van der Reijden, Dr. J.H. Jansen
Dr. W. van Heerde

Research

Central Hematology Laboratory, University Medical Center St Radboud contains three research lines focused on hematological diseases.

- Stem cell transplantation and Immunotherapy
- Molecular Hemato-Oncology
- Thrombosis Hemostasis Organisation Radboud (THOR)

Description of research

Stem cell transplantation and Immunotherapy
Dr. Harry Dolstra, tel 024-3619753, h.dolstra@chl.umcn.nl
Our goal is to develop specific forms of immunotherapy to induce a more potent anti-tumor immune response without damaging normal cells and tissues. Severe damage can lead to graft-versus-host disease (GVHD). Therefore, our research focuses on the identification of immunogeneic proteins that are selectively expressed on tumor cells. These antigens are characterized at the molecular level, and studied whether they are capable of inducing an immune response ex vivo in the human setting and in vivo in animal models. Furthermore, applied research is performed to investigate whether the identified and characterized antigens can be used for dendritic cell vaccination in patients.

Besides regular and specialized cell culture we apply cellular immunological techniques such as T cell stimulation assays, chromium-release assays, ELISA and immuno-flow cytometry. In addition molecular (cell)-biological techniques such as PCR, gene cloning, transfection, retroviral transduction and real-time RT-PCR are used.

Molecular Hemato-Oncology
Dr. Bert A. van der Reijden, tel 024-3610401, b.vanderreijden@chl.umcn.nl or
Dr. Joop H. Jansen, tel 024-3610372, j.jansen@chl.umcn.nl .
One of the main focuses within the Molecular Hemato-Oncology unit is the functional characterization of mutated transcription factors as found in acute myeloid leukemia. We focus on a specific type of leukemia that can be very efficiently treated with high doses of vitamine A. We are studying to what extent the mutated transcription factor (RARA) influences the transcriptional program, and how this is altered by treatment of the malignant cells with vitamine A. In addition, we are studying the biochemical and biological function of a set of genes/proteins that we identified earlier to be rapidly induced after treatment of the malignant cells with vitamine A. These proteins included inhibitors of transcription factors (Id1/Id2 proteins) and RING finger proteins involved in targeted degradation through the ubiquitin-proteasome pathway. Other mutated transcription factors we are studying include WT-1 and

CBF (AML1/CBFB).
Used techniques include standard molecular biological assays (Southern, Northern and Western blotting, DNA cloning, cell culture and cell transfection) and micro array CHIPs, real-time PCR, flowcytometry, immunefluorescence, chromatine immuneprecipitation, yeast-two-hybrid assays, retroviral gene transduction, seldi-tof, ubiquitylation assays and RNA interference.

Thrombosis Hemostasis Organisation Radboud (THOR)
Dr. Waander van Heerde tel 024-3610800, w.vanheerde@chl.umcn.nl
In the western population, thrombosis is responsible for approximately 40% of all deaths. Deregulations of the hemostatic balance my results in either thrombotic complications (for example an acute myocardial infarction) or a bleeding diathesis (for example in hemophilia A patients).

The Central Hematology Laboratory in collaboration with the department Hematology and Hemophilia Care Centre perform fundamental and clinical-related research of the hemostatic balance. The main issues are: a) (genetic) regulation of the coagulation and fibrinolytic pathway; b) Relationship between phenotype and genotype in haemophilia patients; c) the physiological relevance of annexins in the regulation of the hemostatic balance.
In our research activities a whole spectrum of techniques will be used ranging form molecular biology up to protein chemistry techniques. These techniques include protein purification, protein detection, DNA and RNA isolation, DNA and RNA detection including real time PCR. Recently we started with a proteomic approach called SELDI-TOF to determine specific biomarkers in complex samples (for example plasma, or cell lysates).

Opportunities for students
suitable for students Molecular Life Science
(administration code: LM224A, 35 ec, research traineeship and report; LM224C, 6 ec, thesis; LM224D or LM224E, theoretical course)

2.2 Analytical Chemistry (IMM)

Head: Prof.dr. L.C.M. Buydens
Scientific staff: Dr. H.R.M.J. Wehrens, Dr. W. Melssen, Dr. G. Postma
Secretariat: Ms B. Loozen, room HG02.722, tel. 3653180
e-mail: b.loozen@science.ru.nl
Website: www.cac.science.ru.nl

Research
Examples of current projects at the department:
- Developing methods to extract chemical and diagnostic information from Magnetic resonance spectroscopic (MRS) images to diagnose brain tumours (European Community project also in collaboration with UMC, department of radiology).
- Applying chemometrical techniques to the analysis and interpretation of DNA-micro-array data.
- Investigation of relations between molecular structure and biological or physical properties.
- Development and further optimisation of novel statistical modelling techniques.

Description of research
The research in the department of analytical chemistry focuses on chemometrics. Chemometrics is the discipline within Chemistry that develops methods to obtain relevant information from chemical data, by applying techniques such as multivariate statistics, neural networks and genetic algorithms. Increasingly, chemometrical methodologies and techniques are also applied in the optimization of molecular structures with respect to their properties and (bio)chemical activity and in the processing and interpretation of (medical) multivariate images. The research in this department is centred around three main research lines:
- Methodological chemometrics: methodological research on chemometrical techniques like global optimisation methods, neural networks and multivariate statistics.
- Spectroscopic image analysis: linking pixel-based quantification or classification techniques to image processing techniques.
- Molecular chemometrics: applying chemometrics to the analysis, optimisation and determination of molecular structure.

More detailed information can be found on our website: www.cac.science.ru.nl

Opportunities for students
Students are assigned to individual projects and work on their project under the guidance of a direct supervisor, typically a PhD student. On a regular basis, progress of the research is reported orally to the staff and other students. All students are encouraged to participate in an active way to these presentations and discussions. Depending on the specific apprenticeship of a student, specific courses (like Chemometrics II and Capita selecta) are included in the practical training. The bachelors course Chemometrie I is mandatory. Finally, a comprehensive report must be written and an oral presentation (colloquium) should be given.
Suitable profile: Chemistry, Physical-Chemistry and Chemistry-Biology.
(administration code: LM201A, 35 ec, research traineeship and report; LM201C, 6 ec, thesis; LM201D or LM201E, theoretical course)

2.3 Applied Biology

Head: Prof.dr. E.J.J. van Zoelen
Scientific staff: Dr. K. Dechering, Dr. E. Piek
Secretariat: Ms J Rullmann-Freriks, room HG02.204, tel. 3652701
e-mail: j.rullmann-freriks@science.ru.nl
Website: www.celbi.science.ru.nl/project3.htm

Research
- Osteogenomics: from stem cell to osteoblast

Description of research
Human mesenchymal stem cells (hMSC) are pluripotent cells which have the capacity to differentiate into several cell types, such as adipocytes, chondroblasts and osteoblasts. Bone morphogenetic proteins (BMPs) are growth factors which induce osteogenesis *in vivo*. *In vitro*, BMPs potentiate the osteoblast differentiation of hMSCs. Understanding the process of osteogenesis and identifying genes that play key roles in osteoblast differentiation may contribute to the development of improved treatments for patients with bone disease, such as osteoporosis.

Microarray (DNA-chip) analysis is being used to identify those genes which are potential key regulators in osteoblast differentiation of hMSCs. The function of those genes and their role in osteoblast differentiation is established by overexpression of the corresponding cDNA or by selective knockdown of endogenous expression by RNA interference (RNAi). Several bioassays are being used to validate the role of the respective genes in osteoblast differentiation.
In addition to the osteogenomics project, chondrogenomics and adipogenomics projects are in preparation to identify and characterize genes that play a key role in cartilage and fat differentiation, respectively.
Techniques being used in our laboratory include:
Culturing of hMSCs, RNA extraction and cDNA synthesis, microarray analysis, bioinformatics/ statistical data analysis, Sybr Green quantitative RT-PCR analysis, cloning of cDNAs and RNAi oligos into mammalian expression vectors, transfection of cDNAs into mammalian cell lines, alkaline phosphatase assay, calcium release assay, von Kossa staining, Western blotting, cell sorting (FACS), etc.
The osteogenomics project is carried out in close cooperation with Organon scientists. A limited number of traineeships is available at the Target Discovery Unit of Organon Research in Oss.
Dr. Koen Dechering: 0412-663301, koen.dechering@organon.com
Dr. Ester Piek: 024-3652523, e.piek@science.ru.nl

Opportunities for students

If you are interested in a traineeship at our department it is recommended to follow the course Medical Biotechnology.
(administration code: LM217A, 35 ec, research traineeship and report; LM217C, 6 ec, thesis; LM217D or LM224E, theoretical course)

2.4 Biochemistry (UMCN St. Radboud)

Head: Prof. dr. J.J.H.H.M. de Pont
Scientific Staff: Dr. G.J.C.G.M. Bosman, Prof. dr. W.J. de Grip, Dr. T.H. van Kuppevelt
Dr. P.H.G.M. Willems
Secretariat: Ms C. Teunissen, room , tel. 3614259, e-mail: c.teunissen@kwazo.umcn.nl
Website: www.ncmls.ru.nl

Research

- Visual mechanism
- signal transduction and ion transport
- molecules of the extracellulair matrix and tissue engineering

Description of research

Visual mechanism - De Grip/Bosman, tel. 3614262 / 3615390
This group investigates the molecular mechanism of signal expression (light reaction, conformational changes in protein and membrane matrix) and signal transduction (activation of G-proteins, phosphodiesterase, phosphorylation) in the vertebrate photo-receptor membrane. The studied proteins are functionally analyzed in combination with mutagenesis using the baculovirus expression system. The proteins are also structurally analyzed by FT-IR and NMR-spectroscopy.

Signal transduction and ion transport
Willems, tel. 3614589, www.ncmls.ru.nl → membrane biochemistry
Many extracellular stimuli interact with specific cell surface receptors to induce cytosolic Ca2+ signals of high spato-temporal complexity. Strategically localized mitochondria play an important role herein in that they act as Ca2+ buffers and produce ATP in a Ca2+-dependent manner, which is then used for fueling cytosolic Ca2+-pumps. In our research on the cell biological consequences of mitochondrial dysfunction we use cells derived from patients with mitochondrial disorders to elucidate the molecular mechanisms underlying the shaping of the cytosolic Ca2+ signal. To this end we combine live cell imaging with biochemical and molecular biological approaches.

Molecules of the extracellular matrix and tissue engineering
Van Kuppevelt, tel. 3616759, www.ncmls.ru.nl → matrix biochemistry
In the extracellular matrix around each cell specific molecules like proteoglycans and collagens are present. The role of these molecules in cellular and pathological processes, like long emphysema, diabetic nephropathy, muscle dystrophy and tumor formation, is studied in collaboration with clinical groups. In addition these molecules are used to construct matrices that form the backbone in tissue engineering. By adding specific growth factors these matrices are specifically suited to stimulate cells to differentiation to different organs like skin and blood vessels.

Opportunities for students
Suitable for students with Chemical-Biological profile.
(administration code: LM202A, 35 ec, research traineeship and report; LM202C, 6 ec, thesis; LM202D or LM202E, theoretical course)

2.5 Department of Biomolecular Chemistry (IMM - NCMLS)

Head: Prof.dr. G.J.M. Pruijn
Scientific staff: Dr. W.C. Boelens, Dr. N.H. Lubsen, Dr. J.M.H. Raats, Dr. G.W.M. Swart
Secretariat: Ms E. van Genne, room 2.95 NCMLS, tel. 3614254
e-mail: e.vangenne@ncmls.ru.nl
Website: www.ncmls.eu/bmc

Research
- Autoimmune Biochemistry
- Protein Biochemistry: Small stress proteins: structure, function and pathology
- Melanoma research: Progression markers and tumor biology of human cutaneous melanoma

Description of research
Autoimmune Biochemistry: Characterisation and function of autoantigens (Pruijn/Raats)
Patients who suffer from a connective tissue disease, such as rheumatoid arthritis, often show the phenomenon of autoimmunity. These patients produce antibodies to self-proteins, which are referred to as autoantigens. In general, such autoantigens are macromolecules which have important cellular functions. We primarily study the structure and function of autoantigens involved in the synthesis and degradation of RNA and proteins.

Next to that we are interested in posttranslational modifications of proteins (phosphorylation, citrullination), because we believe that these play an important role in the initiation of autoimmunity. In this respect, we are also studying the mechanisms that lead to the breaking of immunological tolerance to self-proteins in autoimmune patients. Finally, we apply the knowledge obtained on the structure of autoantigenic molecules for the development of autoimmune diagnostics.

In our work we use modern (molecular and cell biological) techniques such as selection of recombinant (human) antibodies by phage display, various proteomics techniques, the mammalian two-hybrid system, RNA-protein interactions, confocal microscopy etc.

Protein Biochemistry: Small stress proteins: structure, function and pathology
(Boelens/Lubsen)
The cell protects itself against stress, like heat, radicals or radiation, by synthesizing a set of special proteins, amongst which the 'small heat-shock proteins' (sHsps). The sHsps have *in vitro* chaperone activity: i.e., they prevent the aggregation of other proteins. *In vivo,* they enhance the stress-tolerance of cells. Man has ten different sHsps, which are most abundant in the eye lens, in heart and muscles. In the brain they become induced in Alzheimer's disease and multiple sclerosis. The three-dimensional structures and working mechanisms of the various sHsps are poorly understood.

Our group explores by means of mutagenesis, protein-interaction studies, and cell biological approaches the structure, chaperoning mechanism en cytoprotection of the sHsps, and their roles in diseases, ageing and apoptosis.

Melanoma research: Progression markers and tumor biology of human cutaneous melanoma
(Swart)
Tumor metastasis, the main cause of cancer lethality, is a complex, invasive growth process involving asocial cell behavior in multicellular organisms. Melanoma, a tumor of the pigmented cells in the skin, advances from (i) superficial tumor spread in the epidermis (RGP/radial growth phase), via (ii) invasive growth into the dermis (VGP/vertical growth phase) to (iii) metastasis. Subsequent developmental stages are characterized by typical changes in progression marker genes. The structural and functional characterization of the genes and the encoded proteins is instrumental to learn about the fundamental mechanisms of invasive growth as well as to improve patient diagnostics and, eventually, to design more efficient therapies. In addition to conventional biochemical and molecular cell biological protocols, the experimental strategies include modern gene profiling and functional genomics approaches, targeted gene silencing in cell lines, as well as organotypical cultures and animal models.

Opportunities for students

Compulsory courses for major, choose 2 of the following:

- Apoptosis
- Chemical Biology
- Molecular aspects of host defense, tissue destruction and repair
- Post-transcriptional regulation in health and disease
- Signal transduction and transport

Mandatory course:
- biochemie-moleculaire biologie II (BMB-II)

Recommended courses:
- celbiologie van dieren
- structuur biomoleculen
- immunologie

(administration code: LM102A, 35 ec, research traineeship and report; LM102C, 6 ec, thesis; LM102D or LM102E, theoretical course)

2.6 Bioinformatics (CMBI)

Head:	Prof.dr. G. Vriend
Scientific staff:	Dr. C. van Gelder, Prof.dr. M. Huijnen, Dr. G. Schaftenaar Prof.dr. R. Siezen, Prof.dr. J. de Vlieg
Contact for education:	Dr. C. van Gelder, e-mail: c.vangelder@cmbi.ru.nl
Secretariat:	Ms B. van Kampen, room 010 NCMLS building, tel. 3619390 e-mail: b.vankampen@cmbi.ru.nl
Website:	www.cmbi.ru.nl

Research
- Bioinformatics of protein structures
- Bacterial Genomics
- Comparative Genomics
- Computational Drug Discovery

Description of research
Bioinformatics of protein structures (prof. Dr. G. Vriend, e-mail: G.Vriend@cmbi.ru.nl)
Proteins are very complex molecules. Despite many years of research every day something new is discovered about their structure or function. We work on sequence - structure - function relation analyses of proteins, and on methods for gathering, disseminating, validating and mining data related to proteins (structures, sequences, mutations, ligand binding, expression profiles, etc). The prediction of protein structures and the effects of mutations as well as molecular visualisation are important aspects of our work. We often collaborate with biologists and medics to solve real problems with a real biomolecular origin.
Recommended course: Structuur, functie en bioinformatica.

Bacterial Genomics (prof. Dr. R.J. Siezen, e-mail: R.Siezen@cmbi.ru.nl)
Gram-positive bacteria play an important role in different aspects of food fermentation, ingredient production, food safety and health. In collaboration with NIZO food research (Ede) and the Top Institute Food and Nutrition (Wageningen), bioinformatics tools are being used to analyse and compare complete genomes of food-relevant gram-positive bacteria. Emphasis is put on the positive attributes of lactic acid bacteria (Lactococcus, Lactobacillus, Streptococcus) and the negative attributes of pathogenic and spoilage bacteria (Listeria, Bacillus cereus, Clostridium).
Mandatory course: Vergelijkende Genoom Analyse.

Comparative Genomics (prof. Dr. M. Huynen, e-mail: M.Huynen@cmbi.ru.nl)The -omics era is characterized by tremendous amounts of data (genome sequences, single nucleotide polymorphisms, gene expression data, proteomics data, metabolite concentrations data), and by (relatively) little understanding of these data or of their value for biology. Within the computational genomics group we try to bridge the gap between experimental data and biological knowledge. We focus specifically on prediction of protein function, and protein-protein interactions such as observed in protein complexes or biochemical pathways. In doing that we are not only interested in the functions of the proteins and their interactions in man, but also how these interactions have evolved.
Mandatory course: Vergelijkende Genoom Analyse.

Computational Drug Discovery (prof. Dr. J. de Vlieg, e-mail:jacob.devlieg@organom.com and Dr. G. Schaftenaar, e-mail: G.Schaftenaar@cmbi.ru.nl).
Computational drug discovery is a well-established scientific discipline in pharmaceutical research, critical in the development of new treatments. Bioinformatics for drug discovery has created many opportunities to speed up and rationalise the multidisciplinary drug discovery process. A variety of in silico techniques are applied to solve complex chemical or biological problems including de novo ligand design, virtual screening, molecular modelling, in silico synthesis and computational genomics. The ultimate goal is to develop innovative scientific in silico concepts able to simultaneously optimise compounds with respect to potency, selectivity, efficacy and ADMET properties. Current research is directed at the prediction of ligand-induced active-site conformations in conjuction with docking and build a database with accurate structural information on metabolites.
Recommended courses: Structuur, functie en bioinformatica, Computational Drug Discovery.

Opportunities for students
Suitable for Molecular Life Sciences, Chemistry and Natural Sciences students.
(administration code: LM204A, 35 ec, research traineeship and report; LM204C, 6 ec, thesis; LM204D or LM204E, theoretical course)

2.7 Biophysics

Head:	Prof.dr. C.C.A.M. Gielen
Scientific staff:	Prof.dr. H.J. Kappen, Prof.dr. A.J. van Opstal, Dr. J.A.M. van Gisbergen, Dr. H.H.L.M. Goossens (UMC), Dr. T.F. Oostendorp (UMC)
Secretariat:	Ms M. van Pelt, Ms J. Fontaine, room GG 21.16.0.20, tel. 3614244 e-mail: mbfys@science.ru.nl
Website:	www.ru.nl/mbphysics

Research
- Brain and behaviour
- Machine learning and artificial intelligence

Description of research
The Biophysics group is funded both by the Faculty of Science and the University Medical Centre and collaborates with the Department of Biophysics of the University Medical Centre.

Brain and behaviour
The research focuses on the neuronal information processing by the central nervous system, in particular on the sensory coding of visual, auditory and vestibular information and on sensori-motor transformations which map the sensory information into motor commands (eye, head, and arm movements as well as gait) for appropriate action. The studies include an experimental and a theoretical approach. With regard to experiments the group collaborates with researchers in the F.C. Donders Center (www.ru.nl/fcdonders), which houses advanced equipment for measuring and imaging of neuronal activity in humans and primates.

The topic of neuronal information processing is addressed from different perspectives:
- Experimental research based on system-theoretical approach. By presenting various complex stimuli and by measuring responses to those stimuli, we aim to elucidate and to characterize the functional properties and hierarchical structure of sub-processes involved in perception and action.
- Electrophysiological studies recording neuronal activity in primates and humans.
- Characterization of source location of brain structures that contribute to neuronal activity using the bioelectricity of brain (electro-encephalography, EEG and magneto-encephalography (MEG) in collaboration with the department of Neurology and the F.C. Donders Center.
- Theoretical research modelling biological neurons and the information storage and retrieval by networks of neurons.

The theoretical research focuses on insight in information processing in neurobiological systems as well as on applications of knowledge using artificial neural networks. In the former, we develop models for complex biological neurons and investigate learning and communication between neurons, as well as the dynamics of self-organization and information storage by networks of neurons.

Machine learning and artificial intelligence
One day, we will have computers that can think and learn like humans. But this will be far in the future. Nevertheless, artificial intelligence research is producing useful methods that provide solutions in many branches of industry. At the department of Biophysics, there is an group of physicists that develop novel machine learning methods and that apply these methods to AI applications. In particular, methods that have a close resemblance to methods from statistical physics, such as mean field and Bethe approximations and Monte Carlo sampling, are developed by the group and are among the best methods world-wide. Applications are in the areas of medical expert systems, genetics, multi-agent control problems, and time-series forecasting. Soms of these applications are commercialized through spin-off companies or with industrial partners. Students that are interested to write their Master's thesis in this research direction are adviced to follow courses in statistical physics and the courses Introduction to Pattern Recognition, Machine Learning, and Computational Physics.
See www.snn.ru.nl/nijmegen for more information.

Opportunities for students
The department of Biophysics offers several experimental and theoretical research projects for a (Bachelor and) Master project. Students are advised to contact the head of the Biophysics department or one of the members of the scientific staff for more details.
(administration code: LM211A, 35 ec, research traineeship and report; LM211C, 6 ec, thesis; LM211D or LM211E, theoretical course)

2.8 Biophysical Chemistry (IMM)

Head: Prof.dr. S.S. Wijmenga
Scientific staff: Dr. H.A. Heus, Dr. M. Tessari, Dr. G.W. Vuister
Secretariat: Ms M. de With, room HG03.344, tel. 3652678, m.dewith@science.ru.nl
Website: www.ru.nl/physchem

Research

At the laboratory of biophysical chemistry NMR and other biophysical techniques are employed to study the structure and function of biomolecules. In addition, the NMR methodology is further developed. NMR is ideally suited for functional studies, because it is the only method that can provide information at atomic detail on the three-dimensional structure, dynamics, and the interaction of biomolecules in solution, i.e. under physiological conditions.

Main research areas: - understanding the molecular and physical events behind diseases caused by protein-misfolding such as Alzheimer's;- the unraveling of the protein-protein interactions involved in signaling processes; - infectious agents (hepatitis B virus (HBV), the human immune deficiency virus (HIV), and polio-like viruses); - developing of methods for faster determination of nucleic acid structures.
More information can be found at our website: www.ru.nl/physchem.

The main objective is to learn about biomolecular research, what it is and how it is done and at the same time learn the methods and techniques used in the field of Biophysical Chemistry. This is achieved by actively participating in one of the research projects at the department. Depending on your interest your own project can be more biologically oriented (expression and characterization of proteins or RNAs) or biophysically oriented (structural NMR) or even focused on methodology development (NMR methodology, or developing computational methods for faster structure determination etc). Your research is usually under direct supervision of one of the PhD students or post-docs with regular discussion of progress to one of the principal investigators, who is ultimately responsible for the project. In general, the student becomes a full respected member of the department, and is expected to participate in all its activities, which includes drinking coffee or 'tea' and joining work meetings. There is an open collaborative atmosphere in the group so that anyone can be approached for help and there are technicians who can help with lab work or with the NMR.

Opportunities for students

It is our objective that students with a Chemical or Physics background as well as students with a Molecular Life Science background can successfully complete a stay at the laboratory of Biophysical Chemistry. A separate defined Molecular Life Science track has therefore been set up. Also students with a Biology background are welcome, but may require some extra training in chemical and physical subjects.
Mandatory for MLW: Structure Biomolecules.
Recommended for MLW: Magnetic Resonance I (master course), Structure, Function and Bioinformatics.

(administration code: LM203A, 35 ec, research traineeship and report; LM203C, 6 ec, thesis; LM203D or LM203E, theoretical course)

2.9 Cell Biology (NCMLS, UMCN St.Radboud)

Head: Prof.dr. B. Wieringa
Scientific staff: Dr. J.A.M. Fransen, Dr. W. Hendriks, Dr. C.E.E.M. van der Zee
Dr. D.G. Wansink
Secretariat: Ms M. Reawaruw, tel. 3614329, e-mail: m.reawaruw@ncmls.ru.nl
Website: www.ncmls.nl/celbio

Research

Joint research of the Dept. of Cell Biology is aimed at understanding the pathobiological significance of (I) cellular energy (ATP) and redox (NAD/NADH and NADP/NADPH) reactions, (II) coupling between energy and redox metabolism and actin-based cell shape dynamics and cell motility, and (III) reversible protein phosphorylation reactions involved in the coupling between cell fate and growth regulation, actin cytoskeleton dynamics and metabolic state. Study of these cellular reactions is important for a better understanding of health problems related to cancer cell growth and motility, neurodevelopment and neuro-degeneration and diseases like myotonic dystrophy (DM1) and mitochondrial myopathies.

Description of research

Next to the transcriptome and the proteome, the metabolome forms the third level of organisation of the cell. Among the >5000 small compounds in mammalian cells, energy and redox metabolites like ATP, PCr and (NAD/NADH and NADP/NADPH) have a special position and are utilized in the core pathways of metabolism (glycolysis, PPP-pathway and TCA-cycle, OXPHOS) and involved in virtually all relevant interactions between micro- and macromolecular components of the cell.
Furthermore, distinctly different processes like the formation of projections by astrocytes and neurons, the development of podosomes and invadopodia by malignant cells, the formation of phagocytic cups by macrophages or the generation of lamellipodial/filopodial extensions, and even cytokinesis, share the hallmark that they are actin-based. These processes also have in common that they are under temporal and spatial control of ATP/redox metabolites for the dynamic coordination of actin polymerization behavior, force generation by myosin ATPases, and local control of phosphorylation of proteins. Thus these post-translational phosphorylation reactions at serine, threonine or tyrosine residues in cell cortical proteins and metabolic signaling effects of PCr, ATP/ADP/AMP, GTP/GDP or (NAD/NADH and NADP/NADPH) levels are closely interrelated. Therewith, protein phosphorylation is vitally important for cell growth and viability control.
Central in our interest is also how activity of members of the protein tyrosine phosphatase (PTP) family or the Rho-kinase family member Myotonic Dystrophy Kinase (DMPK) couples to phosphorylation of actin-based machinery or energy/redox enzymes in the cell cortex and determines development and fate of cells in health and disease.

Opportunities for students

All MSc students with a chemical/biological, biological/physical or biomedical profile, with molecular biological and/or cell biological elements in their training program are invited to apply for traineeship opportunities. We assign an experienced supervisor to each individual student. Therefore, we have only a limited number of internship positions available at a given moment. For further information we refer to www.ncmls.nl/celbio
(administration code: LM218A, 35 ec, research traineeship and report; LM218C, 6 ec, thesis; LM218D or LM218E, theoretical course)

2.10 Cell Biology (IWWR, FNWI)

Head: Prof.dr. E.J.J. van Zoelen
Scientific staff: Dr. A.P.R. Theuvenet, Dr. J.E.M. van Leeuwen
Secretariat: Ms J Rullmann-Freriks, room HG02.204, tel. 3652701
e-mail: j.rullmann-freriks@science.ru.nl
Website: www.celbi.science.ru.nl

Research

- Development of EGF receptor antagonists
- Regulation of PDGF alpha-receptor expression in disease
- Propagation of calcium action potentials in NRK cells
- Intracellular targeting of ErbB receptors

Description of research

Research in the department focusses on the role of polypeptide growth factors in the control of proliferation of normal cells and tumor cells. Use is made particularly of cells grown in tissue culture, using a combination of cell biological, molecular biological, biochemical, biophysical and bioinformatical approaches. There are four lines of research in the department:

Development of EGF receptor antagonists
The mechanisms are being studied by which EGF-like growth factors are able to specifically bind their ErbB receptors and activate them by inducing receptor homo- and hetero-dimerisation. Many tumor cells overexpress ErbB receptors and produce EGF-like growth factors themselves. Based on the structure of the natural Drosophila EGF receptor antagonist Argos we are developing clinically relevant antagonists of human ErbB receptors in order to block autocrine growth stimulation of tumor cells.

Regulation of PDGF alpha-receptor expression in disease
PDGFRA plays an important role in neural development. We have detected multiple polymorphisms in the PDGFRA promoter region, based on which strong (H2a) and weak (H1) haplotypes can be identified. We have shown that the H1 allele predisposes to neural tube defects and the H2a allele to glioma brain tumors. Current studies focus on the expression regulation of PDGFRA in neural and glioma stem cells.

Propagation of calcium action potentials in NRK cells
Density-arrested normal rat kidney (NRK) fibroblasts show periodic action potentials, which are driven by multiple ion channels in the plasma membrane. The mechanisms of spontaneous action potential initiation and propagation in these cellular monolayers are being investigated by patch clamp techniques, in combination with molecular RNAi studies to control ion channel expression levels.

Intracellular targeting of ErbB receptors
After ligand binding ErbB receptors are internalised and degraded in proteasomes and lysosomes. Impairment of this proces can result in enhanced mitogenic activity and cancer. In our studies, emphasis is placed on the role of Cbl family adapter proteins, which control the ubiquitination and intracellular sorting of the internalised ErbB receptor.

Opportunities for students
Recommended for traineeships: 3rd year course Animal Cell Biology
(administration code: LM118A, 35 ec, research traineeship and report; LM118C, 6 ec, thesis; LM118D or LM118E, theoretical course)

2.11 Cellular Animal Physiology (IWWR)

Head: Prof.dr. E.W. Roubos
Scientific staff: Dr. B.G. Jenks, Dr. W.J.J.M. Scheenen, Dr. L.T. Kozicz
Secretariat: Ms G. Hulzebos, room HG02.022, tel. 3652702
e-mail: mailto:g.hulzebos@science.ru.nl
Website: www.celanphy.science.ru.ru.nl

Research
The neural and endocrine mechanisms that control adaptation of animals and man to their continuously changing environment.

Description
The research focuses on the neural and endocrine mechanisms that control adaptation of animals and man to their continuously changing environment.
Attention is on two collaborating brain control centres: the hypothalamo-hypophyseal axis and the Edinger-Westphal system. These systems are studied from the gene up to the organismal level, with the skin colour background adaptation system of the frog *Xenopus laevis* as model to obtain more insight into fundamental cellular communication mechanism. Particular attention is being given to various aspects of the functioning of neuronal and endocrine (melanotrope) cells and to the mechanisms responsible for the production, secretion and specific binding of inter- and intracellular signal molecules such as neurotransmitters, neuropeptides and neuronal growth factors, and the translation of these signals into cellular, physiologically meaningful, responses.

This fundamental knowledge is applied in the biomedical and clinical area, in studies on rodent and man, to assess the significance of the adaptation systems for the proper functioning of the mammalian and human brain during acute and prolonged stress. In the latter respect, emphasis is on chronic depression and suicidal behaviour, gender-differences in the stress response, chronic pain, and antidepressant drug targeting.

Techniques include light and electron microscopy, immunocytochemistry (fluorescence, double and triple staining), confocal laser scanning, videoimaging, quantitative RT PCR, siRNA techniques, transgene *Xenopus*, biochemical techniques, patch clamp, morphometry, *in situ* hybridisation, radio-immuno-assay, cell culture, radio labelling, and single cell secretion measurement.

Opportunities for students
BSc students in Chemistry, Molecular Life Sciences and Natural Sciences.
mandatory entry level: Course in Neurobiology (leader: Dr B.G. Jenks)

2.12 Evolutionary Microbiology (IWWR)

Scientific staff: Dr. J.H.P. Hackstein, Dr. S.Y. Moon-van der Staay
Dr. G.W.M. van der Staay, Drs. R.M. de Graaf
Contact: Dr. J.H.P. Hackstein, tel. 3652935, e-mail: j.hackstein@science.ru.nl
Website: www.iwwr.science.ru.nl

Description of research

Hydrogenosomes are membrane-bound organelles of anaerobic unicellular eukaryotes that generate molecular hydrogen and ATP. They evolved from mitochondria as an adaptation to life under anaerobic conditions. Therefore, hydrogenosomes and mitochondria of several freshwater protozoa, as well as flagellates, ciliates and chytridiomycete fungi from the gastro-intestinal tract of vertebrates and invertebrates are studied in a holistic, multidisciplinary approach. One of the central questions is how mitochondria adapted to anaerobic environments, and why certain hydrogenosomes retained a genome while others lost it completely.

Currently, research focuses on
- the genome of the hydrogenosomes of *Nyctotherus ovalis*
- the composition and function of mitochondrial Complex I of *N. ovalis*
- metagenomic approaches to characterise the hydrogenosomes of rumen ciliates
- *in vitro* expression and characterisation of hydrogenosomal genes
- analysis of the macronuclear genome of *N. ovalis*

Biodiversity of unicellular eukaryotes and their symbionts in the oxic-anoxic interphase of fresh water sediments and the gastro-intestinal tract of animals
The presence of hydrogenosomes is the ultimate cause for (endo)symbiotic associations between anaerobic protozoa and methanogenic archaea. A systematic analysis of these symbiotic associations has suggested a strong taxonomic component. Therefore, the phylogeny of hosts and symbionts is studied by molecular genetic techniques. Various techniques e.g. 18S rDNA and ITS sequence analysis, ARDRA and AFLP, have been established to analyse the composition of the aquatic and benthic meiofauna and to evaluate the biodiversity of symbiotic, commensalic and parasitic associations in freshwater sediments and the intestinal tract of animals.
Current research focuses on
- isolation, identification and phylogenetic characterisation of 'gut' ciliates
- molecular genetic analysis of protozoal communities in guts and fresh water sediments

Ciliates as Monitors for Environmental Safety of GMO (CIMES, QLK3-2002-02151)
Because of their unique genome organisation, ciliates with gene-sized chromosomes in their macronuclei are ideal organisms to detect lateral gene transfer (LGT) from bacteria or genetically modified organisms ('GMO') to eukaryotes. Using genomics and experimental approaches, evolutionary and 'recent' LGT from bacteria and transgenic plants into eukaryotes are studied in N. ovalis and the various rumen ciliates.
Current research deals with
- bioinformatical analysis of genome data
- identification and characterisation of 'foreign' DNA in the genome of ciliates

A broad spectrum of molecular genetic and biochemical techniques, including microscopy,

(meta)genomics, bioinformatics and phylogenetic analysis is used -frequently in collaboration with national and international 'top' specialists.
(administration code: LM220A, 35 ec, research traineeship and report; LM220C, 6 ec, thesis; LM220D or LM220E, theoretical course)

2.13 Human Genetics (UMCN St. Radboud)

Contact: Dr. B. Franke,
e-mail: b.franke@antrg.umcn.nl
Website: www.humangenetics.ru.nl

Research

- on genetic diseases comprises inherited blindness and deafness
- on mental retardation
- on renal diseases
- on dysmorphology

Description of research

The department of Human Genetics carries out fundamental and patient-related research. There are three main research lines: the research on genetic diseases comprises inherited blindness and deafness, mental retardation, renal diseases, and dysmorphology.

We also study the role of chromosomal aberrations and related gene/protein defects in the development of familial (hereditary) and non-familial forms of cancer, with primary focus on urogenital tumours and bone- and soft tissue sarcomas. In addition, we focus our research on a subset of multifactorially inherited diseases, such as ADHD and developmental dyslexia on the one hand and autoimmune diseases on the other hand. In this line of research there is also interest in pharmacogenomics. We have excellent in-house facilities for DNA sequencing, linkage analysis, single nucleotide polymorphism analysis, genomic microarray analysis (comparative genomic hybridisation), cDNA-expression microarray analysis, and cell culturing. Depending on the research topic we employ a subset of techniques in the areas of molecular biology and genetics, cell biology, and biochemistry, such as linkage analysis, mutation scanning, Southern, Northern and Western blot analysis, RT-PCR, mutagenesis, yeast two-hybrid analysis, eukaryotic cell transfections, immunocytochemical analysis, and bioinformatics.

Opportunities for students

Contact Mw. dr. B. Franke (b.franke@antrg.umcn.nl)
(administration code: LM225A, 35 ec, research traineeship and report; LM225C, 6 ec, thesis; LM225D or LM225E, theoretical course)

2.14 Medical Microbiology/parasitology (UMCN St. Radboud)

Head: Prof.dr. R.W. Sauerwein
Contact: Dr. W. Roeffen, tel. 3613663, email: w.roeffen@science.ru.nl
Secretariat: tel. 3652935
Website: www.ncmls.ru.nl/mmb/medicalmicrobiolog.asp

Research
Malaria infections, sexual stage development and parasite transmission from man to mosquito:
- transmission blocking activity
- immunological research
- sexual stages of the malaria parasites in the human host

Description of research
At the department of medical microbiology/ parasitology, research focusses on transmission of malaria parasites and the development of its sexual stages. These stages do not cause clinical symptoms but are transmitted by mosquitoes to the next host and are thus responsible for transmission of the disease. Knowledge about transmission of malaria parasites could lead to interruption of the transmission cycle and may prevent further spread of parasites.

Transmission blocking activity
Factors that decrease chances of survival in the mosquito vector are investigated with the use of serological assays.

Immunological research
The reaction of the human immune system during a malaria infection is studied both in vitro and in vivo. Additional to gaining scientific information, this research may enable a better evaluation of future vaccines. Used techniques are: real-time PCR, FACS, ELISA and cell culture.

The development of sexual stages of the malaria parasites in the human host
The interaction between parasite proteins that might influence transmission is investigated with techniques such as 'targeted gene disruption', PCR, southern blot and the production of monoclonal antibodies. Additionally the expression of sexual stage-specific RNA is studied with use of real-time NASBA. These techniques are also applied to study the development of sexual stages during malaria infections, for example after treatment with antimalarial drugs.

(administration code: LM226A, 35 ec, research traineeship and report; LM226C, 6 ec, thesis; LM226D or LM226E, theoretical course)

2.15 Medical Microbiology/Virology (NCMLS)

Head: Prof.dr. J. Galama
Scientific staff: Dr. F. van Kuppeveld, Dr. J. Zoll

Research
The research-theme of the Molecular Virology research-group, which is housed in the Nijmegen Centre for Molecular Life Sciences (NCMLS), is entitled: *"Enteroviruses, chronic diseases, and autoimmunity"*.

Description

Enteroviruses (e.g., poliovirus and coxsackievirus) are important human pathogens that are associated with both acute and chronic diseases. Enteroviruses are small RNA viruses that replicate their genome in the cytoplasm of infected cells. The research-theme of the Molecular Virology group is divided in the following research-lines:
(1) *"Molecular aspects of viral RNA replication"*, focussing on the structural and functional aspects of complex RNA structures in the viral RNA genome in the process of viral RNA replication.
(2) *"Cell biological aspects of virus infection"*, focussing on (i) the molecular mechanisms by which enteroviruses (i) manipulate their host cell in order to suppress anti-viral host cell responses like immune responses and apoptosis, and (ii) rearrange intracellular membranes to create a membranous scaffold for viral RNA replication.
(3) *"Relationship between enterovirus infections and the development of chronic diseases",* focussing on the potential role of enteroviruses in the onset of insulin-dependent (type 1) diabetes mellitus (infection and impairment of pancreatic beta-cells and/or cells of the immune system?).
For a more detailed description and the background of these research-lines, please visit our website www.ncmls.nl/virology.

Opportunities for students

For the research goals described above, we make use of a variety of molecular biological, biochemical and cellular biological techniques. These include *in vitro* mutagenesis, construction of infectious cDNA clones, *in vitro* transcription and *in vitro* translation, RNA/DNA hybridization, CAT and LUC reporter assays, expression and purification of recombinant proteins, analysis of RNA-protein interactions, cell culture, transfection of eukaryotic cells with RNA or DNA. Furthermore, we make use of a variety of microscopical techniques (confocal laser scanning microscopy, digital video imaging, fluorescence resonance energy transfer microscopy, fluorescence recovery after photobleaching) to determine the fate, localization and/or dynamics of GFP-tagged reporter proteins in infected cells.
Opportunities for internships are available for both Molecular Life Science, Natural Science, Biology and Chemistry students. Students are encouraged to indicate and motivate their preference for a specific topic of the internship.

Contact person for internships

Dr. Frank van Kuppeveld.
NCMLS, route 268, room 1.71.
Phone: 024-3617574. E-mail: f.vankuppeveld@ncmls.ru.nl.

2.16 Microbiology (IWWR)

Head: Prof. dr. ir. M.S.M. Jetten
Scientific staff: Dr. J.T.M. Keltjens, Dr. H.J. Op den Kamp, Dr.ir. M. Strous, Dr. A. Pol
Secretary: Ms M. uijt de Haag, room HG02.404, tel. 3652940
e-mail: m.uitdehaag@science.ru.nl
Website: www.microbiology.science.ru.nl

Research

Ecophysiological microbiology is aimed at the diversity and activity of microorganisms in their natural environment, on their mutual interactions and on their survival strategies. The research is focused on the microbial ecology of freshwater systems and in particular on the microbial processes at the very dynamic oxic/anoxic interface between the sediment and the water column. Besides ecological aspects, also the biochemistry, molecular biology and ecophysiology of relevant trophic groups of bacteria involved in the carbon, nitrogen and sulfur cycles are studied.

Description of research

A major research topic is the microbial nitrogen cycle and more specific, the chemolitho-autotrophic bacteria active in this cycle: in the first place anaerobic ammonium oxidizers (anammox), but also aerobic ammonium oxidizers and aerobic nitrite oxidizers. The microbiological research of anammox, in which ammonium and nitrite are converted to nitrogen gas with hydrazine as an intermediate, is leading in the world. More generally, we investigate the interactions of the above-mentioned three groups of autotrophs at the oxic/anoxic interface, and their application in wastewater treatment.

Volatile sulfur compounds are very malodorous and toxic, and are also produced in a number of industrial processes. Further, they have a major impact on global warming and acid precipitation processes. Research is focused on the bacterial production and degradation of volatile organic sulfur compounds. Studies of the degradation are coupled to the application of promising bacterial isolates in treatment of polluted air.

Methane oxidizing bacteria (methanotrophs) utilize methane as their sole source of carbon and energy. Methanotrophs play an important role in the oxidation of methane in natural environments (wetlands, freshwater systems). This research is conducted in close cooperation with the Department of Aquatic Ecology and Environmental Biology and focuses on the function, identity and ecophysiology of both aerobic and anaerobic methanotrophic bacteria in wetland ecosystems.

The experimental approach is polyphasic, including ecophysiology, molecular ecology, biochemistry, cell biology and environmental genomics. We are interested in how biochemistry/cell biology determine the ecological niche differentiation of the bacteria and which environmental factors determine the qualitative and quantitative output of the respective elemental cycle to the atmosphere. Techniques used include enrichment and continuous culture of relevant bacteria in laboratory bioreactors, fluorescence in situ hybridization (FISH), PCR amplification, DNA sequence analysis, denaturing gradient gel electrophoresis (DGGE), 2D-gel electrophoresis, MALDI-TOF mass spectrometry, bioinformatics, stable isotope probing, gas chromatography, HPLC analysis and a variety of protein purification methods.

Opportunities for students

In all of the aforementioned research topics several projects are available for Chemistry, Molecular Life Science and Natural Science students. As a result of the on-going research, projects are constantly be reformulated. The student is supervised by a Ph.D. student, post-doc or staff member. Especially in the first part of the training guidance will be intense: regularly with the supervisor, weekly sessions with other members of the research group. In this period the student will be introduced to literature, and techniques relevant for his/her topic. In the

second part of the training the student will show him(her)self more initiative in planning, designing and performance of experiments. At the end of the experimental period a report has to be written and the work is presented in a seminar. In addition, a literature thesis has to be written on a subject not related to the own research. The theoretical examination consists of capita selecta of modern microbiology; the student will be consulted with respect to the choice of the material.

Requirements
To start with the internship "microbiology", one of the specialized microbiology courses (Physiological Microbiology and Ecological Microbiology) is recommended.
As an introduction to the training the research practical 'Microbiology' (BSc level, contact person: dr. H.J.M. Op den Camp) is very useful.
(administration code: LM227A, 35 ec, research traineeship and report; LM227C, 6 ec, thesis; LM227D or LM227E, theoretical course)

2.17 Molecular Animal Physiology (IWWR)

Head: Prof.dr. G.J.M. Martens
Scientific staff: Dr. F van Herp
Secretariat: B. Portier, room 6.93 NCMLS, tel. 3610565, e-mail: b.portier@ncmls.ru.nl
Website: www.ru.nl/molanphys

Research
- Functional studies on neuronal and neuroendocrine proteins with an unknown role
- The molecular basis of psychiatric disorders: from animal model to translational research
- Linking behavioral somatosensory learning in rats with gene expression profiles (in collaboration with Dr. Peter De Weerd, University of Maastricht)

Description of research
The Department of Molecular Animal Physiology studies the physiology and pathology of neuronal and neuroendocrine cells at the molecular and cell biological level. The research is performed within the context of the Research Schools Nijmegen Center for Molecular Life Sciences (NCMLS) and Nijmegen Institute for Cognition and Information (NICI), and the department participates in the Institute for Neuroscience of the Faculty of Science/UMC St. Radboud.
Examples of our current research activities and possibilities for student projects are:

A. Functional studies on neuronal and neuroendocrine proteins with an unknown role
We explore the physiological roles of a number of proteins of unknown function, including proteins of the secretory pathway, proteins involved in neuronal outgrowth and synaptic plasticity (including brain-derived neurotrophic factor BDNF), and proteins linked to neurodegenerative disorders, such as amyloid-*beta* precursor protein APP, prion protein and synuclein (associated with Alzheimer's, prion and Parkinson's disease, respectively). The studies include the generation and analysis of transgenic *Xenopus* with a cell-specific transgene expression selectively in intermediate pituitary (neuroendocrine) cells. In addition, we apply biochemical +/- approaches (differential display proteomics) to identify novel neuroendocrine proteins.

B. The molecular basis of psychiatric disorders: from animal model to translational research
Early pre- or postnatal stress together with genetic background may play an important role in the development of psychiatric disorders such as schizophrenia. In this project, rats of the apomorphine-susceptible (APO-SUS) and the apomorphine-unsusceptible (APO-UNSUS) line are examined because they closely resemble deficits observed in schizophrenia. The application of DNA-chips/microarrays (and validation with quantitative PCR) has revealed only one gene that is differentially expressed in brain regions of SUS *vs* UNSUS rats, owing to a gene dosage imbalance resulting from a recombination (unequal crossing-over) event. Further analysis of this event and our current studies on epigenetic differences in genomic DNAs from (stressed) Wistar rats and from brain regions of schizophrenic patients may lead to a better understanding of the highly complex mechanisms underlying schizophrenia and related complex neurodevelopmental disorders.

C. Linking behavioral somatosensory learning in rats with gene expression profiles (in collaboration with Dr. Peter De Weerd, University of Maastricht)
We are interested in characterizing gene expression during the acquisition of skills, and are developing an animal model to do so. The whisker system in the rat is a beautiful model system because it permits the controlled delivery of stimuli in somatosensory cortex (barrel cortex). Rats will be trained daily for several weeks until they precisely discriminate the orientation of a textured surface with the whiskers on one side of the head. A first stage of experimentation will consist of training the rats to completion (to characterize the complete learning curve), followed by a molecular analysis of experimental ('trained') and control barrel cortex. In later stages, rats will be trained up to certain levels of performance followed by molecular analysis. This research fits in a larger program where links are sought between gene expression and cognition, for both rats and primates, with the ultimate goal of influencing learning through anti-sense or other techniques.

Techniques used include gene transfer approaches (such as microinjection of DNA to generate transgenic *Xenopus* frogs), (2-D) protein s eparation, proteomics, mass spectrometry, (real-time quantitative/arbitrarily primed)-PCR, microarray analysis, mutagenesis, SNP/CNV genomic analysis, cell culture, electron/fluorescence microscopy and (live) imaging, and behavioral tests (operant conditioning, psychophysics, staircase threshold measurements).

Opportunities for students
Student in Molecular Life Sciences, Chemistry, Natural Sciences; project C: strong cognitive/behavioral interest (for the operant conditioning and training of the rats) and/or chemical/biological profile (for the molecular analysis).
(administration code: LM228A, 35 ec, research traineeship and report; LM228C, 6 ec, thesis; LM228D or LM228E, theoretical course)

2.18 Molecular Biology (IWWR)

Head: Prof.dr. H.G. Stunnenberg
Scientific staff: Dr. C. Logie, Dr. M.A.E. Lohrum, Dr. G.J.C. Veenstra
Website: www.ncmls.ru.nl/molbio/molecularbiology.asp

Research

- Gene expression and epigenetics
- Malaria Vaccines and Proteomics
- Chromatin motors
- The Tumor Suppressor p53
- Embryonic gene regulation

Description of research

Gene expression and epigenetics (Prof. Dr. H.G. Stunnenberg)
The attention and expectations on stem cells as therapeutic tools contrast with the current knowledge of the molecular mechanisms and factors that establish or maintain the pluripotent state. We recently identified a novel basal transcription complex in embryonal cells, TAC, which we are studying in detail. In addition, we explore the binding of factors to chromosomal loci and the histone code; a combinatorial epigenetic code of histone modifications that determines the expression status of individual genes. We use normal and leukemic haematopoietic cells, chromatin immunoprecipitation approaches, and in vitro chromatinized DNA templates

Malaria Vaccines and Proteomics (Prof. Dr. H.G. Stunnenberg)
We are using large-scale high accuracy mass spectrometric proteome analysis of the human malaria parasite Plasmodium falciparum to identify proteins involved in sexual stage biology. Stage specific, secreted and membrane-associated proteins are evaluated as potential transmission blocking components of a malaria vaccine formulation. We are working towards the development of a malaria vaccine with a current focus on the protein Pfs48/45. This protein is essential for the fertilization of the sexual stage of the parasite in the mosquito. We will also test novel proteins identified by proteomic analyses for their usefulness as vaccine targets.

Chromatin motors (Dr. C. Logie)
We are interested in the relation between chromatin structure and the biochemical processes that direct chromosome metabolic events such as transcription, replication, recombination, repair, segregation, condensation and cohesion. Our current research focuses on two multi-protein ATPases: SMC and SNF2. We use the yeast S.cerevisiae to modify and purify chromatin motors. The scientific problems we are currently tackling are the elucidation of the proteomic context of these ATPases, identification of their temporal window of action within the cell cycle and discovering the mode of recruitment of these complexes to their chromosomal targets.

The Tumor Suppressor p53 (Dr. M.A.E. Lohrum)
The tumor suppressor gene p53 is the most frequently mutated gene in all human cancer cases. Recently, two more family members of p53 have been found, p73 and p63, which seem to play important roles during development and in tumorigenesis. p53 has become known as the 'Guardian of the Genome'. p53 and its family members exert their functions mainly by acting as transcriptional activators and repressors. The aim of our research is to elucidate the molecular basis of these transcriptional activation and repression functions and how the p53-family members can cross-talk and regulate each other and what implications this has for cancer and tumor development.

Embryonic gene regulation (Dr. G.J.C. Veenstra)
Focus of this line of research are the regulatory transitions in gene expression during early vertebrate embryogenesis, using Xenopus laevis as a model system. We study newly discovered proteins that are related to known general transcription factors but are unique to metazoans or vertebrates, in addition to studies of epigenetic regulation, DNA methylation and the MeCP2 repressor protein. Mutations in MeCP2 cause Rett Syndrome in humans. We explore the contribution of these proteins to developmental pathways and novel molecular mechanisms of gene regulation. This contributes to our understanding of both normal and abnormal development, growth and differentiation.

Opportunities for students
Students are required to have completed the course Molecular Biology II successfully prior to doing an internship at the department.
(administration code: LM229A, 35 ec, research traineeship and report; LM229C, 6 ec, thesis; LM229D or LM229E, theoretical course)

2.19 Pathology (UMCN St. Radboud)

Contact: Dr. G.N.P. van Muijen, tel. 3614399, e-mail: g.vanmuijen@pathol.umcn.nl
Secretariat: Ms A. Vargas, tel. 3614389, e-mail: a.vargas@pathol.umcn.nl
Website: www.theochem.ru.nl

Research
- Neuro-oncology
- Neurobiology of aging
- Tumor matrix biology
- Angiogenesis
- Rectal Oncology
- Haematopathology
- Glomerulosclerosis

Description
Neuro-oncology
Fundamental biological research on the oncogenetics of brain tumours of different origin, such as oligodendrogliomas, astrocytomas, ependymomen and mixed gliomas. The field of research is: genetic analysis, clinical analysis and pathological analysis. Used techniques: CGH (Comparative Genomic Hybridisation), CGH-array, expression profiling, (F)ISH (Fluorescent In Situ Hybridisation), karyotyping, DNA en RNA isolation, sequence-analysis, LOH (Loss of Heterozygosity) analysis, MLPA (Multiplex Ligation-dependent Probe Amplification), tissue culture, histological techniques.

Neurobiology of aging
Research related to the onset and development of Alzheimer's disease. Study on protein-protein interactions, protein aggregation (protein -biochemistry) and in vivo protein clearance and interactions (in rat muscle and brain). Other techniques in this study: Immunohistochemistry, tissue culture and proteomics.

Tumor matrix biology
A tumour can be regarded as an intricate, yet poorly understood, organised tissue, the function of which is maintained by a dynamic interplay between neoplastic cells, host cells and the extracellular matrix. Type I collagen is the predominant matrix protein of the dermis and its metabolism (synthesis and degradation) plays an important role in the onset and development of squamous cell carcinoma and melanoma. Using animal models, immunohistochemistry, mRNA in-situ hybridisation, in vitro co-cultures, and collagen-binding studies we are currently elucidating how the extracellular matrix modulates tumour progression.

Angiogenesis
Since angiogenesis is regarded as important for tumor growth and metastasis, anti-angiogenic therapy is considered as a potentially powerful anti-tumor therapy. Since tumors in organs with high blood vessel densities can also progress via infiltrative growth, anti-angiogenesis will not suffice and anti-vascular therapies are needed. We recently identified a novel tumorvessel-specific marker which will be examined for its targeting potential. Techniques: phage display, immunization, immune precipitations and protein analysis, transfection, animal tumor models.

Rectal Oncology
3D reconstruction of rectal carcinoma. The distribution of different tumor characteristics (precence of cytokines and blood vessels, pattern of adhesion molecules etc.) will be studied to explore the biological mechanisms behind tumor growth. a complete paraffine embedded tumor of the rectum is already present. Techniques: immunohistochemistry, Immunofluoresence, confocal scanning laser microscopy, mRNA in situ hybridization.

Haematopathology
Malignant lymphomas, tumors of the imune system, comprise a large group of different entities according to morphology, phenotype and genetic background. Characterisation of different subtypes of B-cell lymfomas as a goal to find markers that could be important for diagnostic and prognostic questions. Techniques: molecular (isolation of DNA/RNA from diagnostic samples, (RT)-PCR, Fluorescent In Situ Hybridisation, array-CGH -comparative genomic hybridisation-, mRNA expression-array), immunohistochemistry, protein detection (like Western blot), and proteomics (like SELDI-TOF MS).

Glomerulosclerosis
Focal glomerulosclerosis is a common form of kidney disease that may cause permanent kidney failure in children and adults, and occurs when scar tissue is formed in some of the glomeruli of the kidney. Recently, two cell types in the glomerulus, the podocyte and parietal epithelial cell have been given an important role in the development of focal glomerulosclerosis.

The experimental approach of the current project consists of a mouse model (transgenic) for focal glomerulosclerosis. In this model we aim to identify specific processes that are involved in the development of the scar tissue in the glomerulus and envisage on the interaction between the podocyte and parietal epithelial cell and the expression of specific genes or proteins (e.g. growth factors) that may have an important role in the development of the disease.

The interactions and gene or protein expression will be assessed by electron microscopy, immunohistochemistry (IHC), In situ hybridization (ISH), RT-PCR and western blot.

(Administration code: LM232A, 35 ec, research traineeship and report; LM232C, 6 ec, thesis; LM232D or LM232E, theoretical course)

2.20 Molecular Pharmacology and Toxicology (NCMLS, UMCN St. Radboud)

Head: Prof.dr. F.G.M. Russel
Scientific staff: Dr. R. Masereeuw, Dr. J.B. Koenderink, Dr. R.P. Bos
Secretariat: Ms L. Triebels, room 7.89 NCMLS, tel. 3613691
e-mail: e.triebels@pharmtox.umcn.nl
Website: www.ncmls.eu

Research

- Transport processes and toxicity
- Mechanisms of drug toxicity, cellular injury and protection
- Molecular epidemiology and toxicity

Prerequisites:
Farmacochemie (Medicinal Chemistry)
Recommended courses:
Levende cel (Living cell)
Algemene fysiologie (General physiology)
Moleculaire basis van ziekten (Molecular basis of disease)

Description of research

Transport processes and toxicity
The human body is continuously exposed to a great variety of xenobiotics via food, drugs, occupation and environment. Evolution has equipped the body with a plethora of protecting systems to defend itself against the potentially harmful effects of these compounds. One of the important defense mechanisms include the active extrusion of xenobiotics by commonly shared transport proteins, mainly located in kidney, liver and intestine. In our research we investigate the molecular properties of transporters belonging to the ATP Binding Cassette (ABC) and Solute Carrier (SLC) superfamilies, with special reference to their role in drug efficacy and safety.

Mechanisms of drug toxicity, cellular injury and protection
Adverse drug reactions (ADRs) related to organ toxicity, and drug hypersensitivity are responsible for the top 3 of drug withdrawals due to toxicity. Today, no adequate translational strategies are available to predict safety. We are interested in studying the molecular mechanisms of drug toxicity in the kidney and vascular system, and developing predictive translational biomarkers by proteomic profiling of blood and urine samples from animal studies and selected patients. In addition we focus particularly on the heme oxygenase system as a novel therapeutic target in tissue protection and regeneration.

Molecular epidemiology and toxicity
There are tight links with the Research Lab Molecular Epidemiology (RLME, dr P.T.J. Scheepers, phone 024-3616878, P.Scheepers@epib.umcn.nl) of the Department of Epidemiology and Biostatistics (UMC St Radboud). The toxicological research of the RLME is directed to the development and use of methods for risk assessment of human exposure to chemicals present on the workplace or in the general environment. Focus is on the development of biomarkers by identifying metabolites and adducts of carcinogens and reprotoxic substances in body fluids and exhaled air with mass spectrometry, and to validate their use in health risk assessment.

Opportunities for students
The labs of the department are housed in the preclinics building of the UMC St Radboud and the NCMLS research building. Students can participate in the research lines mentioned above; for specific projects see the website of the department.
(administration code: LM205A, 35 ec, research traineeship and report; LM205C, 6 ec, thesis; LM205D or LM205E, theoretical course)

2.21 Physiology - Cell Physiology (NCMLS, UMCN St Radboud)

Head: Prof.dr. R. Bindels
Scientific staff: Dr.P. Deen, Dr. J. Hoenderop
Contact: Dr. J. Hoenderop, tel. 3610580, e-mail: j.hoenderop@ncmls.ru.nl
Website: www.physiology-nijmegen.nl

Research
- Regulation of electrolyte and water transport in kidney and intestine

Description of research
The section Cell Physiology from the department of Physiology in Nijmegen has a long long-standing reputation in the field of membrane transport, and, in particular, epithelial transport. Research at this department is focused on aquaporin water channels, epithelial calcium and magnesium channels and sodium-chloride cotransporters. One line of research is focused on the identification of novel ion transporters in kidney and small intestine. Using advanced molecular biological techniques we identified and characterized new ion and water transporters including aquaporin water channels and epithelial calcium and magnesium channels.
Our research aims to clarify the cell biological consequences of mutations in the genes encoding for these renal transporters, which are the cause of diseases such as Nephrogenic Diabetes Insipidus, Bartter and Gitelman syndromes and disturbances in the calcium and magnesium homeostasis of the body. Another line of research aims to understand the factors that determine the activity of epithelial transporters, which include phosphorylation, glycosylation, regulated trafficking and hormonal regulation.
The obtained knowledge will not only substantiate the role of epithelial transporters under (patho)physiological conditions, but could ultimately also give way to the development of pharmacological strategies to treat ion en water-related mal(re)absorption disorders. For more information please also consult our website: www.physiology-nijmegen.nl

Methods and Techniques: Depending on the subject the student can obtain experience with a wide variety of techniques including:
- Molecular-biology: recombinant DNA technology, Northern en Southern blots, real-time PCR, fusion proteins, siRNA.
- Maintenance of cell lines: transfection and culture of various cell lines.
- Biochemistry: enzyme and ion transport activity measurements, cell signaling techniques, pull-down assays, proteomics, yeast-two-hydrid assays, 2D-gel electrophoresis.
- Immunology: immunohistology, immunoblots, preparation of antibodies, immunoprecipitations.
- Imaging: real-time cytosolic ion concentration measurements with video and confocal microscopy.
- Miscellaneous: radio isotopes, animal research, electrophysiology, bioinformatics.

Opportunities for students
Students will only be guided by senior PhD students or Post-doc researchers. The projects are carefully planned and the amount of positions is limited. The department of Physiology is a dynamic, enthusiastic and internationally orientated research group with an excellent scientific track record.
Suitable profile: students in (Bio)Chemistry, Biology and Molecular Life Sciences

2.22 Plant Cell Biology (IWWR)

Head: Prof.dr. C. Mariani
Scientific staff: Prof.dr. G. Angenent, Dr. W. Vriezen
Secretariat: Ms E. Schaberg, room HG02.309, tel. 3652777
e-mail: e.schaberg@science.ru.nl
Website: www.pcb.science.ru.nl

Research
- flower development
- hormonal regulation of fruit-set and early fruit development in Tomato
- anther development under heat stress in tomato
- identification of new sources of resistance to *P. infestans* in wild accessions of *Solanum* section *Solanum*

The research of the department is targeted to developmental processes that underlie flower and fruit development on a cellular as well as on a molecular level. Our current studies focus on the function of a class of homeotic genes in petunia flower development and on signaling events in tomato flower which lead to fruit development. In addition, we have a project in cooperation with 'The Centre for BioSystems Genomics' to identify new sources of resistance genes to *P. infestans* in wild accessions of Solanum.

Description of research
Flower development is regulated by large MADS-box family of transcription factors. Until recently only one group of MADS-box genes (the MIKC-type genes) was known in plants. These genes are all very homologous and were found to function mainly in the flower, establishing the floral organ identity (the ABC model). Much less is known about the function of another larger group of MADS-box proteins (type I MADS-box). We try to obtain a better insight in the function and evolution of type I MADS box gene family by isolating gene of this family from *Petunia hybrida*. Once gene sequences are known it is possible to analyze their function by gene silencing using RNA interference or by isolation of mutants with disrupted type I genes (transposon tagged mutants). This project is carried out at Plant Research International in Wageningen.

Hormonal regulation of fruit-set and early fruit development in tomato
Tomato is one of the most important agricultural crops with a production of over 115 million tons a year. The ripening of tomato fruit has been studied for years but very little is known about the regulation of fruit set and early fruit development. It is known, however, that plant hormones are involved in these processes. Application of the plant hormones auxin or gibberellin to the pistil of a tomato flower is enough to induce fruit development without fertilization.

We do research on the role of hormones and their signaling pathways that switch on fruit development after fertilization. Transcript profiling experiments (cDNA-AFLP, micro arrays) are used to identify genes involved in gibberellin, auxin signaling pathways and suggested the involvement of other hormones. Based upon these data it is very likely that several plant hormones together regulate fruit set and early fruit growth. To understand the mechanism by which these hormones work together we analyze the function of the isolated genes in the flower. For this purpose we modulate their activity by making transgenic tomato plants, and analyze the effects on fruit set.

Anther development under heat stress in tomato
Successful development of tomato fruits is strongly dependent on environmental conditions, especially temperature. Plants grown under high temperatures often have anthers without fertile pollen meaning that fruit set cannot occur. This is a considerable problem in fruit production in many parts of the world. The sensitivity to high temperature differs between different tomato cultivars. By comparing genome-wide gene expression of heat sensitive cultivars with that of heat tolerant cultivars, we try to identify genes that are important in the response to high temperature. The identity of these genes will be elucidated by DNA sequencing and their relation to heat tolerance by gene expression analysis. Finally, gene function will be analysed in transgenic plants as described above and in plants with mutations in the gene of interest.

Identification of new sources of resistance to ***P. infestans*** in wild accessions of ***Solanum*** section ***Solanum.***
This project aims at identifying new interesting trades in the genus *Solanum* of the Solanaceae family, which may confer resistance to diseases or other adaptabilities to particular environments. We are studying the correlation between geografical distribution and genomic diversity of *S. Dulcamara* in Europe by means of molecular taxonomy.
Another project deals with the knowledge that wild *Solanum* species are resistant to different pathogens. Therefore wild species are often used in studies focused on the identification of plant disease resistance genes (*R* genes). The aim of this project is to test and identify *Phytophthora infestans* resistance in unexplored accessions of African wild *Solanum* because they possibly offer a new pool of *R* genes.

Opportunities for students
Students can choose to participate in different fields of plant research using molecular, physiological and/or cytological approaches. Techniques used can be DNA/RNA analysis ((RT/Q-)PCR, (cDNA-)AFLP, *in situ* hybridization), microscopy (electron microscopy, CLSM) and/or physiological (analysis transgenic plants).

2.23 Plant Genetics (IWWR)

Head: Prof.dr. T. Gerats
Scientific staff: Dr. J. Peters
Secretariat: Ms E. Schaberg, room HG02.309, tel. 3652777
e-mail: e.schaberg@science.ru.nl
Website: www.pg.science.ru.nl

Research
- Functional analysis of genes involved in flower development and evolutionary aspects of flower development
- Identification and analysis of genes involved in (male) meiosis
- Map-based cloning of genes responsible for particular mutant phenotypes
- Investigation of the structural and genetic basis for horizontal stem growth and adventitious rooting

Description of research
Floral development is studied in *Petunia hybrida*. We study the function of several homeotic genes involved in determining how different parts of the flower develop. Thereby, we want to find out how flower development is regulated, and what the evolutionary background is of these developmental processes (for relevant publications see: www.pg.science.ru.nl/en/michielvandenbussche.html).

Male meiosis is studied in *A. thaliana*. To investigate the effect of meiotic genes on recombination frequency, RFP and GFP T-DNA lines are available that enable us to count green and/or red seeds (see www.pg.science.ru.nl/en/project_hedatale.html).
With the help of AFLP and other molecular markers the gene(s) responsible for certain mutants in *Arabidopsis* can be determined using a map-based cloning approach. In these projects we regularly collaborate with other laboratories that have interesting mutants to be identified (see www.pg.science.ru.nl/en/project_peters2.html).

In collaboration with Experimental Plant Ecology (Dr. Josef Stuefer) the horizontal stem growth and adventitious rooting is studied in *P. altiplana*. Most plant species are either erect or clonal, implying that we cannot study intraspecific variation and plasticity in stem direction, structure and function in natural populations. Therefore, experimental hybrids have been produced between a stoloniferous (*P. altiplana*) and an erect species (*P. hybrida* W138) of the genus *Petunia*. In this project we analyze and compare stem structure and function in different hybrid generations and back-cross populations of the above-mentioned interspecific hybrid system.

Opportunities for students
The research is particularly suitable for students interested to perform plant molecular work with a genetic basis. Techniques used in our laboratory: high-throughput DNA isolation, (Q) (RT) PCR, molecular marker technology, (cDNA) AFLP, running a LI-COR sequencer, GATEWAY cloning technology, RNAi, plant transformation, *in situ* hybridization, 2,3,4 yeast hybrid, genome walking, (S)EM.
In addition plant work in the greenhouse is very important, *e.g.* phenotyping of mutants, making crosses.
The differentiation course 'plant genome analysis' is recommended.

(administration code: LM222A, 35 ec, research traineeship and report; LM222C, 6 ec, thesis; LM222D or LM222E, theoretical course)

2.24 Rheumatology (UMCN St. Radboud)

Scientific staff: Dr. P.M. van der Kraan, Dr. F. van de Loo, Dr. P. van Lent
Contact: Dr. P.M. van der Kraan, tel. 3616568
e-mail: p.vanderkraan@reuma.umcn.nl
Website: www.umcn.nl

Research

- Auto-regulated treatment of arthritis
- Osteoarthritis and Cartilage Tissue Engineering
- Mechanisms and modulation of chronic inflammation and joint tissue destruction during Rheumatoid Arthritis

Description of research

The Rheumatology Research Laboratory provides the opportunity for students in Molecular Life Sciences to carry out a trainee program in one of the research programs. The main purpose of the trainee programs is to introduce students in the world of biomedical research by active participation in this field of research. Students are provided with a research project, which can be carried out in the trainee period. Under the supervision of a senior scientist, both the practical and the theoretical part of the research project have to be covered by the trainee. All the research projects have to be presented orally and in a written report.

The main goal of the Rheumatology Research Laboratory is to elucidate the basic biological mechanism of joint destruction during joint diseases such as rheumatoid arthritis and osteoarthritis. Therefore research is performed from DNA to the whole organism. Insight in the molecular and cell biological basis of joint destruction has to be translated in new advanced therapies to prevent further joint destruction and to stimulate repair of damaged tissues.

The following subjects regularly provide student projects for MLW students

1. Supervisor: Dr. Fons van de Loo, *Auto-regulated treatment of arthritis*:
   - Construction of viral vectors with transgenes under control of a candidate promoter
2. Supervisor: Dr Peter M. van der Kraan, *Osteoarthritis and Cartilage Tissue Engineering*
   - Tissue Engineering of articular cartilage
   - Role of cytokines and growth factors in osteoarthritis
3. Supervisor: Dr Peter van Lent , *Mechanisms and modulation of chronic inflammation and joint tissue destruction during Rheumatoid Arthritis.*
   - Macrophages: Regulators of tissue damage during rheumatic diseases.
   - Metalloproteinases: Enzymes causing irreversible cartilage damage during arthritis.

Opportunities for students

If you are interested to work as a trainee on the laboratory Experimental Rheumatology & Advanced Therapeutics Nijmegen please contact Dr. Peter M. van der Kraan, see above. (administration code: LM234A, 35 ec, research traineeship and report; LM234C, 6 ec, thesis; LM234D or LM234E, theoretical course)

2.25 Organismal Animal Physiology (IWWR)

Head: Prof.dr. G. Flik
Contact: Prof.dr. G. Flik, tel. 3653242, e-mail: g.flik@science.ru.nl
Secretariat: tel. 3653244
Website: www.organphy.science.ru.nl

Research
- Stress-adaptation in fish

Description of research
Mission: The research of the group focuses on the regulation of adaptation to stress and the role of communication between neuroendocrine systems (hypothalamus-hypophysis-interrenal and hypothalamus-hypophysis-thyroid axes) and the immune system. Stressors such as crowding or changes in temperature often have negative influences on growth and overall performance and may induce increased susceptibility for diseases due to immune suppression. Hormones from hypothalamic, pituitary, thyroidal and interrenal sources (CRH, TRH, prolactin, growth hormone, ACTH, MSH, endorfines, T3/T4 en cortisol) as well as from the innate immune system (interleukins, TNF's etc.) play an important role in the response of vertebrates to a stressor to reach tolerance or realise adaptation.

The dynamic interaction of an animal with its environment basic to adaptation is studied in the largest group of vertebrates, the bony fish, that offer wonderful models to study this broad research topic. Studies are performed on adult fish as well as on their early (and sensitive) developmental stages; emphasis is given to structure function relationships in both central (brain, hypophysis) and peripheral (gills, gut, kidney, immune system components) organs during the adaptive response. The research approaches include molecular biology, cellular, organ and organismal physiology.

Methods/techniques: In our research techniques are secundary to the research questions we formulate, but essentially every modern technique can be implemented from molecular biological tools to intact animal studies; imaging-techniques are key to many lines of research and in this context light and electron microscopy, confocal laser-scanning microscopy and functional MRI are operational. Immunocytochemistry and in-situ-hybridisation are important methods within the imaging program.

Collaboration: Part of the research of the department is carried out in close collaboration with the departments of Cellular Animal Physioogy (Prof. dr. E.W. Roubos) and of Animal Ecophysiology (Prof.dr. S.E. Wendelaar Bonga); a collaboration with the department of Pharmacology (Prof.dr. F Russel/ Dr. R. Masereeuw) focuses on multidrug resistance proteins in fish kidney and brain capillaries. Outside Nijmegen intensive formalised collaborations have been established with the Interuniversity Reactor Institute (Delft TU), the department of Cell Biology and Immunology, the department Fish Culture and Fisheries (Wageningen University), research institutes in Antwerpen (RUCA, fMRI), Canada (i.a. Antigonish, Ottawa, Edmonton, Hamilton, Vancouver), USA (Berkeley and Hawai'i), Japan (Tokyo and Osaka) and (in EU context) laboratories in Norway, Portugal, Spain, France and Greece. Research in EU context concerns the role of PTHrP (parathyroid hormone related protein, a hypercalcemic hormone in fish) in calcium metabolism, growth and development of seabream, effects of food supplements

(unsaturated fatty acids and vitamin-D metabolites) on growth and development of seabream, sea bass and salmonids, ecofysiological effects of parasites (salmon lice) and temperature variation as stressors in fish in the wild and in aquaculture settings.

Opportunities for students

The department offers several possibilities to carry out research. At the transition of the batchelor's /master's phase, there is the possibility for a 10-weeks "ministage" to learn to know the style of research and the mentality and atmosphere of the department. In the master's phase, we prepare an outline of a personal program for a research (6 -9 month) focused on the individual wishes for techniques and model systems. There are ample possibilities to carry out research abroad; in that case we generally advise to carry out part of the work in Nijmegen as a training and preparation for the research to be carried out in the institute abroad.

(administration code: LM216A, 35 ec, research traineeship and report; LM216C, 6 ec, thesis; LM216D or LM216E, theoretical course)

2.26 Skin Biology and Experimental Dermatology

Contacts: Dr. J. Schalkwijk, tel. 3614094, Dr. P. van Erp, tel. 3613548

Research

- Epidermal host defense mechanisms
- Epidermal cell kinetics
- Novel methods for monitoring gene expression
- Dermal extracellular matrix proteins
- Tissue engineering

Description of research

In case you are interested to participate as a student in these projects, please contact Dr J.Schalkwijk (tel 3614094) or Dr P.van Erp (tel 3613548).

The Laboratory of Skin Biology and Experimental Dermatology is a well-equipped facility for basic and biomedical scientists working on molecular cell biology of skin and skin diseases. We are member of the Nijmegen Center for Molecular Life Sciences (NCMLS). The laboratory is housed within the University Medical Center at the Rene Descartesdreef 1.
The primary function of human skin is to act as a barrier against chemical, microbial and mechanical injury. Using cell biological approaches, large scale expression profiling technology and molecular genetics we are studying genes that are important in all aspects of barrier function, and thus in maintenance of skin homeostasis. The proteins that we are currently interested in are involved in epidermal differentiation, cutaneous innate immunity and mechanical properties of the dermal connective tissue. Understanding of these basic biological processes of the skin provides insight into monogenic and multifactorial diseases of the skin.

Epidermal host defense mechanisms: protease inhibitors and antimicrobial proteins
We identified several epidermal protease inhibitors (SKALP/elafin, SLPI, cystatin M/E) that are involved in cutaneous host defense or regulation of skin barrier function. These small proteins are produced in large quantities in the differentiation programs associated with

disturbance of epidermal homeostasis. In skin diseases such as psoriasis and atopic dermatitis, the regulation of keratinocyte differentiation and proliferation is disturbed. Identification of the regulatory steps in the activation of keratinocytes would allow development of rational therapeutic agents in these major skin diseases. While studying these processes, we have developed and extensively characterized culture models for normal and activated epidermal keratinocytes. These models are currently used to develop high throughput systems for pharmacological and toxicological screening.

Epidermal cell kinetics
Psoriasis research has been a major point of interest of our department, focusing on the mechanisms involved in disturbance of epidermal proliferation and differentiation. The effect of conventional anti-psoriatic drugs and new experimental drugs on clinical and cell biological parameters has been extensively studied. Both in cell culture and in the skin of human volunteers we have studied growth and cell cycle kinetics of epidermal keratinocytes following exposure to trauma or inflammatory stimuli.We have developed *in vitro* models to study recruitment of cells from G0, and induction of quiescence or differentiation both for murine and human keratinocytes. Currently we are investigating the stem cell and transiently amplifying cell population, using flow cytometric analysis.

Novel methods for monitoring gene expression
Serial analysis of gene expression (SAGE) and gene-chip technology are used to monitor the changes in gene expression patterns in cultured keratinocytes and in biopsies of human skin, following external stimuli and during disease. These powerful technologies can be used to study effects of cellular stimuli or the effects of drugs on cellular behaviour. SAGE libraries of cultured keratinocytes have been prepared and analyzed. These data are available at the NCBI web site. We are currently analyzing keratinocyte gene expression profiles (cultured cells and skin biopsies) using a 19.000 60-mer oligo array.

Dermal extracellular matrix proteins
We have recently elucidated a genetic cause of a new type of Ehlers-Danlos syndrome (EDS) and hypermobility type EDS. Both are caused by deficiencies for the matrix protein tenascin-X. We are currently investigating the role of tenascin-X in assembly and stability of collagen and elastic fibers in skin and joints.

Tissue engineering
Three-dimensional, air-exposed culture models for dermal fibroblasts and epidermal keratinocytes are used to study cell biology of the skin in vitro. In addition, these constructs can be used for drug screening and ultimately for reconstructive purposes (burns, ulcers, large surgical defects).

Opportunities for students

Suitable for students Biology and Molecular Life Science
(administration code: LM235A, 35 ec, research traineeship and report; LM235C, 6 ec, thesis; LM235D or LM235E, theoretical course)

2.27 Supramolecular Chemistry (IMM)

Head: Prof.dr. R.M. Nolte
Scientific staff: Dr. J.J..M. Cornelissen, Dr. J.A.A.W. Elemans, Dr. M.C. Feiters
Secretariat: Ms D.D. van der Wey, room HG03.014, tel. 3652676
e-mail: d.vanderwey@science.ru.nl
Website: www.orgchem.science.ru.nl

Research

- Biohybrid amphiphiles
- Processive catalysts
- Molecular electronics
- Biomimetic chemistry

Description of research

Since the first synthesis of an organic molecule (urea) by Woehler in 1827 the size and complexity of molecular structures have increased steadily. Organic molecules and macromolecules (polymers) are traditionally made by covalent synthesis.
Since the introduction of Supramolecular Chemistry by Pedersen, Cram and Lehn (1970's) new routes have become available for the design and construction of large molecular structures, nowadays even reaching the nanometer range (1-500 nm). These large molecules are prepared by different techniques, an important one being self-assembly.

Self-assembly, sometimes described as 'molecular programming', is a two-step process: the first step involves the synthesis of building blocks, which have specifically designed shapes and properties. In a second step these building blocks are (self)-assembled by using non-covalent interactions, e.g. hydrogen bonding, pi-pi stacking, electrostatic interactions, metal-ligand coordination bonds and van der Waals interactions. The outcomes of this process are amazing, complex architectures, which are reminiscent of the majestic structures found in Nature. They are studied in house with different techniques, including NMR, electron microscopy, atomic force microscopy, and scanning tunneling microscopy. The challenge is to optimize the design process in such a way that functional structures, e.g. having special materials properties or specific catalytic properties, are obtained.

Projects that are currently in progress include:

- *Biohybrid amphiphiles*. Amphiphiles are molecules that possess both a hydrophilic and a hydrophobic part. Well-known examples are the phospholipids molecules, which are components of cell membranes. In this project so-called super-amphiphiles and giant amphiphiles are synthesized. These molecules are composed of a hydrophobic polymer (polystyrene) and a hydrophilic polypeptide or a protein (enzyme). When dispersed in water a self-assembly process takes place leading to nanostructures, e.g. fibers, complex helical structures and spheres. The latter structures can encapsulate enzymes and are used as nano-reaction vessels (artificial cells).

- *Processive catalysts*. DNA polymerases are complex enzyme systems that are used by Nature to make copies of DNA. Many of these 'processive' enzymes have a toroidal shape and completely enclose the biopolymer while moving along its chain. The overall

architecture of these systems resembles that of rotaxanes, in which a long molecule is threaded through a macromolecule. We have taken this example from Nature as a source of inspiration to design synthetic catalytic systems that can bind to polymer chains and make changes in this chain (e.g. addition of oxygen atoms) while moving along it (artificial motors).

- *Molecular electronics.* Electronic devices are becoming increasingly smaller and chip structures are approaching the limits of what is possible by top-down lithographic techniques. A new strategy is to design and construct electronic components by bottom-up self-assembly techniques. In this project molecules (e.g. special types of phthalocyanine and porphyrin dyes), that spontaneously self-assemble to form micrometer-long cables and ring-like structures, are designed and synthesized. They are studied with respect to their energy and electron conducting properties by different physical techniques (in collaboration with the Department of Physics and the HFML institute in Nijmegen).

- *Biomimetic chemistry*. Cationic lipids are developed for condensation with DNA and applied in gene therapy, an approach to replace or add a functional copy of a defective gene to a cell in a diseased organism. Cyclodextrins, water-soluble cavity-containing molecules, are functionalized for the development of unidirectional molecular wires, to be applied in a synthetic self-assembled system for photocatalysed hydrogen evolution.

Opportunities for students
Suitable for Chemistry and Natural Science students.

2.28 Synthetic Organic Chemistry (IMM)

Head: Prof.dr. F.P.J.T. Rutjes
Scientific Staff: Dr. F.L. van Delft
Secretariat: Ms M. Versteeg, room HG03.028, tel. 3653389, j.versteeg@science.ru.nl
Website: www.molchem.science.ru.nl/rutjes

Research
The resulting new molecules with often specific (biological) properties and/or the newly developed techniques are applied in multidisciplinary research projects such as:
- Design and synthesis of new antibiotics based on naturally occurring aminoglycosides
- Development of new drugs against rheumatoid arthritis (with NCMLS (Prof. Pruijn), LUMC (Dr. Drijfhout), Chiralix and ModiQuest).
- Development of a diagnostic tool for monitoring the activity of thrombin during blood clotting (with UM (Prof. Hemker)).
- Synthesis of natural products with specific biological activity
- Synthesis and biological evaluation of carbohydrate building blocks as 'chain stoppers' in anticancer therapy (with NCMLS (Dr. van Kuppevelt)
- Synthesis and evaluation of pan-cholecystokinin (CCK) receptor binding ligands for radionuclide targeting of CCK-receptor positive tumors (with UMC St Radboud (Prof. Boerman, Prof. Oyen)
- Development of bio-orthogonal ligation methods (with Dr. Cornelissen)
- Design and synthesis of germination stimulants (with Prof. Zwanenburg and Prof. Bouwmeester (WUR))

Description of research

The research focuses on the synthesis of enantiopure, multi-functionalized heterocyclic molecules - so-called 'druglike' building blocks - which may be of use for a variety of applications. In the synthesis of these molecules, which are predominantly amino acid-based structures and carbohydrate derivatives, the emphasis lies on the development of new 'chemical tools', with particular focus on catalytic methods under sustainable and mild reaction conditions. This includes the following areas:

- Biocatalysis: enzymes are mild and environmentally benign catalysts that can be used to modify organic molecules. Besides application of hydrolytic enzymes (lipases, amidases, nitrilases, sulfatases), enzymes that are capable of forming synthetically useful carbon-carbon bonds are investigated, such as hydroxynitrile lyases and aldolases. Synthetic challenges lie especially in the generation of enantiomerically pure compounds from racemic or non-chiral molecules. Furthermore, collaborations with molecular biology groups result in modified enzymes which are obtained via genetic engineering.
- Transition metal catalysis: transition metal-based catalyst systems (involving Pd, Ru, Cu, W, Ti) are applied in the functionalization and/or cyclization of highly functionalized molecules. For example, ring-closing metathesis is studied as a viable method for the synthesis of fluorinated building blocks, unnatural sugars, or conformationally constrained peptides. Pd-mediated processes are used for the synthesis of unnatural amino acids, and Cu-mediated reactions are being explored to prepare triazole building blocks.
- Organocatalysis: in addition to bio- and metal-catalysts, also chiral amines (e.g. proline) can act as a catalyst to create enantiopure compounds. These types of reactions are being explored in a stereocontrolled approach to synthesize all possible stereoisomers of 1,3-aminoalcohols and diamines
- Technology development:
  - Parallel synthesis: within our group, a fully automized synthesis robot and a semi-automated, modular parallel synthesis facility (in collaboration with the company Chiralix) are available for combinatorial synthesis development
  - Synthesis in microreactors: in collaboration with the Bio-organic chemistry group, a microreactor platform has been established that can be used for reaction screening and optimization
  - High pressure-mediated synthesis: dedicated high pressure equipment has been developed that can be used for exploring new reactions in a parallel fashion at a pressure of 15.000 bar

Opportunities for students

Any of these topics, but also additional projects are open to Master's students in Chemistry, Molecular Life Science or Natural Science. For additional information contact the secretariaat or visit our website.

mandatory course:
- Organic chemistry 1

recommended course:
- Synthetic practical courses, Organic chemistry 2 and Metal-organic chemistry

2.29 Tumor immunology (NCMLS)

Head: Prof.dr. C.G. Figdor
Scientific staff: Prof.dr. G.J. Adema, Dr. R. Torensma, Dr. J. de Vries
Contact: L. de Jager, tel. 361760053010, e-mail: l.dejager@ncmls.ru.nl
Website: www.ncmls.nl

Research

- The Dendritic cell as professional antigen presenting cell
- Immuunresponse towards melanoma
- Biophysical aspects of cell adhesion

Description of research

At the department of Tumorimmunology fundamental immunological research is performed. The aim of our research is to unravel the role of the immune system and in particular the dendritic cell. Although we perform fundamental reseach our goal is to implement the results of this basic reseach into the clinic. To do so we cover a broad range from fundamental in vitro research to experimental therapy for cancer patients. This should lead to better treatment of these patients. We focus on melanoma (skin cancer), kidney cancer and hematological tumors (leukemia). More information can be found on our homepage.
Just a few running projects:

The Dendritic cell as professional antigen presenting cell.
Central question: why is a DC a superior antigen presenting cell

- identification of DC specific molecules (DC-SIGN, DC-STAMP, DC-CK1 were discovered so far)
- functional characterization of DC specific molecules
- cell biological charactertization of DC subsets

Immuunresponse towards melanoma
Cloning of a melanocyte differentiation antigen enabled a detailed immunological study of the immune response towards melanoma. Hallmarks are:

- better antigen presentation by dendritc cells
- specific helper and cytotoxic T-cell response
- clinical grade production of a melanoma vaccine
- a mouse model enabling the study of tolerance induction and immune response induction for melanoma
- experimental therapy using tumurantigen loaded dendritic cells for melanoma patients

Biophysical aspects of cell adhesion
Cell adhesion is a very dynamic process that is tightly regulated even down to the molecular level. In this research line several biophysical approaches are combined in order to address mechanistic questions ranging from the single molecular to the cellular level. Most of these are based on fluorescence measurements either by quantitative flow-cytometry, or (confocal) fluorescence microscopy. However, given the limited resolution of optical microscopy, high-resolution techniques such as electron microscopy and scanning probe microscopy are exploited as well (co-localization). Dynamic processes are monitored using specific imaging techniques like fluorescence recovery after photobleaching (FRAP), fluorescence resonance

energy transfer (FRET), and particle tracking analyses (co-migration). Atomic force microscopy is used to assess the forces that are at play in cell adhesion directly, at the single molecular level. Currently, we are trying to relate the outcome of these molecular scale measurements to the dynamic properties of the entire cell by examining video imaging analyses of cell (trans-) migration and rolling on various substrates. For this, close collaborations with the Biophysical Techniques and Applied Optics groups of the Utwente, as well as the NCMLS imaging facility (MIC) and the UMC hematology departments have been established.

A broad spectrum of cellbiological, immunological, biochemical and molecular biological methods are used to study celladhesion, migration, proliferation, cytotoxic assays, immunofluorescence, hybridoma technology, ELISA, immuunprecipitation, western, southern, northern blotting, RT-PCR, sequencing, site directed mutagenesis, cDNA transfection, recombinant protein production, protein purification and in situ hybridisation.

Opportunities for students

Coaching: Students are considered as future reseachers. They work together with their coach on specified parts of actual projects. Studentprojects are carefully planned. Only postdocs or senior AIO's coach one student at the time to guarantee the quality. However, this means that the number of slots is limited.
The atmosphere at the TIL: enthousiatic fundamental research laboratory with many international contacts
(administration code: LM236A, 35 ec, research traineeship and report; LM236C, 6 ec, thesis; LM236D or LM236E, theoretical course)

2.30 FC Donders Centre for Cognitive Neuroimaging

Contact: Dr. P. Fries, tel. 3610657, e-mail: pascal.fries@fcdonders.ru.nl
Website: www.ru.nl/fcdonders

Description

The Centre houses 9 research groups, each with a particular research domain within cognitive neuroscience. For information, see www.fcdonders.ru.nl
No preceding course requirements.

Opportunities for students

Internships of minimally 6 months full-time can be done at the F.C. Donders Centre for Cognitive Neuroimaging
(administration code: LM223A, 35 ec, research traineeship and report; LM223C, 6 ec, thesis; LM223D or LM223E, theoretical course)

2.31 Laboratory for Experimental Urology (UMCN St. Radboud)

Head: Prof.dr. J.A. Schalken
Scientific staff: Dr. E. Oosterwijk, Dr. G.W. Verhaegh
Secretariat: Ms R. Rasolo, NCMLS route 267, tel. 3617662
e-mail: r.rasolo@ncmls.ru.nl
Website: www.umcn.nl/scientist/afdelingen/urologie

Research

- Characterization of prostate cancer-associated non-coding RNAs
- The role of cell adhesion molecules in cancer progression
- Targeted therapy in renal cell carcinoma
- Cancer stem cells as potential new tumor targets

Urological cancers are common malignancies in humans and are responsible for about 18% of all cancer deaths. Currently, effective treatment is lacking for most bladder, kidney and prostate cancer patients with advanced disease. The main focus at our laboratory is the understanding of the mechanisms involved in cancer initiation and progression with the aim to develop tools for the early detection of cancer and to develop adequate cancer treatments.

Description of research

Characterization of prostate cancer-associated non-coding RNAs. Recent large-scale transcriptome studies revealed that the majority of primary nuclear transcripts correspond to transcripts that do not possess protein-coding capacity (so-called non-coding RNAs) and in general are highly cell type specific. We have identified a prostate-specific ncRNA (PCA3) that is strongly over-expressed in prostate cancer. In addition to PCA3, other ncRNAs (incl. microRNAs) associated with prostate cancer have been identified. The role of these ncRNAs in tumor cell growth in vitro and in vivo will be studied. To obtain insight into the mechanism of action of these ncRNAs, their interaction partners and target genes will be identified. Overall, these studies will provide unique knowledge of the pivotal pathways for prostate carcinogenesis, and hence may lead to the development of innovative therapies.

The role of cell adhesion molecules in cancer progression. The loss of cell-cell adhesion contacts plays an important role in the progression (invasion and metastasis) of urological malignancies. The best-characterized cell adhesion complex is the E-cadherin-catenin complex. We have identified new proteins that co-localize with the E-cadherin-catenin cell adhesion complex at the plasma membrane. The expression of the newly identified cell adhesion-associated proteins in tumor specimens will be studied to establish their potential as novel markers for tumor progression and as targets for therapy.

Targeted therapy in renal cell carcinoma. Renal cell carcinoma is characterized by the over expression of carbonic anhydrase IX (CAIX/G250). We have shown that the CAIX/G250 protein is an excellent molecule for targeting purposes. In addition, we have shown that the CAIX gene promoter is a suitable promoter to express genes in a tumor-specific fashion. In order to generate new treatment modalities, such as combinations with immuno gene therapy, the student can be involved in testing the targeting ability of newly modified molecules that target CAIX in vitro and in vivo.

Cancer stem cells as potential new tumor targets. As mentioned, treatment is lacking for most kidney and prostate cancer patients with advanced disease. It is likely that current therapies fail to attack the most relevant tumor cell population, namely the cell population that re-populates the tumor (so-called cancer stem cells). To detect new targets for the effective treatment of advanced prostate and kidney cancer we are isolating cancer stem cells from surgical specimens using differential adherence and FACS sorting. Then, these cell populations will be characterized for growth potential and differentiation characteristics. Ultimately we will investigate whether specific target molecules can be defined that can be used to develop new targeted therapies.

Techniques: Recombinant DNA technology, cell and tissue culture, protein-DNA/RNA binding assays, promoter assays, RNA interference, microarray analysis, quantitative RT-PCR, Northern and Western blot analysis, immunohistochemistry, flow cytometry, tumorigenicity assays.

Opportunities for students

Recommended courses: Cell Biology of Animals, Cell Communication, Immunology, Molecular Basis of Disease, Biochemistry and Molecular Biology II/III.
(administration code: LM237A, 35 ec, research traineeship and report; LM237C, 6 ec, thesis; LM237D or LM237E, theoretical course)

2.32 Laboratory for Pediatrics and Neurology (UMCN St. Radboud)

Head: Prof.dr. R.A. Wevers
Scientific staff: Dr. L.P.W.J. van den Heuvel, Dr. R.J.T. Rodenburg, Dr. W. Ruitenbeek
Dr. Ir. M.M. Verbeek, Dr. L.A.J. Kluijtmans, Dr. D.J. Lefeber
Secretariat: Ms S. Hoenderop, tel. 3614567, e-mail: mailto:s.hoederop@cukz.umcn.nl
Website: www.umcn.nl/lkn

Research

- Mitochondrial disorders
- Neurochemistry of Neurodegenerative and Neurometabolic disorders
- Proteomics and neuromuscular disorders
- Disorders of Glycosylation
- Renal development in health and disease or Pediatric Nephrology

Description of research

The Laboratory for Pediatrics and Neurology works on 1. genetic and metabolic disease and 2. neurochemistry. Via our secretary more detailed information is available on the research lines of the laboratory. A wide variation of techniques is available at the level of metabolites, proteins (proteomics) and at the molecular genetic level. The main research lines are:

Mitochondrial disorders
The Nijmegen Center for Mitochondrial Disorders (NCMD) is an international reference center for patient care, diagnostics and research of mitochondrial patients. The NCMD investigates about 500 patients and/or patient biopsy samples on a yearly base. The research group characterized most of the 39 structural nuclear encoded complex I genes and found first mutations in such genes in various complex I deficient patients. The group currently is involved in the elucidation of the cell biological consequences of human complex I deficiency.

Neurochemistry of Neurodegenerative and Neurometabolic disorders
Research focusses on the following topics: 1) Pathogenesis of Alzheimer's disease (AD). In order to get more insight into the pathogenesis of this neurological disorder, cell culture and animal models are used. 2) Biomarkers for neurodegeneration. It is difficult to clinically distinguish between various neurodegenerative disorders (dementia syndromes such as AD; movement disorders such as Parkinson's disease) early in the disease process. We aim to develop biomarkers for these disorders in order to improve and accelerate the clinical

diagnosis. 3) Disorders of neurotransmitter metabolism. Diagnosis of these disorders relies on specialized biochemical diagnostic assays. Novel genetic disorders have been identified by our laboratory in the past years and it is expected that the number of inherited disorders will continue to expand.

Proteomics and neuromuscular disorders
The Nijmegen proteomics facility centre in our laboratory uses state of the art techniques (2-dimensional electrophoresis, MALDI, LC in combination with fourier-transformed mass spectrometry). For research purposes the laboratory concentrates on neuromuscular diseases and on the human proteome of various subcellular organelles in muscle.

Disorders of Glycosylation
Genetic defects in protein glycosylation lead to severe multi system disease in the first year of life. Our studies focus on the molecular background of such defects.

Our studies focus on:
- elucidation of primary defects in as yet unsolved cases
- development of new methylation (expression arrays, proteomics)
- O-glycosylation mechanisms

Renal development in health and disease or Pediatric Nephrology
In the pediatric nephrology the research is focussed on: a) The pathogenicity of the hemolytic uremic syndrome; b) Inherited tubular transport defects; c) The role of the extracellular matrix in renal pathology; d)Efficiency of renal replacement therapy. The studies are performed on the level of metabolites (metabolomics), protein (proteomics) and DNA/RNA (genomics).

Opportunities for students
Suitable for students Biology and Molecular Life Science
(administration code: LM219A, 35 ec, research traineeship and report; LM219C, 6 ec, thesis; LM219D or LM219E, theoretical course)

2.33 Nephrology Research Laboratory (NCMLS)

Head: Dr. J. van der Vlag
Scientific staff: Prof.dr. J. Berden, Prof.dr. J. Wetzels, Dr. L. Hilbrands
Contact: Dr. J. van der Vlag, 5.83 NCMLS, 3616539, j.vandervlag@ncmls.ru.nl
websites: www.ncmls.ru.nl (theme: 'Infection, immunity and tissue repair'); www.ncmls.ru.nl (department: 'Nephrology')

Research
Transplantation immunology research line:
- Tolerogenic dendritic cells prolonging graft survival after manipulating Toll like receptors.

Glomerular diseases research line:
- Heparan sulfate (proteoglycans) HSPGs in (glomerular) inflammation.
- Apoptosis-induced chromatin modifications in the autoimmune disease SLE.
- Maturation of dendritic cells by apoptotic blebs and chromatin in SLE.
- Parietal epithelial cells in glomerular diseases.

Description of Research
The research of the division of Nephrology focuses on the pathophysiology, immunology and treatment of renal diseases, and is embedded in research theme 5.5 "Renal Disorders" of the Radboud University Nijmegen Medical Centre and in the Nijmegen Centre for Molecular Life Sciences research theme "Infection, Immunity and Tissue Repair". The fundamental research in the Nephrology Research Laboratory is fueled by clinical problems (i.e., proteinuria, glomerular nephritis, glomerular sclerosis and transplant rejection) and focuses on two main research lines, *Transplantation Immunology and Glomerular Diseases.* In our fundamental research we apply a wide variety of approaches (immunological, molecular and cell biological techniques) at different levels, i.e. *in vitro* (cell culture), *in vivo* (animal models) and in patient's material (serum, urine, biopsies).

Opportunities for students
Internships are possible and suitable for (Medical) Biology, Molecular Life Science students and Biochemistry students. After an interview with the student one of the research projects listed below will be selected for the internship. The internship will be finished by a written report and an oral presentation. For detailed information on the projects, contact Johan van der Vlag.

(administration code: LM230A, 35 ec, research traineeship and report; LM230C, 6 ec, thesis; LM230D or LM230E, theoretical course)

2.34 Nijmegen Centre for Mitochondrial Disorders (UMCN)

Head:	Prof.dr. J. Smeitink
Scientific staff:	Dr. B. van den Heuvel, Dr. W. Koopman, Dr. L. Nijtmans
	Dr. R. Rodenburg, Dr. P. Willems
Contact:	Dr. L. Nijtmans, tel. 3610938, e-mail: l.nijtmans@cukz.umcn.nl
websites:	www.eumitocombat.org
	www.ncmls.nl

Research
- Elucidation of the assembly pathway of human Complex I (CI)
- Cell biological consequences and mitigation of mitochondrial dysfunction

Description of research
The Nijmegen Centre for Mitochondrial Disorders is a full-facility international reference centre for clinical care, biochemical, pathological and molecular diagnostics and research of patients suspected for or with established disturbances of the mitochondrial energy metabolism. The mitochondrial research is acknowledged in the Nijmegen Center for Molecular Life Sciences theme Metabolic Genomics and the main research program V Metabolic and Genetic Disorders of the UMCN.

The main topic of our research concerns the oxidative phosphorylation (OXPHOS) system in health and disease with the final aim to develop new treatment strategies for genetic disorders of the system in man. Special attention is given to human complex I (CI) or NADH:ubiquinone oxidoreductase.

Prof. Smeitink is coordinator of the established European consortium 'EUMITOCOMBAT' in which 12 universities and 21 research groups out of nine different European countries work together. With this extensive international network we are able to offer students the possibility to do a traineeship abroad.

Elucidation of the assembly pathway of human Complex I (CI)
(Dr. Leo Nijtmans, Dept. Paediatrics UMCN, tel. 024-3610938; L.Nijtmans@cukz.umcn.nl)
Research interests include the biogenesis of mitochondria and in particular the complexes involved in the process of OXPHOS, with a specific focus on one of the largest multi-protein complexes that are known in nature: Complex I (CI). The assembly of this giant enzyme is very intricate in view of the fact that it consists of at least 46 subunits which are encoded either by the nuclear or mitochondrial DNA.
Research questions investigated comprise: what is the sequence of assembly of subunits of CI? What are the crucial steps in the assembly? What are the functions of the individual accessory subunits of CI? How is assembly affected in CI deficient patients? Answers to these research questions provide insight in the molecular mechanisms leading to mitochondrial disorders.
We advice students to follow at least one of the Courses on Molecular Biology, Cell biology and/or Biochemistry.

Cell biological consequences and mitigation of mitochondrial dysfunction (Dr. Peter Willems and Dr. Werner Koopman, Dept. Membrane Biochemistry NCMLS, tel. 024-3614589, e-mail W.Koopman@ncmls.ru.nl)
Research focuses on the (patho)physiology of metabolic disease and mitochondrial dysfunction with special reference to genetic disorders of the OXPHOS system. Emphasis lies on the combination of biochemistry, molecular biology and advanced life cell imaging to assess the molecular mechanisms underlying the cellular consequences of mitochondrial dysfunction. Of particular interest for the latter is the search for therapeutics that can improve dysfunction. Measurements are performed on cell lines and primary cultures of patient skin fibroblasts and skeletal muscle myotubes. Research topics focus on:

- Mitochondrial and cellular Ca2+ and ATP homeostasis.
- Mitochondrial network complexity and mitochondrial dynamics.
- The role of mitochondria in oxidant generation.
- Regulation and consequences of the above during normo- and pathophysiology.

Opportunities for students

Suitable for students Molecular Life Science
(administration code: LM231A, 35 ec, research traineeship and report; LM231C, 6 ec, thesis; LM231D or LM231E, theoretical course)

3 Courses

3.1 Master courses in Molecular Life Science

Besides research traineeships and professional training, the Masters' program also includes master courses in Molecular Life Science. For O-variant students at least 15 ec should be covered with these courses. For students of the other variants at least 12 ec should be covered with master courses in Molecular Life Science.

According to the university rules, a 3 ec Philosophy course has to be included. A selection should be made from the courses summarized in this paragraph.

Note: Each 45 ec research traineeship includes a theoretical course covering 4 ec. If students follow a research traineeship at a department that is involved in one of the courses listed below, the course can be taken as part of the traineeship. The total Masters' program has to contain 120 ec.

Capita selecta:

- **Friday September14 -November30 (period 1):**
  Caput Metabolism, transport and motility(3 ec)
  CaputApoptosis (3 ec)
  Caput Human Fertility and infertility (3 ec)
  Caput Trends in Plant Science (3 ec)

- **Friday December7 - March 7 (periode 2):**
  Caput Molecular Biology; Gene Expression, Chromatin and Disease (3 ec)
  Caput Oncology (3 ec)
  Caput Adaptation Physiology (3 ec)
  Caput Microbiology (3 ec)

- **Friday March 21-June 27 (periode 3):**
  Caput molecular aspects of host defense, tissue destruction and repair (3 ec)
  Caput Molecular and Cellular Neurobiology (3 ec)
  Caput Signal Transduction and Transport (3 ec)
  CaputPost-translational regulation in Health and Disease (3 ec)
  Caput Endocrinology (3 ec)

Department of Organic Chemistry:
Caput Instrumental analysis (2 ec, Sept/Oct 2007)
Caput Physical organic and supramolecular chemistry (2 ec, Nov/Dec 2007)
Caput Polymer Chemistry (2 ec, Jan/Feb 2008)
Caput Metal catalysis in organic Synthesis (2 ec, March/April 2008)
Caput Molecular materials (4 ec May/June 2008)
Advanced Organic Chemistry (6 ec, Sept 07 - June 08)
Chemical Biology (6 ec, 4 weeks course, around April 2008)
Advanced crystallography (4 ec, spring 2008)
Advanced molecular structure determination (4 ec, NEW2007/2008!)

Department of Analytical Chemistry:
Caput Chemometrics II (4 ec)
Caput Analytical Chemistry

Department of (bio)physical Chemistry:
Magnetic Resonance II (4 ec)
Magnetic Resonance IIIa (3 ec)

Master courses in Bioinformatics
Bioinformatics of Protein Structure (4 ec)
Bioinformatics: Data, Techniques and Applications (3, 4 or 6 ec)
Computational Drug Discovery (4 ec)

Research related courses:
Working with Radionuclides level 5B (2 ec) Sign in by h.hogenkamp@amd.ru.nl
Laboratory Animal Science and Alternatives (4 ec) Sign in by d.vandepol@cdl.umcn.nl

Philosophy courses
Evolution and the mind
Science & Literature
Bio-ethics for lifescientist

- ***Subscription for the master courses is needed! See the following website:*** *www.ru.nl/tis/introductie_tis/introductie_tis/*
- ***Timetables of courses as well as dates of examination can be found on the website of the Education Institute for Molecular Science: www.ru.nl/moleculairewetenschappen.***

Capita selecta: Metabolism, transport and motility

Course id: **LM011** *3 ec* 14 september - 30 november 2007 dr. L.P.W.J. vanden Heuvel
dr. P.M.T. Deen
mw dr. R. Masereeuw
prof. dr. B. Wieringa

Teaching methods
- 20 hrs interactive lectures

Pre-requisites
recommended: 'Biochemie en moleculaire biologie II' and 'Celbiologie der dieren'

Learning outcomes
Make students familiar with the biomedical significance of energy and metabolites in the "small molecular world" and how the role of these compounds is integrated in the larger cellular network for metabolism, transport and motility. Specifically, students should be able to
- appreciate the significance of 'metabolic, transport and motion research' for molecular life sciences
- recognize current possibilities and developments in the field
- implement the newly obtained knowledge in future research activities

Description
Students will be offered a comprehensive series of introductory lectures on the topics of interest that go beyond basic (bachelor) knowledge of biochemistry and cell-biology textbooks. They will be asked to read background literature and use information at websites to make themselves familiar with knowledge on the significance of metabolite profile analysis, the role of energy and redox metabolism in cell viability and mobility control, (reverse) genomics and proteomics for the study of transport proteins, channelopathies, mitochondrial diseases, and multifactorial disorders. Emphasis will be on the value of multi-disciplinary approaches.

Subjects
- The essence of metabolic investigations
- Multifactorial disorders
- OXPHOS system diseases
- Proteomics and human pathology
- Water channels
- Body water homeostasis
- ABC transporters and solute carriers
- Regulation of drug transporters in health and disease
- Coupling of energy/redox metabolism to cell viability and motility control
- Biochemical adaptation to energy and redox stress

The course will be focused on aspects of metabolism, transport and motility in muscle, brain, kidney disease and cancer and other related health problems.

Literature
Literature assignments and hand-outs are distributed during the lectures

Examination
Written examination

Extra Information
Contact: Dr. L. van den Heuvel (024-3617983 or 14428), B.vandenHeuvel@cukz.umcn.nl

Capita selecta: Apoptosis

Course id: **BM004B** *3 ec* september 14 - november 1, 2007 dr. F. van Kuppeveld
dr. W.C. Boelens
dr. H. Dolstra

Teaching methods
- 18 hrs lecture
- 2 hrs problem session
- 60 hrs individual study period

Pre-requisites
Biochemistry and Molecular Biology II (BMB-II)

Learning outcomes
After completing the course the student should be able to understand what apoptosis is, how it is regulated and in which way it is involved in the many different cellular processes. Apoptosis is a highly regulated process that is needed to kill a cell clean and neatly. For a very long time the process was neglected, but now the importance of the process is generally accepted. Apoptosis is involved in many different aspects of life, such as embryonic development, tissue homeostasis and regulation of the immune response. Deregulation of the apoptotic process plays an important role in the development of autoimmune diseases, cancer and viral infection.

Subjects
- Introduction Molecular Aspects of Apoptosis
- Apoptosis and Cancer
- Apoptosis and Stress
- Suppression and Induction of Apoptosis by Viruses
- Apoptosis and Inflammation

Examination
Written exam.

Extra information
contact: dr. W. Boelens, phone 36 16753, email: w.boelens@ncmls.ru.nl

Capita selecta: Human fertility and infertility

Course id: **BM012B** *3 ec* september 14 - november 30, 2007 dr.ir. P. de Boer

Teaching methods
- 13 hrs lecture
- 13 hrs student presentation
- 12 hrs student project

Pre-requisites
This caput has been developed as an extension to the element 'human fertility and germcells' of course BB047B, Human embryology and reproduction (Humane embryologie en voortplanting) of the BSc phase. Some grounds in genetics, molecular biology, cell biology, anatomy, histology/cytology and endocrinology all help in applying these principles to human reproduction.

Learning outcomes
The goal of this course is to enable participants to practise the integration of knowledge of the various fields as mentioned above. From this integration, a more independent judgement of spontaneous human reproduction relative to artificial human reproduction can be developed. Also the critical evaluation of research outcomes as published in the international literature, is one aspect of this course, as is the delineation of lacuna(s) in our understanding of human reproduction.

Description
Central to the caput is the evaluation of quantity and quality of human gametes, eggs and sperm. Quality control mechanisms in both oogenesis and spermatogenesis will receive attention. Union of gametes and the subsequent cleavage divisions are included, as is the establishment of pregnancy by implantation. Aspects of human behaviour, as these are related to gamete transport in both the male and the female, are part of the course.

Examination
Participants each write an essay, which is also the basis of the mark obtained. Ideally, the essay which is based on the presentations of the participants, gives an overview of the nature of human reproduction, evaluating the known and unknown elements. The essay can be both in Dutch or in English.

Capita selecta: Trends in plant science

Course id: **BM020B** *3 ec* september 14 - november 30, 2007 prof. dr. ir. G.C. Angenent
prof. dr. A.G.M. Gerats
prof. dr. C. Mariani

Teaching methods
- 20 hrs lecture
- 26 hrs individual study period

Pre-requisites
Background in molecular biology is helpfull but not absolutely required

Learning outcomes
This caput series discusses new developments in plant sciences and how these developments are being used for research and biotechnological applications. Various aspects of molecular regulation at the cellular level and the impact on tissues and the whole plant level will be taught.

Description
An important trend in plant science is the elucidation of molecular networks that control the functioning of the cell, tissues and the organism. Central in these studies are molecules that transduce signals. Examples are the well-known and recently rediscovered phytohormones, ligands and receptors, and transcription factors. The molecular networks are also controlled by other mechanisms, e.g. microRNAs and chromatin remodeling, which will be discussed. An important tissue in plants is the meristem. How plant meristems are formed and how they produce the differentiated organs will be addressed.
Functional genomics tools and datasets are becoming more and more important in studying molecular processes in organisms. Some of these tools will be discussed and examples will be given how they are used in nowadays research. Our basic knowledge about these processes and factors involved has increased substantially during the last decade, which has led to new opportunities for food and non-food applications. A number of these biotechnological applications will be discussed.

Literature
The subjects will be discussed based on review papers, which will be made available to the students.

Examination
Written examination

Extra information
contact: Prof G. Angenent, g.angenent@science.ru.nl
or E. Schaberg, 3652777/3652773, e.schaberg@science.ru.nl

Capita selecta:
Molecular biology: Gene expression, chromatin and disease

Course id: **BM009B** *3 ec* december 7, 2007 - march 7, 2008 C. Logie
prof. dr. ir. H.G. Stunnenberg
dr. G.J.C. Veenstra

Teaching methods
- 24 hrs lecture
- 56 hrs individual study period

Pre-requisites
Biochemistry and Molecular Biology II or similar course

Learning outcomes
This course aims to showcase current insights in the role of gene expression with respect to cancer, congenital disease, embryonic development and establishing cellular identity. Special emphasis will be on epigenetics (heritable modifications of chromosomes), transcription factors and the molecular biology of tumor suppressors.

Subjects
- Introduction chromatin structure and function
- Epigenetics as molecular memory
- Chromatin and cancer
- Imprinting and imprinting syndromes
- Animal models for the pathology of chromatin dysfunction

Literature
Literature: Lectures, PowerPoint print-outs

Examination
Written

Extra information
Contact person: dr. Logie tel: 3610525, c.logie@ncmls.ru.nl

Capita selecta: Oncology

Course id: **BM015B** *3 ec* december 7, 2007 - march 7, 2008 dr. G.N.P. van Muijen

Teaching methods
- 26 hrs lecture
- 54 hrs individual study period

Learning outcomes
To gave insight into fundamental and medical aspects of tumor growth. Oncogenesis, tumor progression, distribution of the various types of tumors, diagnostic procedures and various therapeutic options will be discussed. Finally, psychologic implications of cancer will be discussed.

Subjects
- Principles of neoplastic growth
- Epidemiological aspects of tumors
- Chemical carcinogenesis
- Tumor stem cells
- Tumor stroma
- Hereditary tumors
- Chemotherapy and receptor-mediated therapy
- Immunotherapy
- Radiotherapy
- Psychological aspects of cancer

Literature
Readers

Examination
Written exam.

Capita selecta: Adaptation physiology

Course id: **BM010B** *3 ec* december 7, 2007 - march 7, 2008 prof. dr. G. Flik
dr. P.H.M. Klaren

Teaching methods
- 26 hrs lecture
- 54 hrs individual study period

Pre-requisites
Acquaintance with the content of the Bachelor courses 'Adaptation Phyiology' and 'Endocrinology' is highly recommended, but not a strict requirement.

Learning outcomes
Increased insight in dedicated aspects of the broad field of adaptation physiology through interactive lectures on recent developments in this research field.

Description
This series of lectures focuses on organismal physiology: regulatory mechanisms in the intact animal are addressed (Integrative Physiology). The central theme is how animals (including the human being) have adapted to realise a dynamic interaction and to cope with continuously changing environmental conditions. Homeostatic and allostatic principles are discussed. Two internal systems are predominantly involved in this adaptation: the nervous system and the endocrine system. Together these systems control the activity of peripheral endocrine and non-endocrine targets, resulting in a functional adaptive response. In this regulation the hypothalamus and pituitary gland are pivotal as relays between the central nervous system and peripheral organs; in the hypothalamus signals from central and peripheral sensors are integrated with peripheral (endocrine) signals from e.g. the immune system and gastrointestinal tract. The intensive interaction of the immune system and the neuroendocrine system is illustrated with the stress response, based on ongoing recent research towards the neuroendocrine mechanisms at the basis of active and passive coping strategies in animal models. Next attention is given to a selection of adaptive strategies relating to cyclical changes (diurnal, mensal, circannual), biological clocks, feeding and endocrine mechanisms underlying (sleep) activity, reproduction and migration. Some lectures will be dedicated to topics that received attention in recent papers and science sections of news papers.

Literature
The lectures will be published as power points (without subtexts!) on Black Board.
Eckert and Randall: Animal Physiology
Sherwood et al: Animal Physiology. From genes to organisms.
Science pages of NRC, Volkskrant

Examination
The exam is an essay/open ending type on ten selected topics.

Extra information
contact: Mrs. D. Maurits (D.Maurits@science.ru.nl)

Capita selecta: Microbiology

Course id: **BM014B** *3 ec* december 7, 2007 - march 7, 2008 prof. dr. ir. M.S.M. Jetten
dr. H.J.M. op den Camp

Teaching methods
- 48 hrs individual study period
- 22 hrs lecture

Pre-requisites
1st year course 'Biology of Microorganisms' and preferably the courses 'Physiological Microbiology' and 'Ecological Microbiology'

Learning outcomes
The lectures and literature evaluations aim to give students insight in the newest developments within selected research fields of microbiology.

Description
The topic of the Caput varies each year. The past years the following topics were selected:
- Microorganisms and symbiosis
- The microbiology of the geochemical cycles
- Extremophiles
- Microbial interactions in ecosystems

Examination
By written exams and oral presentation.

Capita selecta:
Molecular aspects of host defense, tissue destruction and repair

Course id: **LM012** *3 ec* March - June 2008

prof. dr. G.J.M. Pruijn
Prof.dr. J. Schalkwijk
dr. P. van der Kraan
dr. R. Torensma

Teaching methods
- 20 hrs interactive lectures

Pre-requisites
Biochemie en Moleculaire Biologie II (BB017C) required; Immunologie (BB019B) recommended

Learning outcomes
After completing the course the student is aware of the molecular mechanisms underlying tissue destruction and repair and has knowledge of the various ways in which the immune system is challenged by both exogenous and endogenous triggers. The student has learned how the immune system responds to these triggers and understands the relationship with infectious and chronic diseases. The student has gained insight into the experimental approaches that are applied to study the molecular and cell biological aspects of infection, immunity and tissue repair.

Description
The course will be focused on two types of tissues: skin and cartilage

Subjects
- Immune system
- Autoimmunity
- Inflammation
- Animal models
- Stem cells
- Tissue repair

Literature
Hand-outs distributed during the lectures

Examination
written examination

Extra Information
Contact: Prof.dr. G. Pruijn, 0-243616847, G.Pruijn@ncmls.ru.nl

Capita selecta: Molecular and cellular neurobiology

Course id: **BM001B** *3 ec* march 28 - june 20, 2008 dr. B.G. Jenks
prof. dr. E.W. Roubos
prof. dr. G.J.M. Martens

Website
www-celcom.science.ru.nl

Teaching methods
- 20 hrs lecture

Pre-requisites
Bachelor level Cell Biology, Molecular Biology and Neurobiology

Learning outcomes
The aim of this course is to give students an appreciation of current issues in Neurobiology, particularly molecular and cellular aspects and how these can impact on neurodgenerative diseases and behavior.

Description
This course considers advanced topics of molecular and cellular aspects of neurobiology. Particular attention is given to where such mechanisms impact on behaviour. Among the topics covered in recent years are: Hypothalamic Control of Feeding; Oxytocin: a Multifunctional Behavioral Neuropeptide; The Neurobiology of Fear; Adult Neurogenesis; The Molecular and Cellular Mechanisms involved in Neurodegeneration; Genetic and Epigenetic Mechanisms underlying Neurodevelopmental Disorders. A selection of these, or similar topics will be presented in the course. Instructors for the course are: Bruce Jenks (10h of lectures), Gerard Martens (8h) and Eric Roubos (2h). The lectures are in English (Exam can be in English or Dutch).

Examination
Written exam

Capita selecta: Signal transduction and transport

Course id: **BM016B** *3 ec* march 28 - june 20, 2008 dr. P.H.G.M. Willems
dr. A.P.R. Theuvenet

Teaching methods
- 20 hrs lecture
- 60 hrs individual study period

Learning outcomes
Students gain knowledge and insight into the biophysical aspects of signal transduction by polypeptide growth factors, neurotransmitters and hormones. Emphasis lies on the use of patch-clamp and cellular imaging techniques in biomedical research. Lectures will be based on most recent scientific papers.

Description
Part A.'Electrical aspects of Signaltransduction'
(Coordinator Theuvenet, a.theuvenet@science.ru.nl, 3652013)
- Bioelectricity and cellular growth regulation
- Cell communication via gap junctions and cancer
- Ion channels as signal transducers
- Ion channels and apoptosis
- Ion channels and disease, channelopathies

Part B.'Cellular Imaging in Four Dimensions'
(Coordinator Willems, p.willems@ncmls.ru.nl, 3614589)

I. Principles of fluorescence and electron microscopy
- Introduction in microscopy
- Genetically-encoded green fluorescent proteins

II. Microscopy: Applications in biology and medicine
- Imaging of Intracellular Protein Routing in Health and Disease
- Imaging of Cellular Ion Homeostasis in Health and Disease
- Imaging of Mitochondrial Plasticity in Health and Disease

Examination
The final written exam includes both parts of course.

Extra information
contact: mrs. J. Rullmann, 3652701, j.Rullmann@science.ru.nl

Capita selecta:
Post-transcriptional regulation in health and disease

Course id: **BM027B** *3 ec* march 28 - june 20, 2008

dr. N.H. Lubsen
prof. dr. G.J.M. Pruijn
dr. G.W.M. Swart

Teaching methods
- 20 hrs lecture
- 60 hrs individual study period

Pre-requisites
Biochemistry and Molecular Biology II (BMB-II)

Learning outcomes
After completing the course the student is aware of the identification of post-transcriptional regulation as a major factor in control of health and disease and has knowledge of the various ways in which the levels of gene products can be regulated post-transcriptionally. The student has learned that cell responses to environmental changes are fine-tuned by subtle modifications of RNA and proteins, and that disturbance of the fine-tuning may promote acute and chronic disease (inflammation, auto-immunity, cancer).

Subjects
Error-prone macromolecular synthesis:
- molecular misreading
- leaky scanning during translation initiation

RNA modifications and processing:
- Post-transcriptional modification of structural RNAs
- RNA editing
- Alternative splicing of pre-mRNA
- Nonsense mediated decay
- Regulation of gene expression by microRNAs

Protein modifications and processing
- Post-translational modifications and subcellular localization
- Post-translational modifications and disease
- Proteolytic activation of enzymes and cellular signaling

Literature
Hand-outs, distributed via blackboard

Examination
Written examination

Extra information
contact: G. Swart, 3614266, g.swart@ncmls.ru.nl

Instrumental analysis for molecular chemistry

Course id: **SM015A** *3 ec* Autumn dr. M.C. Feiters

Teaching methods
- 16 hrs problem session
- 10 hrs lecture

Pre-requisites
- SRM4
- organische chemie 1
- magnetic resonance I (recommended)

Learning outcomes
Independent interpretation and evaluation of NMR and mass spectra, independent planning of strategy for purification by chromatography.

Description
Important techniques for the characterization of compounds by instrumental analysis are treated. The emphasis is on NMR and mass spectrometry of organic compounds; in the integrated problems IR and the results of elemental analysis are also included. Furthermore chromatography is treated.

Literature
Handouts and papers will be distributed during the course.

Examination
Written examination.

Physical organic and supramolecular chemistry

Course id: **SM023B** *3 ec* November-December 2007 prof. dr. R.J.M. Nolte
dr. J.J.L.M. Cornelissen
dr. J.A.A.W. Elemans

Teaching methods
- 18 hrs lecture

Description
This course gives an overview of modern developments in physical organic and supramolecular chemistry, and is meant as an extension of the 'Advanced Organic Chemistry' course. The topics are based on the recent literature. Subjects that will be discussed include self assembling molecular systems, host-guest chemistry, supramolecular materials and biomimetic catalysis.

Literature
Lecture notes and original literature.
Anslyn & Dougherty 'Modern Physical Organic Chemistry', University Science Books, 2006

Examination
Written examination.

Polymer chemistry

Course id: **SM019A** *3 ec* January-February 2008 prof. dr. ir. J.C.M. van Hest
prof. dr. E.W. Meijer

Teaching methods
- 18 hrs lecture

Learning outcomes
After completing the course the student will be able to understand the most important polymer chemistry definitions and methodologies, of which synthesis and molecular aspects will receive most attention. The student can relate polymerization mechanism to polymer properties. Furthermore, with the aid of special topics, the student will become familiar with recent trends in polymer chemistry.

Description
The first part of the course Polymer Chemistry will give an introduction into different aspects of this multidisciplinary area, such as history, properties and applications of polymers. The preparation of the most common polymers will be discussed from a molecular point of view. The relationship between synthetic methodology and macromolecular properties and, as a result, between synthesis and applications will be emphasized. The second part deals with some special topics of recent developments in the field of polymer chemistry.

Topics:
- chain polymerization
- radical polymerization
- ionic polymerization
- coordination polymerization
- step polymerization
- ring opening polymerization

Special topics, such as
- controlled polymerization mechanisms
- dendrimers
- biopolymers

Literature
- Hand-outs and lecture notes (handed out during the course).
- Recommended: 'Polymers', Walton and Lorimer, Oxford Chemistry Primers, Oxford University Press, ISBN 019850389X.

Examination
Written examination.

Application of metal-catalysis in natural product synthesis

Course id: **SM018A** *3 ec* March/April 2008 prof. dr. F.P.J.T. Rutjes

Teaching methods
- 16 hrs lecture

Pre-requisites
SRM1, SRM2, SRM3, Syntheseconcepten 2, Organische Chemie 1, or the equivalent thereof.

Learning outcomes
After completing the course, the student can apply a variety of metal-catalyzed transformations for the stereoselective formation of CC-, CN- and CO-bonds. Furthermore, the student has developed a basic feeling for the general strategies that one can apply for the construction of complex molecular scaffolds that are present in natural products.

Description
Transition metal-catalyzed reactions are becoming increasingly important tools to the synthetic organic chemist. Various metals, combined with suitable organic ligands, provide catalysts that can be efficiently used for the formation of CC-, CN- and CO-bonds in functionalized organic molecules. In this course, an overview will be provided of recently developed transition metal-catalyzed reactions (involving a.o. Pd, Ru, Cu, Mn and Ti). Furthermore, an important aspect of this course is the application of these reactions in total syntheses of natural products and biologically active compounds of which various examples will be highlighted.

Literature
Lecture notes and scientific papers.

Examination
Assignment: writing a scientific proposal for natural product synthesis

Molecular Materials

Course id: **SM292A** *3 ec* May-June 2008 prof. dr. A.E. Rowan
dr. R. de Gelder

Teaching methods
- 30 hrs lecture

Pre-requisites
Organic chemistry 3, Supramolecular chemistry

Learning outcomes
To acquire a basic knowledge of the relationship between function and architecture of materials with particular emphasis on self-ordered systems and polymers for applications in OLEDS, OFETS, liquid crystal devices and nanoelectronics.

Description
The basic concepts and chemistry of optoelectonic devices such as OFET (organic field effect transistors), solar cells, liquid crystalline devices will be discussed. The properties and synthesis of conductive materials viz. bucky balls, carbon nanotubes and organic polymers will be described. As part of the course expert guest speakers from companies and other universities will discuss the applications of these materials in house hold devices.

Literature
Handouts and scientific papers.

Examination
written examination, scientific report and presentations

Advanced organic chemistry

Course id: **SM024A** *6 ec* September 2007-June 2008

dr. M.C. Feiters
prof. dr. F.P.J.T. Rutjes
dr. F.L. van Delft
dr. J.J.L.M. Cornelissen

Teaching methods
- 170 hrs problem session

Learning outcomes
After completing the course the student will be able to solve independently and critically most of the organic chemistry problems that they may come across during his master program in organic chemistry, in particular those relating to mechanisms of important and complex reactions in organic chemistry and their regio-, stereo- and enantio-specificity and selectivity. Furthermore, the students will be familiarized with more advanced physical organic chemical principles, such as free energy relations, kinetic analyses and the hydrophobic effect.

Description
In the workshop you will be taught to solve problems without the immediate use of a book and instructor, by simply using common sense and your current knowledge of organic chemistry. The instructor will help you whenever necessary and on an individual basis.
In the interactive lectures the organic chemistry topics for the doctoral exam are discussed on the basis of chapters and problems of Clayden (see Literature), with an emphasis on chapters 31 to 42.
Before the course, the students are expected to familiarize themselves with chapters 1-30 of Clayden, which are considered to discuss the topics already covered in the bachelor phase.
With respect to the physical organic part 'Modern Physical Organic Chemistry' will be used as the text book.

Literature
Clayden, Greeves, Warren and Wothers, Organic Chemistry', Oxford University Press 2001.
Anslyn & Dougherty 'Modern Physical Organic Chemistry', University Science Books, 2006.

Examination
Written examination. Workshop and lectures are a preparation for the monthly exams in organic chemistry.

Advanced crystallography

Course id: **SM155** *4 ec* Spring dr. R. de Gelder
dr. H.L.M. Meekes
prof. dr. E. Vlieg

Teaching methods
- 30 hrs lecture

Pre-requisites
- FMM5
- Recommended: condensed matter

Learning outcomes
After completing the course the student will have a working knowledge of the symmetry of crystals and its application in understanding the structure and properties of crystals. In addition, the student will be acquainted with modern developments in crystallography.

Description
Symmetry plays a fundamental role in the structure and properties of crystals. This is a 'classic' subject that remains highly relevant, because crystals are used in a wide range of applications. All important symmetry aspects will be discussed, including point groups, crystal systems and space groups. The close link between symmetry and properties will be shown in examples like chirality, bi-refringence and piezo-electricity. These will be discussed using the mathematical tool of tensors. The course concludes with a survey of recent developments in crystallography, including synchrotron radiation, time-resolved crystallography, structure determination of polycrystalline materials, the use of coherent radiation and surface crystallography.

Literature
- C. Hammond, "The basics of crystallography and diffraction", second edition (Oxford University Press, 2001).
- Optional: J.F. Nye, "Physical properites of crystals - Their representation by tensors and matrices" (Oxford University Press, 1985)

Examination
Written examination

Advanced molecular structure determination

Course id: **SM026A** *3 ec*

dr. M.C. Feiters
prof. dr. A.E. Rowan
dr. R. de Gelder

Teaching methods
- 16 hours lectures/workshops on instrumental analysis
- 10 hours lecturing on characterization

Pre-requisites
- SRM4
- organische chemie 1
- magnetic resonance I (recommended)

Learning outcomes
Independent interpretation and evaluation of crystallography, molecular modeling, nuclear magnetic resonance (NMR), electron paramagnetic resonance (EPR), and X-ray absorption spectroscopy (XAS, EXAFS) data.

Description
The basic principles of crystal structure determination by X-ray diffraction and the application of these principles in practice are explained. The mathematical treatment is kept at a relatively low level and the emphasis is on how X-ray crystallography fits within modern chemistry, why it is important and what it can do.
Important spectroscopic techniques (NMR, EPR, EXAFS) for structure determination are treated, with an emphasis on coordination and organometallic compounds. Molecular modeling techniques are treated in order to develop an insight in the feasibility and dynamics of molecular structures.

Literature
Crystallography: Crystal Structure Determination, William Clegg, Oxford University Press, ISBN 0-19-855901-1.
For other topics, handouts and papers will be distributed during the course.

Examination
written examination

Chemometrics II

Course id: **SM103** *4 ec* in mutual agreement with student(s) prof. dr. L.M.C. Buydens

Teaching methods
self study and presentation

Pre-requisites
chemometrie 1

Description
Students are given one subject, typically a lesser known chemometrical technique, which they have to study and apply. They should present the technique, and the results of applying them, in a classical lecture. Also the comparison with other alternatives is important. The course aims at deepening the knowledge in the field of chemometrics.
Subjects: modern chemometrical techniques.

Literature
Relevant references will be handed out.

Examination
Presentation.

Capita selecta Analytical Chemistry

Course id: **SM104** *3 ec* in mutual agreement with student(s) prof. dr. L.M.C. Buydens

Teaching methods
self study, presentations and discussion

Pre-requisites
Chemometrie 1

Learning outcomes
After completing the course, the student should be able to
- critically assess the content of scientific papers and lectures
- summarise the main points of scientific papers
- present these clearly and concisely in a lecture

Description
Students are given three recent overview papers on one subject from analytical chemistry, and present these in two lectures. The course aims at broadening the background in analytical chemistry.
Subjects:
- modern analysis techniques
- new applications of analysis techniques

Literature
Relevant papers will be handed out.

Examination
Presentation, and participation in discussion.

Magnetic resonance II

Course id: **SM023B** *5 ec* second semester prof. dr. A.P.M. Kentgens
prof. dr. S.S. Wijmenga

Teaching methods
- 30 hrs lecture
- 10 hrs question session

Pre-requisites
Mandatory: Magnetische Resonantie I
Advised: Structuur Biomoleculen, Structuur Functie en Bio-informatica, Vaste Stof Chemie

Learning outcomes
At the end of this course the student knows the basic theory behind modern techniques for Biomolecular and Solid-State NMR. On the basis of this knowledge he/she can predict the outcome of NMR pulse sequences employed in modern liquid state NMR of moderately complex spin systems. The student recognizes the basic manifestations of single crystal and powder NMR spectra in the solid-state and can extract and interpret the interaction parameters contained in the spectra.

Description
This course treats the basics of modern techniques for Biomolecular and Solid-State NMR. Various topics will be treated in view of advanced applications of NMR in Life Science and Materials Science. The themes that will be addressed are:
- Reprise: Larmor precession, rotating frame, Bloch equations;
- Basic NMR hardware and principle of the measurement;
- The density operator concept, QM approach of the rotating frame;
- The Operator Formalism, in order to be able to analyze the effect of NMR pulse sequences on coupled spin system;
- The nuclear spin Hamiltonian and its spectral manifestation in liquids, liquid crystals (alignment), single crystals and powders;
- Use of spherical tensor operators;
- Motion (coherent and incoherent): averaging, exchange;
- The mechanisms of spin-spin and spin-lattice relaxation;
- multi-dimensional NMR;
- phase cycling, selection of coherences, canceling unwanted signals;

Literature
- M. Levitt, 'Spin dynamics'.
- J. Cavanagh, 'Protein NMR Spectroscopy. Principles and Practice'.

Examination
Written examination, open book.

Magnetic resonance IIIa, Advanced biomolecular NMR

Course id: **SM024** *3 ec* Spring prof. dr. S.S. Wijmenga

Teaching methods
- 30 hrs lecture

Pre-requisites
Structuur Biomoleculen, Magnetische Resonantie I, Structuur Functie en Biomoleculen, Magnetische Resonantie II

Learning outcomes
After the course the student *knows about* advanced applications of NMR in the field of Structural and Functional Biology. The student *knows* how advanced structure determination of biomolecules is carried out and knows its practical implementation. The student *knows about* advanced applications of NMR to study the dynamics and interactions of biomolecules.

Description
This course treats the practical aspects of the application of advanced multidimensional NMR to the study of biomolecular structure, function, and interactions. This includes structure determination of proteins and nucleic acids (spectral assignment, structure calculation, and structure validation). Recent novel BioNMR methods will be treated such as application of residual dipolar couplings and the study of dynamics. Also, the use of NMR in the characterization of interaction cellular processes will be discussed. In as far as the NMR background is concerned the course largely builds on Magnetic Resonance I and II and 'Structuur biomoleculen'. For students with a Molecular Life Sciences background and who have not followed Magnetic Resonance II, a differentiation can be set up.

Literature
Articles and reference books.

Examination
Written examination, open book.

Bioinformatics of protein structure

Course id: **CMBI103** *4 ec* Spring prof. dr. G. Vriend

Teaching methods
Students work on a difficult protein structure related research topic.

Pre-requisites
- basic bioinformatics knowledge, i.e. 'Methoden: bioinformatica'
- structuur, functie en bioinformatica

Learning outcomes
After this course the student will be able to analyse protein structures for the purpose of designing wet-lab experiments such as designing functional mutations, chimeras, etc. The student will be able to include advanced protein structure bioinformatics tools and concepts such as crystal packing analysis, sequence mapping on structures and structure base sequence variability analysis in these studies.

Description
Some of the topics that may be discussed:
- The relation between the technique used to solve the structure and structural characteristics such as mobility distributions, crystal packing artefacts, etc.
- Multiple Structure superposition and comparison
- Molecular dynamics
- Homology modelling
- Computational inclusion of 'other' knowledge. How can biophysical, biochemical, medical, etc., data help us understand a molecule?

Literature
Material is handed out during the course.

Examination
Written report.

Bioinformatics seminars: data, techniques and applications

Course id: **CMBI104** *4 ec* Autumn prof. dr. G. Vriend

Teaching methods
seminars with associated literature

Pre-requisites
BSc in chemistry or molecular life sciences or natural sciences

Learning outcomes
After following the seminar series, the students will have a broad overview over the molecular and biomolecular bioinformatics possibilities, and the research fields of the four bioinformatics groups of the CMBI. The students will be able to apply the theory explained in the seminars to solve simple problems from the every day practice of molecular and biomolecular informatics.

Description
There are 12 seminars of 2 hours (6 ec), but students can also follow 6 seminars (3 ec) or 8 seminars (4 ec).
The topics are (see also website www.cmbi.ru.nl/edu/seminars):
- Nuclear Receptors
- Bacterial Genomics
- Predicting interactions between genes based on genome comparisons
- Structure Validation
- Exploring Protein Sequences
- Force Fields and Modelling
- QM in practice
- Pathways and Molecules
- Finding signals in the DNA
- Systems Biology
- Genome Sequence Annotation
- Finding orthologous groups

Literature
Material is handed out during the course

Examination
An assigment is handed out after each seminar. The final grade for the seminar series is determined by averaging the grades from the 12 assignments.

Computational drug discovery

Course id: **CMBI101** *4 ec* Spring prof. dr. J. de Vlieg
dr. G. Schaftenaar

Teaching methods
- 17 hrs lecture
- 25 hrs laboratory course

Pre-requisites
Basic bioinformatics and (medicinal) chemistry knowledge; preferentially specific knowledge on 3D protein structures and ligands

Learning outcomes
The course will improve the participants understanding of how drugs are discovered, and the crucial role played by computational methods in this process. After attending this course students will be able to better understand why drug-receptor interactions and other physical-chemical characteristics are important to drug efficacy. Finally the course will provide a basic practical understanding of a number of standard computational drug design tools, such as Molecular Modelling, MD, 2D and 3D searching, Docking, Comfa, Homology Modelling etc.

Description
It is the intent of the course to describe some of the recent advances in drug discovery informatics, with a focus on the application of *in silico* tools to real life drug design problems. Topics include micro array analysis for target discovery, homology modelling, sequence analysis, virtual screening and 2D&3D database searches, molecular docking and QSAR/CoMFA. The practical component of the course will provide participants the opportunity to work with the different *in silico* tools and databases available to a modern in silico drug hunter. The course is given in close collaboration with the pharmaceutical company NV Organon, Akzo Nobel.

Literature
Material is handed out during the course.

Examination
Presence at lectures and practicals mandatory.
Team presentation for those who do the 3 ec variant.
After completing the course, there is a supplement of 1 ec; examination is a presentation (code CMBI102).

Course Working with Radionuclides Level 5B

Course id: **BM007B** *2 ec* 2007, december 3 - 7 and also several times in 2008 A.L.M. de Leeuw W.P. Moerman

Website
www.ru.nl/amd

Teaching methods
- 5 hrs lecture
- 9 hrs question session
- 1 hrs problem session
- 6 hrs laboratory course

Learning outcomes
The intended purpose of the course "Radiation expertise level 5B" is to impart to the student such competence and skills in the field of radiation protection that he/she, after having successfully completed the instruction course, has gained an adequate level of expertise to enable him/her to independently apply radioactive substances. This course is requested by legislation for all students and workers who will work with radioactive substances without direct supervision. This applies mainly to students in their masters study, but in some cases also to students in their bachelor study.

This one week course contains lectures and laboratory exercises dealing with most aspects of radiation safety, radiation protection or health physics, whichever term you prefer to use. Participants spend approximately 20% of their time performing laboratory exercises using radiation detection equipment. These laboratory exercises complement the health physics principles covered in lectures. Topics include: Radiation Physics, Radiation Detection and Measurement Techniques, Radiation Dosimetry, Radiation Biology, Assay Techniques, Shielding, Legislation and Health Physics Principles. The diploma examination is in multiple choice format. The diploma is valid in the Netherlands.

The course is not only open to students, part of the members are from hospitals and companies.

Description
This five day course is necessary for working in a radionuclide laboratory.
The course will be given on Monday to Friday, 09:00 - 17:00.
The course will be given several times a year in Dutch. Once a year it will be given in English.

Subjects
- radiation physics
- radiation risk and effects
- practical radiation safety
- legislation

More information: www.ru.nl/amd → cursussen → cursussen stralingsdeskundige

Literature
The following materials in dutch will be sent to each student who applies for the course.
- Cursistenhandleiding cursus Stralingshygiëne niveau 5B (dictaat)
- Practische Stralingshygiëne, G. Brouwer en J. van den Eijnde (ISBN 9031333352)

Examination
There will be a written exam. By sufficient result the student will receive a certificate which is valid in Holland and gives you the right to work autonomous with radioactive materials.

Extra information
contact: Ria Hogenkamp (3613178, h.hogenkamp@amd.ru.nl)

Laboratory animal science and alternatives

Course id: **BM024B** *4 ec* several times in 2007-2008 dr. ir. P.P.A.M. Leenaars

Learning outcomes

The course has the aim to gain knowledge and insight to design an animal experiment in a scientific and ethically justified manner, taken into account that alternatives (refinement, reduction, replacement) are not possible.

The program of the course on laboratory animal science comprises the requirements cited in article 9 of the Wet op de dierproeven (Experiments on Animals Act) and the Felasa category C demands. The certificate of completion of the course together with an academic degree in biomedical science will lead to a legal recognition to design animal experiments in the Netherlands.

Description

The objective of the course an laboratory animal science is to present basic facts and principles that are essential for the humane use and care of laboratory animals and for the quality of research.

The course will focus on:
the responsible and appropriate use of animals in scientific experiments in which alternatives (refinement, reduction, replacement) play an essential role.

The student:
- will be able to make an ethical argumentation whether the use of laboratory animals in a specific experiment is acceptable (the benefits outweigh the expected adverse effects)
- has insight in the consequences of the animal experiment on the welfare/distress of the laboratory animal and how to effectively tackle this
- will form a critical attitude towards the use of animals in scientific research
- will be able to design an appropriate animal experiment which meets the legal requirements and scientific demands (statistics for example)
- has insight in the possibilities for alternative methods (reduction, refinement and replacement).

Literature

- handboek proefdierkunde. Proefdieren en dierproeven, alternatieven en ethiek. Redactie: dr.L.F.M. van Zutphen, dr. V. Baumans en dr.ir. A.C. Beynen, Elsevier Gezondheidszorg Maarssen, Vierde, niet herziene druk. ISBN 903522615 I
- Blokboek AM01: Proefdierkunde en alternatieven

Examination

The examination en judging of the course is based on a written exam, several reports and presentations (design of an animal experiment; critical analysis of an article, etc.).
When the examination and judging is satisfactory the course-member will receive the art.9 certificate (see above). The course is not an mandatory part of the study Biology. The course is organised in the Centraal Dierenlaboratorium. Several (external) guest lecturers will appear.

Evolution and the Mind

Course id: **FFIL202A** *3 ec* prof. dr. C.H. Luthy

Website
www.ru.nl/fil-beta

Teaching methods
- 14 hrs problem session

Learning outcomes
The most immediate aim is to bring about an appreciation of the profound implications of evolutionary biology for a number of issues that don't inherently belong to biology, and to allow science students to address them in a philosophical way. A secondary aim is to bring about an understanding of scientific questions as arising in particular historical circumstances. The particular skill that will be promoted in this course is the use of rational argument in oral and written presentations.

Description
By claiming that all life forms have developed from lower forms thanks to a blind process of natural selection, Darwin's *Origin of Species* (1859) opened up a whole box of implicit problems. This course is devoted to studying one set of them, namely to the implications of evolutionary theory for the human mind. Questions that Darwin's readers understood to be pressing are: Doesn't evolutionary theory abolish the soul? If so, what then is the mind? Are mental states just inactive shadows of brain states? And what then of free will? Is it a figment of imagination? But if there is no free will, what then should we do with ethics, which is based on the assumption that we are free to choose between different courses of action? In this course, we will look at the very diverse answers that have been given to these questions, from Darwin's own time up to our own.

Literature
Will be distributed in the course

Examination
Each student will be asked to write four reaction papers and one short concluding essay.

Science & Literature (Philosophy 2)

Course id: **FFIl205** *3 ec* third quarter prof. dr. H.A.E. Zwart

Website
www.filosofie.science.ru.nl

Teaching methods
- 14 hrs problem session

Description
The course is devoted to analyzing literary documents in scientific research. These documents are interesting for at least two reasons. To begin with, they may tell us something about actual research practices (laboratory life). More importantly perhaps, they may help us to understand societal responses to scientific developments. In other words, literary documents may help us define what is so special about scientific knowledge (in comparison with other types of knowledge), but they may also assist us in addressing the societal dimensions of science (the interactions between scientific research activities and their social or cultural environment). In 2007 the focus will be on the work of Michael Crichton, whose novels deal with recent developments in scientific research (notably fields such as genomics, ICT, nanoscience and environmental science) but also with the societal impact of science as well as with the way in which societal developments influence and shape the course of research fields and programs.

Literature
- Monograph on science and literature by lecture
- Lecture notes (ppt)
- A literary document

Examination
Student paper

Extra information
Thursday 08.45-10.30

Bioethics for Lifescientists

Course id: **FFIL203B** *3 ec* fourth quarter drs. M.A.M. Drenthen

Website
www.ru.nl/fil-beta/onderwijs_2005_1.html

Teaching methods
- 24 hrs problem session

Learning outcomes
After finishing this course:
- the student should be familiar with different approaches in bioethical theory (deontology, utilitarism)
- the student should be able to apply these ethical theories to relevant cases in modern life sciences
- the student should be able to take an argued position in ethical debates about these issues

Description
This course offers an introduction to the field of bioethics for biosciences students. Students are introduced into the nature of bioethics and ethical theory. Next, we will discuss a broad range of bioethical issues relating to people, animals, plants, environment, and the practice of bioscience research. The focus is on developing the students' power of reasoning and judgement in ethical debates and discussion.
This course will be taught in English. However, if there are less then 2 foreign students, it will be held in Dutch. In that case, foreign students will get an alternative assignment.

Literature
Texts will be made available via Blackboard.

Examination
Attendance is mandatory, especially at the first meeting.
Maximum number of applicants: 20.
The examination en judging of the course is based on written assignments, oral presentations and participation in class discussions.

Students should sign up for the course via Blackboard, at least two weeks before start of the course.

Study Tour Chemistry

Course id: **SM300** *4 ec*

Teaching methods
- Preparation of the tour
- Writing preparatory and final reports
- Participate in presentations
- Participate in the study tour

Pre-requisites
Bachelor of Chemistry

Learning outcomes
Participants: introduction to carreer possibilities in universities, research institutes, gouvernment and industry; getting to know the culture and history of an other country.
Members of the study tour committee: development of social and organisational skills, preparation of the study tour, maintaining relations with parties to be visited and with sponsors.

Description
The study tour is being organized by students with guidance of and under the responsibility of 2 members of the academic staff. Participating students are members of the study tour committee. This committee organizes the entire study tour (planning, organizing and implementing the day-to-day programme; and, of course, fund-raising).
Participants prepare the study tour in small groups by means of organizing and attending lectures and making preparatory reports under the leadership of several members of the academic staff; groupreports are presented to all participating students.

Examination
Examination of and participation in making of preparatory and final reports, and presentations; participating in the study tour.

3.2 MT variant

The MT variant prepares students for a management position as an academic professional. The program consist of one research in natural science, and one project in management. The total master program of 120 ec should be approved by the examination board.

Overview of the research year with a total of 54 ec
- Research internship (45 ec)
- Molecular Life Science topical courses (9 ec)

Overview of MT components with a total of 57 ec
- Bedrijf & Maatschappij (5 ec),
- Organisatiekunde (5 ec),
- Innovatiemanagement (5 ec),
- Strategie & Marketing (5 ec),
- Financieel economisch management (5 ec)
- Algemene managementvaardigheden (2 ec)
- Kennis en ondernemerschap (3 ec)
- Research strategie en management (3 ec)
- Industriële fijnchemie (3 ec)
- *Electives in the MT program should be chosen after consulting the MT-coordinator*

Additional guidelines:
Participation in the courses ´Innovatiemanagement and Strategie´ & ´Marketing´ is only possible after fulfilling the courses ´Bedrijf & Maatschappij´ and ´Organisatiekunde´.

Start of the graduation project is only allowed after:
1. fullfilling at least 45 ec of the research year (includes the practical component of the research intership as part of the master program);
2. and having finished for the greater part of the 5 mandatory MT courses

For more detailed information: www.ru.nl/science/mt or contact:

Prof. Dr. B. Dankbaar (b.dankbaar@science.ru.nl)
Drs. J. van den Broek (J.vandenbroek@science.ru.nl)

Business & Society

Course id: **FMT001B** *5 ec* fall semester dr. G.A.N. Vissers
prof. dr. B. Dankbaar

Teaching methods
- 28 hrs lecture

Pre-requisites
Master student FNWI

Learning outcomes
The aim of this course is for students to:
- Develop an understanding of the processes of mutual influence that exist between science, technology, economy, and society, and get acquainted with concepts and theories from economics and social sciences that seek to explain these processes.

Description
Of the courses within Management & Technology curriculum, Business & Society is the first to be given. The course will provide students with an overview of theories and perspectives concerning the position and the functioning of firms and industries in the wider economy, national and international, and in society. In particular, themes from industrial history and industrial economy will be explored, but also issues related to current concepts like 'information society', 'knowledge economy', and 'globalization'. These subjects will be discussed, partly on the basis of project assignments, and their implications for the university, firms, and government will be considered.

Subjects
- Economic history, especially industrial development in the 20th century
- Industrial revolutions and economic change
- National and regional differences within and between market economies
- National and sectoral systems of innovation
- The interactions between technology and organization
- The knowledge economy

Literature
- Thomas K. McCraw (ed.), *Creating Modern Capitalism. How Entrepreneurs, Companies and Countries Triumphed in Three Industrial Revolutions*, Harvard University Press, 1997

Examination
Written assignment and group presentation

Organization Theory

Course id: **FMT002B** *5 ec* spring semester prof. dr. B. Dankbaar

Teaching methods
- +/- 15 lectures (see for detail Blackboard)
- practices

Pre-requisites
MT Course Business & Society

Learning outcomes
- Students acquire knowledge of the main concepts and approaches in organization theory
- Students are able to apply this knowledge to issues of organizational design and change

Description
This course offers an introduction into the fundamental insights of organization theory dealing with questions like: What are organizations? How are they structured? How do they interact with their environment? What is organizational culture? And how are organizations designed and managed? Organizations are complex systems and consist of people with different interpretation-schemes. As a result, organizations have to deal with a variety of problems and dilemmas. The course offers students methods and instruments to diagnose organizational problems and to deal with the problems and dilemmas of organizing.
Content:
Apart from studying and discussing a text on organization theory, the students will make presentations of their analysis and views on selected business cases

Literature
Gareth Jones, Organization Theory, Design and Change, 5th edition

Examination
Written examination and discussion of a business case

Innovation management

Course id: **FMT003B** *5 ec* fall semester drs. ing. P.M. Vos
ir. L.J. Lekkerkerk

Teaching methods
- 30 hrs problem session

Pre-requisites
- Master student FNWI
- BEM & Organisatiekunde in completion with a minimum of a 6

Learning outcomes
The purpose of the course is for students to :
- Acquire knowledge in the field of innovation management including Research and Development and New Product Development
- Apply this knowledge in theoretical cases, eventually acquire sufficient knowledge to apply this knowledge in 'real life' settings
- Judge the value of scientific knowledge in the field of innovation management including Research and Development and New Product Development
- Learn how to design a research project in this field

Description
Innovation determines the dynamics of the economy. Organizations innovate to stay viable. This course focuses on issues of innovation from a management perspective. The main issues concern the dilemmas of innovation management and innovation enhancement: how (and to what extent) are these processes manageable? In these processes different factors play an important role, such as creativity, enterpreneurship, structure, linkages, and a bit of luck. This course offers the student knowledge about the structure and nature of the innovation process (product as well as process innovation). Furthermore, it offers the students instruments to cope with the different dilemmas of innovation management.

The following themes will be treated:
- Managing for innovation
- Strategy
- Establishing effective external linkage
- Building effective implementation mechanisms
- Creating the innovative organization
- Assessing and improving innovation management

Literature
Not Available (See Black Board)

Examination
assignments and a written exam

Strategy & Marketing

Course id: **FMT004B** *5 ec* fall semester

Teaching methods
- +/- 15 interactive lectures including guest lectures (see for detail Black Board)
- individual assignments
- a group project to develop a well-founded Business Plan for a high-tech product or service.

Pre-requisites
- Master student FNWI
- BEM & Organisatiekunde in completion with a minimum of a 6 ec

Learning outcomes
After completion of the course, students are familiar with market oriented views of innovation and with several important forms of market research; they are able to describe the circumstances in which market orientation will influence innovation processes and to discuss the nature of such influence for business and product development. Students will also be familiar with strategy formation, with different types of strategy and the related perspectives, and with the relationships between general business strategy and innovation strategy.

Prime course objectives are that:
- participants acquire updated insights regarding challenges and opportunities in high-tech markets
- participants understand the virtue and limitations of traditional strategic marketing thinking and tools in emergent, high-tech markets, and
- participants apply their understanding of strategy and marketing concerning High-Technology to develop a well-founded business plan within their own technological discipline.

Description
Marketing is the business function that deals with discovering and meeting customers' unfulfilled needs and wants. Strategy underlines the need to align this function to the objectives of the business, the other business activities and -last but not least- to the external market environment of the firm. Strategic marketing in high technology environments poses its own unique challenges due to the complexity and novelty of the technology. Some of those challenges include articulation of the value proposition, decision making with limited information on customers, and coordination with other market players. In order to succeed in this environment, firms need to be able to understand unarticulated needs, forecast the development of nascent markets, and position themselves appropriately in the competitive landscape.

High-tech firms operate under conditions characterized by high degree of market and technological uncertainty. Technological changes can occur rapidly. Products offered are novel and for buyers often difficult to evaluate. Moreover, high-tech firms often operate in emergent industries with "fuzzy"and rapidly changing industry boundaries.

Such conditions -deviating from those captured in most marketing texts- represent specific challenges for high-tech firms to survive and prosper. It should also be noted that the rapid developmentes in modern technologies within science (e.g. biotechnics, informatics, chemics, mathematics, etc.) exert influence on markets and marketing practices only superficially dealt with in traditional strategic marketing textbooks. The "driving question" that arises form the situation described above is: "Provides strategic marketing added value for firms operating in high-tech markets?"And, if so, "why and how ?"

The focus of this course will be on the strategic marketing to accompany a technology and not on the technical or scientific aspects of the high-tech products. Besides lectures, students will work on a group project (i.e. to set up a High-tech Business Development Plan) throughout the term to analyze the marketing strategy for a technology-based product or service.
This course focuses on issue related to strategy and marketing of firms, such as:

- Technology and market
- Relation between R&D and Marketing
- Business strategy and product strategy
- Market research
- Relation with customers
- Distribution, supply chain and pricing

Literature

- Mohr, Sengupta, Slater (2005) *Marketing of High-Technology Products and Innovations* (2nd international edition) Pearson Prentice Hall, ISBN 0-13-123023-9
- Reader (links of articles will be published at Blackboard)

Examination

- Written exam (literature)
- Report and Presentation project

Finance & Accounting

Course id: **FMT005B** *5 ec* spring semester drs. R.A. Minnaar

Teaching methods
- +/- 15 lectures (see for detail Black Board)
- practices

Pre-requisites
Master student FNWI

Learning outcomes
The financial accounting part should give you a firm understanding and working knowledge of:
- The basic accounting terminology and the process for recording, summarizing and reporting economic events of a business enterprise;
- The interpretation and analysis of financial statements as a basis for business decisions.

The management accounting part is to develop the student's knowledge of the process of evaluating performance and decision making using accounting information as a basis. After taking this course you should be able to interpret, use and evaluate internal accounting information.

Description
Accounting information is an integral part of the business environment and an understanding of accounting information is an essential tool in the process of making business decisions. The primary objective of this course is to develop the student's knowledge of accounting as a tool in making business decisions. The emphasis in this course will be on both the user and the preparation of accounting information in a business context.

This course consists of two parts. Financial- and management accounting.
In the financial accounting part, you will be introduced to accounting theory and practice using the models of sole proprietorships and corporations, with an emphasis on merchandising companies. The emphasis and focus of financial accounting is on financial information used by parties' external to the firm. Specific topics will include: the definition and scope of accounting; systems used to account for and control transactions; inventory costing; the measurement of income and equity; and a special emphasis on financial reporting and the analysis of financial statements.

The management accounting part of this course emphasizes the use of accounting information for internal planning and control purposes. As business managers, you will be involved in a variety of management decisions. Some examples of the issues that you might encounter include: "How much should we charge for this product or service?"; "What elements contribute the most to this business?"; "How is my company doing compared to the competitors?"; "Is this person a good manager?"; "Are my costs under control?" "Does this capital investment make sense?" A range of information may influence such decisions and management (internal) accounting information is among the most significant.

In this part, the fundamentals of managerial accounting, profit and cost accumulation are introduced. Specific topics covered include: cash flows, capital budgeting, cost allocation, product costing, differential costing for short and long-term decisions, performance evaluation, and the concepts related to the time value of money.

Literature

Needles, Powers & Crosson; Principles of Accounting 2008e, Tenth Edition; Houghton Mifflin; ISBN 0-618-73661-1989-4

Examination

- A final written 3 hour exam with open questions.
- Bonus points based on assignments, cases, participation and mid-term test.

Algemene managementvaardigheden

Course id: **FMT014A** *2 ec* Coursedate: June-July drs. J.G.J. van den Broek

Teaching methods
- Vaardigheidstraining (32 uur), zelfstudieopdrachten (24 uur)
  Inleidingen, zelfstudieopdrachten, vaardigheidstrainingen, presentaties
- Cursusdata in studiejaar 2006-2007
  12/06 (nm), 19/06 (nm), 30/06 (hele dag), 01/07 (hele dag) en 02/07 (hele dag)

Pre-requisites
Deze cursus heeft het karakter van een training. Hierbij is de nuance in de interactieve processen cruciaal. Voor de diepgang en kwaliteit vereist dit van alle betrokkenen taal op het niveau van "native speaker".
Daartoe bedienen we ons bij dit keuzevak van de **Nederlandse taal**.
Voor studenten uit de afstudeervariant Management & Toepassing (afstudeervariant MT) kan deze cursus gelden als een keuzevak.

Maximale groepsgrootte: inschrijving en plaatsing
In verband met de vaardigheidstrainingen kunnen slechts 14 studenten per cursus deelnemen. Plaatsing geschiedt aan de hand van de volgorde van inschrijving. Studenten uit de afstudeervariant MT krijgen voorrang.

Learning outcomes
De training beoogt een aantal vaardigheden (zie Beschrijving) verder te ontwikkelen. Studenten leren strategieën en technieken, die toepasbaar zijn in diverse professionele situaties.

Description
- Strategisch denken en handelen
- Problem solving
- Projectmatig werken
- Adviesvaardigheden
- Het creëren van win-win situaties
- Onderhandelen
- Omgaan met weerstanden en conflicthantering
- Vergadertechnieken
- Zelfreflectie en het persoonlijke ontwikkelingsplan van de startende academicus

Examination
Actieve participatie vaardigheidstrainingen en schriftelijke eindopdracht.

Research Strategy and Management

Course id: **FMT011A** *3 ec* spring semester prof. dr. J. de Wit

Teaching methods
The class consists of 10 interactive lectures of 2 hours. The material presented will be sent after every lecture to the students by e-mail.
After every lecture the students have 1 week to answer questions to train the material given to them. This will be done in small groups. The results will be discussed during the next lecture.

Pre-requisites
Master student FNWI

Learning outcomes
The student will be informed on the following aspects of Research Strategy and Management:
- career development possibilities
- development of industrial research
- important inventions
- industrial strategies
- research strategy and management (from 1st to 4th generation)
- knowledge management
- cooperation between university and industry
- innovation and venturing
- case studies on radical innovation
- the Balanced Score Card method
- project selection methods
- R&D tools
- sustainable development in the 3rd world

All information will be illustrated with examples from the practical experience of the teacher during more than 20 years in industrial research management.

Description
Research Strategy and Management is an important discipline in many forms of research. It is the intention to inform Master students and junior researchers on all aspects of R&D management in relation to business strategies. The class is mainly intended for students who want to start a management career relatively soon after getting their MSc or PhD diploma and therefore follow the MT variant as their Master education. This career can start in industry but also in government, a consultancy firm or as owner of a private company. The class is also suited for students whose first choice is not the MT variant but still want to receive general information on the aspects of modern R&D management

Literature
As part of the first lecture a list of books that can be consulted will be given. Also use can be made of Internet to answer the questions. Other forms of knowledge gathering are of course also possible.

Examination
One week after the last lecture a written examination is given. This examination takes 3 hours.

Science and Entrepreneurship

Course id: **FMT012A** *3 ec* spring semester

Teaching methods
- 20 hour lectures + 60 hours self-study and assignments
- Training exercises in various commercial skills
- Internet desk studies on business-related issues
- This course will be taught in Dutch only

Pre-requisites
Minimum of three years of academic training in one of the sciences

Learning outcomes
The goal of the course is to provide insight in aspects of the commercial utilization of results from scientific research to advanced (3rd year or higher Bachelor, Master or PhD) students. The course has a particular emphasis on issues around starting up a commercial (high-tech) enterprise. Also various entrepreneurial skills are addressed. At the end of the course students will be able to write a concise business plan.

Description
For a knowledge-driven economy, such as the EU, it is of prime importance to apply scientific findings and new technologies as starting-points for commercial activities. Evidently, also research results from universities can contribute to the economic growth of our society. How this commercialization and valorization of knowledge can be realized in practice is the main topic of this course.

Subjects
- Research and development in academic versus industrial setting
- Funding of scientific research and development (ROI, (inter-) national government funding programs for R&D, venture capital, banks)
- Intellectual property rights (patents, confidentiality and pitfalls)
- Entrepreneurship ("unique selling proposition", business plans, legal and financial aspects of start-up companies, entrepreneurial skills and mentality)

Literature
During the lectures hand-outs of the presented subjects will be supplied.

Examination
- At the end of course students will be required to submit a business plan on an idea of choice. This proposal will be judged primarily on how convincing it is, but also on originality and thoroughness
- Written assignment

Industrial Chemistry

Course id: **FMT013A** *3 ec* will perhaps not be scheduled for 2007/2008 prof. dr. F.P.J.T. Rutjes

Teaching methods
- 30 hrs lecture (interactive teaching and training during 1 week)

Description
The lecture series are given from as industrial perspective and can be seen as a course in business economics in the language of science and technology. There are two series, each of them presented every other year, mostly as a 1 week Short Course of 25-30 hrs interactive teaching and training in May or June. The course is for master student as well as Ph.D. students. Students from several universities do participate. Often R&D-workers from industry take part as well.

The two series are a general overview of the chemical industry and a more specialized series on an actual topic. The panorama series reviews the chemical industry from petrochemicals and biomass to bulk and fine chemicals and life science products. The full business chain from product- and process development, R&D, marketing/sales, company strategy, safety and environmental issues are being treated. International developments,trends in society and its interactions with science, technology and industry are discussed.

The specialized series takes an actual topic. Presently sustainability, catalysis and precision in chemistry are key words as well as chirality, agrification, fermentation and process technology in life sciences applications. Integration of organic synthesis and biosynthesis is a main topic 'High speed R&D' and modern techniques as HTE and HTS in (industrial) R&D are explained. Academic possibilities vs. industrial reality is the guiding principle for these themes.

Examination
Written examination.

Extra information
The lecture series are mandatory for students taking the minor Industrial Chemistry. The series can be part of the master programme in organic chemistry. The series can also be part of the variant Management and Technology.

Master thesis Management & Technology track

Course id: **FMT010B** *27 ec* spring semester prof. dr. B. Dankbaar
drs. ing. P.M. Vos

Teaching methods
- Self-education
- Under supervision of a supervisor(s)

Pre-requisites
- The master thesis for the MT-track is the final part of the Master curriculum for Master-students from the Faculty of Science of the Radboud University
- who have finished the required courses and 'master-research' in their own discipline; and
- who have successfully completed the required courses of the MT-track: Business & Society, Organization Theory, Innovation Management, Strategy & Marketing, and Finance & Accounting.

Description
The master-thesis consists of performing a research project on the interface of science, technology, society and organization. This research project will be performed in a profit or non-profit organization. It is important that the student is performing research contributing to the solution of an organizational or practical problem for which a combination of knowledge from natural science and management science is required or at least useful. The duration of the project should normally not exceed six months, from the start until final presentation of the thesis.

Examples of research topics are:
- Diagnosing the implementation of technological innovation in organizations;
- Developing a business plan for a new product;
- Doing market research for a high tech product;
- Developing and/ or evaluating instruments for assessing and developing HRM-policy in R&D departments;
- Developing instruments to improve collaboration between university and companies;
- Developing en/ or evaluating public policy-instruments on innovation, science, and environmental issues;
- For inspiration, see also the MICORD-research program (see ISIS- web site)

Projects:
The project consists of the following stages, which are all closed with a specific activity:
- Preparation of research, resulting in a research proposal
- Performing research, resulting in a research report
- Presenting the results of your research at the organization involved
- Defending your research report at the university

Literature
- Guidebook of the final MT research project (presently only available in Dutch), see the MT- web site

We advise you to use books about how to do business research, for example:
- Saunders, M. et al. (2003), ***Research Methods for Business Students*** *(3th ed.).* Harlow: Prentice Hall.
- Cooper, R., Schindler, P., S. (2006) ***Business Research Methods*** *(9th ed.), McGrawhill, New York*

Examination
- See guidebook

3.3 C variant

The C-variant trains students in the direction of communication of science, internally or towards society. Professionals can be active within fields of journalism, intermediairy organisation such as the NGO (non-gouvernemental organisation). The programme consist of one research internship in natural science, and one project in communication. This two year master program consist of 120 ec and should be approved by the examination board.

Overview of the research year with a total of 54 ec
- Research internship (45 ec)
- Molecular Life Science topical courses (9 ec)

Overview of the C-components with a total of 57 ec
a. Mandatory courses in the first year (12 ec):
- Introduction Science Communication(3 ec)
- Science and Societal Interaction (3 ec)
- Risk Communication (3 ec)
- Boundary Work (3 ec)

b. Mandatory courses in the second year (9 ec):
- Framing Knowledge (3 ec)
- Knowledge Society (3 ec)
- Science, Media and Strategy (3 ec)

c. C-Electives, to be approved by the responsible lecturer within the C-variant

For more detailed information: www.betacom.science.ru.nl or contact:
Dr. A. Souren (a.souren@science.ru.nl)
Dr. R. van den Born (r.vandenborn@science.ru.nl)

Science & Societal interaction

Course id: **FC002B** *3 ec* third quarter dr. J.G. van den Born

Website
www.betacom.science.ru.nl

Teaching methods
- 7 hrs lecture
- 7 hrs problem session

Pre-requisites
Basic articles from the reader of the course: 'Introduction Science communication'.

Learning outcomes
The student:
- develops knowledge and understanding in the field of public participation, regarding natural-scientific topics in societal processes.
- applies this knowledge by developing a participation-plan. Attention is paid to different levels of participation and methods and tools of participation. Also, a distinction of the different stakeholders is made, and ways to reach them are explored.
- is introduced in and applies the methods and tools for the design of an objective and research questions of a research plan.
- is able to formulate an advice by means of a group discussion and to present and argue this advice in front of experts in the field of participation.

Description
Science communication is usually not a linear process, but comes into being through interaction. In this course is dealt with ways to involve citizens and other stakeholders in an interactive process when scientific topics are on the agenda. Questions as why would you involve stakeholders and why not, who would you involve and on which level are under discussion. With regard to the question who to involve it is important to get a grip on 'the public'; who will and can be involved? And what are the benefits for people to participate in such a process? Finally, we learn about the different methods and tools that can be used in the planning of a participation project, such as debates and focus groups.
In this course the students are introduced in the basic principles of stakeholder participation, students design a participation plan themselves and debate with experts on the field of participation on an actual case.

Literature
- Reader (can be purchased at the start of the course).
- Verschuren, P. en Doorewaard, H. (2004). Het ontwerpen van een onderzoek. Lemma. ISBN 90-5189-886-X. 223 pagina's.

Examination
An assignment.

Internship and Essay Master Communication

Course id: **FC0006B** *30 ec*

drs. R. van den Born
dr. A.F.M.M. Souren

Website
www.betacom.science.ru.nl

Pre-requisites
Msc projects with 30 ec is only for students who do the whole Master Communication Studies

Description
For more information see: www.betacom.science.ru.nl .

Framing Knowledge

Course id: **FC0010C** *3 ec* first quarter dr. J.G. van den Born

Website
www.betacom.science.ru.nl

Teaching methods
- 6 hrs lecture
- 8 hrs problem session

Pre-requisites
The course 'risk communication' is recommended.

Learning outcomes
The student:
- will be introduced in the field of cognitive psychology (knowledge)
- will have insight in the role of perceptions, interests and strategies in conflict situations (knowledge)
- can cooperate in a group of fellow students with regard to the assignment (skills)
- can design an interview guide, learn to interview, and to work out and interpret the interview results (skills)
- can debate (skills)

Description
Framing knowledge is an introduction into perceptions; frames that individuals use to look at and understand the world around them. It is important to be conscious of the fact that everyone has their own background and patterns of thought. For example, a farmer has a different idea of what nature is than a city dweller, and a scientist has a different perception of a laboratory animal than an ethicist.
When looking closer at laborious and failed negotiations, it is not impossible that different perceptions are underlying the whole matter, perceptions the stakeholders are often stuck to. To recognize these frames is the first step of understanding and solving a conflict. Connected to these frames are individuals (or groups) interests and strategies to act and negotiate.
In this course the students are also introduced to the basic principles of interviewing, they learn to design an interview guide and finally interview a stakeholder in the case we investigate during the course.

Literature
reader (can be purchased at the start of the course).

Examination
An assignment.

Knowledge Society

Course id: **FC0011C** *3 ec* third quarter dr. A.F.M.M. Souren

Website
www.betacom.science.ru.nl

Teaching methods
- 7 hrs lecture
- 7 hrs problem session

Pre-requisites
The course builds on previous courses from the Mastertrack Science Communication(especially Risk Communication) , and is part of the obligatory part of the Mastertrack. In addition, the course is open as an optional course for all MSc. Students.

Learning outcomes
- Students are familiarised with the different roles of scientists in the Knowledge Society
- Students are familiarised with the implications for science communication
- Students are familiarised with shifts in the knowledge infrastructure and with techniques and strategies to analyse these shifts
- Students are familiarised with the pro's and con's of multi-, inter-, and transdisciplinary-settings they will encounter in professional contexts
- Students are trained in essay-writing

Description
Present day society has been characterized as developing towards a 'Knowledge Society'. Scientific knowledge has become more important and new technologies have a sometimes unprecedented impact. At the same time, the position of (academic) science is under pressure and apparent shifts take place in the role and authority of science in society. Knowledge is an issue.
In this course we reflect on these changes, and discuss the possible implications of these shifts for MSc. students in their future professional life. We ground these discussions in actual working practice brought to the classroom by guest speakers, and complement these by models and approaches that are currently used in assessments of the Knowledge Society.
The course combines a practical and theoretical component. Discussions among students, teachers and guest speakers are matched with analyses of current scientific insights on the Knowledge Society. A professional training in essay-writing completes the course.

Literature
Reader or book to be purchased at the start of the course

Examination
Essay

Science & Media: strategies and trends

Course id: **FC0013C** *3 ec* second quarter H.M. Dresen
drs. R.P.M.M. Welters

Website
www.betacom.science.ru.nl

Teaching methods
- 14 hrs question session

Pre-requisites
This course is part of the Mastertrack Science Communication, and also open as optional course for all MSc. students.
In either case, finishing the course *Introduction Science Communication* is a pre-requisite for taking part in this course.

Learning outcomes
- students will increase their abilities in media-oriented writing, and will be shown ways how to further increase these abilities in the near future.
- students will increase their knowledge of the strategical considerations and ethical codes involved in the process of transmitting information from the academic to the public arena.
- student will gain understanding of a) the current state of science reporting in the media and b) ways in which the representation of science and technology in the media has changed over the last few decades.
- students will get acquainted with several methodological alternatives for studying trends in science reporting in the media (as a subfield within the Social Studies of Science)

Description
The course consists of two interrelated parts:
1. A training in media-oriented writing (given in Dutch), which will adress both the process of writing itself and the broader strategical and ethical considerations involved in the process of transmitting information from the academic to the public arena.
2. An introduction to the academic field of studying Science-in-the-Media, as a subfield within the Social Studies of Science. The examples we will study are intended to increase the students understanding of the current state of science reporting in the media. While studying these examples, the students will also get acquainted with different methodological alternatives for studying trends in how the media represent scientific expertise.

Literature
Course material will be available at the start of the course

Examination
Journalistic writing assignment & analytical assignment

Extra information

Dutch language:
Part of this course (i.e. the training in media-oriented writing) will be given and examined in Dutch, as it is aimed at gaining access to the Dutch media landscape. Participants who do not write Dutch need to register six weeks in advance of the start of this course by sending an email to the coordinating lecturer of this course (H.M. Dresen) asking for an English language arrangement.

Number of participants:
The number of participants for this course is limited, due to the character of the training in media-oriented writing. Students will be accepted in the order of their registration. Students of the Science Communication mastertrack have priority in placement, if they register six weeks in advance of the start of this course.

Introduction Science Communication

Course id: **FC001B** *3 ec* first quarter dr. J.G. van den Born

Website
www.betacom.science.ru.nl

Teaching methods
- 7 hours lectures
- 7 hours seminars

Pre-requisites
This is the first course of the Mastertrack Science Communication. It is part of the obligatory programme of the Mastertrack. In addition the course is open as an optional course for all MSc. students.

Learning outcomes
- Students are familiarised with science communication practice
- Students are familiarised with science communication theory
- Students are trained by a professional in presentation techniques

Description
Nowadays every scientist gets involved in science communication in his or her professional life. In this course we give an overview of science communication strategies and of seminal views on science communication practices and theories.
Focus is on communication with the public and with target groups within the general public on issues that involve scientific knowledge. Scientific communication (communication among scientists for instance at scientific meetings) is not the main issue, although the training in presentation techniques applies to those communication practices as well.
Students will also study and present classic examples of succesful popularization of scientific insights, in the shape of TV documentaries, films, fiction and non-fiction books, and 'visitables'.

Literature
Reader or book to be purchased at the start of the course

Examination
Written exam, participation and presentation

Extra information
Monday 13.45-15.30
First meeting 10 September 2007

Risk Communication

Course id: **FC003B** *3 ec* second quarter dr. A.F.M.M. Souren

Website
www.betacom.science.ru.nl

Teaching methods
- 7 hrs lecture
- 7 hrs problem session

Pre-requisites
The course builds on previous courses from the Mastertrack Science Communication, and is part of the obligatory part of the Mastertrack. In addition, the course is open as an optional course for all MSc. Students.

Learning outcomes
- Students are familiarised with the specific characteristics of Risk Communication in relation to Science Communication
- Students are familiarised with actual cases and practices in Risk Communication
- Students are familiarised with the difference between Risk Communication and Uncertainty Communication
- Students are familiarised with determinants of public perception of Risk and Uncertainty
- Students are familiarised with the role of the different actors and stakes in Risk Communication (for instance companies, government, local population) and how to position themselves among these actors

Description
Present day society has been characterised as a Risk Society. The communication of risk and the public understanding of risk have become important issues in the professional careers of scientists inside and outside universities. This course prepares MSc. students for those instances where they will become involved in risk communication in their professional career. Those instances can be unexpected and confronting. For instance when you are consulted as an expert to report in the 8 o'clock news. In those cases you have to decide whether or not to be explicit about the risks for vulnerable groups, or whether or not to mention the current scientific debate over the exact height of the risk. Those choices are complicated and involve ethical and scientific considerations. To others, risk communication will become part of their professional career more frequently, while informing society about possible impacts of scientific techniques, medical treatments, environmental threats or the possible effects of their life style.
The course aims to prepare students to actively engage in risk communication and to analyse, reflect on and assess risk communication practices.
The course combines a practical and theoretical component. Discussions among students, teachers and guest speakers are matched with analyses of current scientific insights on issues of risk communication, risk perception and uncertainty.

Literature
Reader or book to be purchased at the start of the course

Examination
To be announced

Boundary-Work:
The Tension between Diversity and Sustainability

Course id: **FC0041C** *3 ec* fourth quarter prof. dr. F.W.J. Keulartz
drs. I.E.M. Dankelman

Website
www.betacom.science.ru.nl

Teaching methods
- 20 hrs question session

Learning outcomes
Students should gain some basic insights in the tension between the heterogeneity of actors that (should) have a stake in natural resources management on the one hand and the need for an integrated approach and close cooperation among these various stakeholders on the other. They should be able to specify and discuss general strategies of so-called ‘boundary work' to deal with this tension between diversity and sustainability.

Description
Climate change, air pollution, deforestation, loss of biodiversity, stratospheric ozone depletion, land and freshwater degradation - all these environmental problems have effects that transcend national boundaries; they cannot be solved by the unilateral decisions of individual states but require international cooperation. Moreover, these problems are interconnected and cannot be solved in isolation. For instance, climate change can lead to depletion of the ozone layer, loss of biodiversity, land degradation, desertification, and alteration of the global hydrological cycle.

These negative impacts in turn reinforce each other through feedback loops, which results in a serious threat to land productivity, food supply, and freshwater availability. Because they are so closely connected, these global environmental threats require an integrated approach. But such an approach is frustrated by the existing multiplicity of communities with diverse and sometimes diverging ethical visions and moral vocabularies. So, there is a strong tension between on the one hand the diversity of actors that have a stake in sustainable development and on the other hand the need for a close cooperation between these various stakeholders. This tension between sustainability and diversity can only successfully be resolved through processes of communication, conflict management and consensus building across the lines that separate communities and their social and moral worlds. Such ‘boundary work' is the central topic of this course.

Literature
J. Keulartz: Werken aan de grens - een pragmatische visie op natuur en milieu. Damon, 2005.

Examination
Students should study the literature, participate in discussions, make at least one presentation, and write a brief essay.

Visible Scientists

Course id: **FC0040B** *3 ec* fourth quarter prof. dr. H.A.E. Zwart

Website
www.betacom.science.ru.nl

Teaching methods
- 12 hrs question session
- 14 hrs problem session

Learning outcomes
Gaining insight into the importance as well as the problematic nature of societal interaction. Participants will learn how to address issues such as: Does public visibility enhance or endanger the reliability and relevance of research? The course will also pay attention to academic skills involved in reading, writing and presenting research materials.

Description
A highly influential stereotypical view of scientists depicts them as invisible laboratory researchers, working silently and at a safe distance from their societal and cultural environment, communicating their findings to a small circle of fellow experts. Reality is often completely at odds with this stereotypical view. Quite often, prominent scientists are acutely aware of the importance of societal communication and interaction, and sometimes they are quite good at it and / or invest a substantial amount of time in this aspect of their work. They know how to involve broad audiences in this research, how to gain public attention, how to raise public support. Societal interaction may also greatly affect the course of their research activities and the development of their research agenda. We will take a more or less biographical approach, focusing on the research as well as the societal communication of particular scientists of renown. In 2005, for example, we studied the life and work of James Watson and Craig Venter, prominent in the field of genomics.

Literature
p.m.

Examination
Essay & ppt presentation
Dit vak wordt als keuzevak (binnen de C-variant) aangeboden.

3.4 E variant

The E-variant educates students toward becoming a first-degree teacher in Chemistry, Biology* or both*. During the first year a natural science internship is taken. The second year is completely education-oriented and organized by the ILS (Instituut voor Leraar & School). The total master program of 120 ec has to be approved by the examination board of Molecular Life Science.

Overview of the research year with a total of 54 ec
- Research internship (45 ec)
- Molecular Life Science topical courses (9 ec)

Overview of E-components in the second master year with a total of 57 ec:
- Combination of education traineeships and didactics courses

* Students who wish to obtain a license in Biology or both Chemistry and Biology may have to take an additional program consisting of courses/internships. This is in addition to the regular master program.

For more detailed information see www.ru.nl/ils/ or contact:

Mw. E. Verbeet, Instituut voor Leraar en School (ILS), tel: 024-3530093 of 024-3530094, e-mail: e.verbeet@ils.ru.nl or Mw. drs. U. Nguyen, coordinator of Molecular Life Science, tel: 024 365 3028, e-mail: u.nguyen@science.ru.nl

Familiarisation traineeship Education

Course id: **FE0001B** *3 ec*

Teaching methods
- Traineeship secondary education 60 hours
- Preparations/traineeship assignments/report 20 hours

Learning outcomes
The 'Work experience E-orientation' offers students the opportunity to further familiarise themselves with the E(ducation)-orientation during the master phase (following the CEM-course as part of the bachelor phase).

Description
Planning: The traineeship at a secondary education institute does not only involve working alongside the teacher and observing, but also teaching a class yourself (8 lessons) and discussing these with the supervisory school teacher.

Experience shows that you will need to be at school 2 days per week for a period of 4 to 5 weeks in order to acquire the necessary experience. However, the student is free to make other arrangements in consultation with the traineeship school concerning some other schedule.
The schools offer two possible periods for the purpose of this work experience, namely from October 1st until December 1st and from February 1st until April 1st. This periods are generously scheduled in order to give the student and the school the opportunity to flexibly plan the traineeship in the course of the fourth year of one's studies.

Supervision: The university provides supervision in the form of a teaching methodologist from the Institute for Teachers and School (ILS). This institute teacher arranges an introductory meeting, maintains contacts with the schools, provides literature and assignments and assesses the report. The institute teacher visits the traineeship school once for consultations on location, supplemented with a lesson observation, if desired.
Secondary school teachers supervise at school.

Extra information
This work experience traineeship is not mandatory, but it is certainly advisable for everyone who wishes to be a fully-qualified teacher. The traineeship can be flexibly scheduled.

Contact: secretariat of the Institute for Teachers and School, Gymnasion, tel. 024-3530093 or 3530094.

The traineeship department of the ILS makes arrangements for trainee posts based on the applications pertaining to this particular form of traineeship. Please keep in mind that it may prove necessary to use a weekly rail pass.

4 Organisation master in Molecular Life Science

4.1 OER Master Molecular Life Science 2007/2008

Deel II - Masteropleiding

Paragraaf 1 Algemene bepalingen

Artikel 1.1 Toepasbaarheid van de regeling

Deze regeling is van toepassing op het onderwijs en de examens van de masteropleiding Moleculaire Levenswetenschappen (Molecular Life Science), hierna te noemen: de opleiding. De opleiding wordt verzorgd door het onderwijsinstituut Moleculaire Wetenschappen (hierna te noemen: het onderwijsinstituut) binnen de faculteit Natuurwetenschappen, Wiskunde en Informatica (hierna te noemen: de faculteit), in samenwerking met het Radboud Universiteit Nijmegen Medisch Centrum.

Artikel 1.2 Begripsbepalingen

De in dit reglement voorkomende begrippen hebben, indien die begrippen ook voorkomen in de Wet op het hoger onderwijs en wetenschappelijke onderzoek (WHW) de betekenis die deze wet eraan geeft.

In deze regeling wordt verstaan onder:
a. de wet: de Wet op het Hoger onderwijs en Wetenschappelijk onderzoek afgekort tot WHW en zoals sindsdien gewijzigd;
b. opleiding: de masteropleiding bedoeld in artikel 7.3a, lid 1 onder b van de wet;
c. student: hij of zij die is ingeschreven aan de Radboud Universiteit Nijmegen voor het volgen van het onderwijs en/of het afleggen van de tentamens en de examens van de opleiding;
d. bacheloropleiding: de opleiding, genoemd in artikel 7.3a van de wet;
e. practicum: een praktische oefening als bedoeld in art. 7.13, lid 2 onder d van de wet, in één van de volgende vormen:
het maken van een scriptie;
het maken van een werkstuk of een proefontwerp;
het uitvoeren van een ontwerp- of onderzoekopdracht;
het verrichten van een literatuurstudie;
het schrijven van een computerprogramma;
het verrichten van een stage;
het deelnemen aan veldwerk of een excursie;
het uitvoeren van proeven en experimenten;
of het deelnemen aan een andere onderwijsactiviteit, die gericht is op het bereiken van bepaalde vaardigheden.
f. tentamen: een onderzoek naar de kennis, het inzicht en de vaardigheden van de student met betrekking tot een bepaalde onderwijseenheid, alsmede de beoordeling van dat onderzoek door minstens één daartoe door de examencommissie aangewezen examinator.
g. examen: toetsing, waarbij door de examencommissie wordt vastgesteld of alle tentamens van alle tot de master behorende onderwijseenheden met goed gevolg zijn afgelegd, voor zover de examencommissie niet heeft bepaald dat het examen tevens omvat een door haar zelf te verrichten onderzoek naar de kennis, inzicht en vaardigheden van de examinandus alsmede de beoordeling van de uitkomsten van dat onderzoek. (conform artikel 7.10 van de wet).
h. examencommissie: de examencommissie van een opleiding ingesteld conform artikel 7.12 van de wet. Zie ook Structuurregeling RU.
i. examinator: degene die door de examencommissie wordt aangewezen ten behoeve van het afnemen van tentamens, conform artikel 7.12 van de wet;
k. EC: studiepunten conform het European Credit Transfer System

l. werkdag: maandag t/m vrijdag m.u.v. de erkende feestdagen.
m. studiegids: de gids voor één van de opleidingen genoemd in artikel 1 bevattende de specifieke informatie voor de masteropleiding
n. instelling: Radboud Universiteit Nijmegen

Artikel 1.3 Doel van de opleiding

Met de opleiding wordt beoogd:
a. kennis, vaardigheid en inzicht op het gebied van de Moleculaire Levenswetenschappen,
b. academische vorming,
c. onderzoeksvariant (O-variant) aanvullend aan het in a en b genoemde: voorbereiding op een promotieonderzoek d. management- en toepassingvariant (MT-variant), aanvullend aan het onder a en b genoemde: kennis, vaardigheid en inzicht op relevante terreinen van de bedrijfskunde en bestuurskunde;
e. wetenschapscommunicatievariant (C-variant), aanvullend aan het onder a en b genoemde: kennis, vaardigheid en inzicht op relevante terreinen van de communicatie;
f. educatievariant (E-variant), aanvullend aan het onder a en b genoemde: het verwerven van competenties als docent.

Artikel 1.4 Vorm van de opleiding

De opleiding wordt voltijds verzorgd.

Artikel 1.5 De examens van de opleiding

1. In de opleiding kunnen de volgende examens worden afgelegd:
a. het master examen.

Artikel 1.6 Studielast

1. De studielast wordt uitgedrukt in EC. Eén EC is gelijk aan 28 uren studie.
2. Het masterexamen heeft een studielast van 120 EC.

Artikel 1.7 Taal

1. Het onderwijs wordt in het Engels gegeven, de tentamens en het examen (de examens) worden afgenomen in het Engels. Het onderwijs kan in het Nederlands worden gegeven indien de herkomst van de studenten geen Engelstalig onderwijs vereist.

2. Voor in het Engels verzorgd onderwijs is de Gedragscode vreemde taal van de RU Nijmegen van toepassing. (zie appendix)

3. Voor deelname aan het in het Engels verzorgde onderwijs en eventueel de tentamens is een voldoende beheersing van het Engels vereist. Aan deze eis is voldaan, als de student:
1. in het bezit is van een diploma voorbereidend wetenschappelijk onderwijs; of
2. in het bezit is van een diploma van voortgezet onderwijs, behaald aan een Engelstalige instelling van voortgezet onderwijs binnen of buiten Nederland; of
3. in het bezit is van een diploma hoger beroepsonderwijs; of

4. in het bezit is van een bachelordiploma behaald aan een Nederlandse universiteit; of
5. een van de onderstaande toetsen heeft afgelegd:
* de TOEFL met een score van 550 of hoger voor de papieren versie;
* de TOEFL met een score van 215 of hoger voor de computer versie;
* de IELTS met een score van 6 of hoger.
De examencommissie kan in voorkomende gevallen beoordelen of een student de Engelse taal in voldoende mate beheerst.

Paragraaf 2 De Masteropleiding

Artikel 2.1 Samenstelling master opleiding (O-variant)

De masteropleiding omvat de volgende onderdelen met de daarbij vermelde studielast:

1. Een tweetal natuurwetenschappelijke onderzoeksstages, elk met een omvang van 45 EC, onder verantwoordelijkheid van een docent waarvan de leerstoelgroep betrokken is bij het bacheloronderwijs in de Moleculaire Levenswetenschappen. De twee stages moeten plaatsvinden bij verschillende leerstoelgroepen. Deze onderzoeksstages omvatten:
a. een praktische component (bestaande uit praktisch werk en verslag) met een omvang van 35 EC
b. een theoretische component (voorzien van een toets) met een omvang van 4 EC
c. een scriptie met een omvang van 6 EC
Een lijst met afdelingen waar onderzoeksstages gevolgd kunnen worden aan het begin van het studiejaar bekendgemaakt.

2. Natuurwetenschappelijk masteronderwijs (12 EC). Dit omvat keuze-onderdelen uit theoretische en praktische cursussen die specifiek zijn toegespitst op het onderzoeksterrein van de Moleculaire Levenswetenschappen. Het onderwijs wordt onder andere aangeboden in de vorm van caputcolleges. Een overzicht van de hiervoor in aanmerking komende cursussen, wordt aan het begin van het studiejaar bekendgemaakt.

3. Vrije ruimte (15 EC)
Onderdelen die vrij kunnen worden gekozen. Hiervan zijn 6 EC volledig vrij invulbaar (mits academisch en toetsbaar) en dien de overige 9 EC natuurwetenschappelijk, academisch en toetsbaar ingevuld te worden, dit ter beoordeling van de examencommissie.Het is toegestaan deze vrije ruimte geheel of gedeeltelijk te koppelen aan een van de onderzoeksstages.

4. Een cursus met een wijsgerig karakter (3 EC) met een verplichte keuze uit:
- Evolutie en Filosofie
- Filosofie en ethiek van de moleculaire levenswetenschappen en Medische Biologie
- Wetenschap & Literatuur

Artikel 2.2 Samenstelling master opleiding (MT-variant)

De masteropleiding MT-variant omvat de volgende onderdelen met de daarbij vermelde studielast:

1. opleidingsspecifieke onderdelen met een totale studielast van 54 EC:
a. Een natuurwetenschappelijke onderzoeksstage, met een omvang van 45 EC, als boven.
b. Natuurwetenschappelijk masteronderwijs (9 EC). Dit omvat keuze-onderdelen uit theoretische en praktische cursussen die specifiek zijn toegespitst op het onderzoeksterrein van de Moleculaire Levenswetenschappen. Het onderwijs wordt onder andere aangeboden in de vorm van caputcolleges. Een overzicht van de hiervoor in aanmerking komende cursussen, wordt aan het begin van het studiejaar bekendgemaakt.

2. MT-onderdelen met een totale studielast van 57 EC:

a. verplichte onderdelen:
- Bedrijf & Maatschappij (5 EC)
- Organisatiekunde (5 EC)
- Innovatiemanagement (5 EC)
- Strategie & Marketing (5 EC)
- Financieel economisch management (5 EC)

b. MT-keuzevakken (5 EC) te kiezen uit:
- Kennis en ondernemerschap (3 EC)
- Research strategie en management (3 EC)
- Industriële fijnchemie (3 EC)
- Algemene managementvaardigheden (2 EC)
- dan wel een onder goedkeuring van de voor de variant verantwoordelijke docent vrij te kiezen vak

c. een afstudeerproject (27 EC)

3. Vrije-keuzeruimte met een omvang van 6 EC; deze moet toetsbaar en op academische niveau worden ingevuld.

4. Een cursus met een wijsgerig karakter (3 EC) met een verplichte keuze uit:
- Evolutie en Filosofie
- Filosofie en ethiek van de moleculaire levenswetenschappen en Medische Biologie
- Wetenschap & Literatuur

Artikel 2.3 Samenstelling master opleiding (C-variant)

De masteropleiding C-variant omvat de volgende onderdelen met de daarbij vermelde studielast:

1. Opleidingsspecifieke onderdelen met een totale studielast van 54 EC:
a. Een natuurwetenschappelijke onderzoeksstage, met een omvang van 45 EC, als boven.
b. Natuurwetenschappelijk masteronderwijs (9 EC). Dit omvat keuze-onderdelen uit

theoretische en praktische cursussen die specifiek zijn toegespitst op het onderzoeksterrein van de Moleculaire Levenswetenschappen. Het onderwijs wordt onder andere aangeboden in de vorm van caputcolleges. Een overzicht van de hiervoor in aanmerking komende cursussen, wordt aan het begin van het studiejaar bekendgemaakt.

2. C-onderdelen met een totale studielast van 57 EC:

a. Verplichte vakken in het eerste jaar (12 EC):
- Introduction Science Communication(3 EC) (voorheen: inleiding massacommunicatie)
- Science and Societal Interaction (3 EC) (voorheen: communicatie en verandering)
- Risk Communication (3 EC) (voorheen: crisis en risicocommunicatie)
- Boundary Work (3 EC) (voorheen: grenswerk)

b. Verplichte vakken in het tweede jaar (9 EC):
- Framing Knowledge (3 EC) (voorheen: kaders en beelden)
- Knowledge Society (3 EC) (voorheen: kennis in context)
- Science, Media and Strategy (3 EC) (voorheen: strategieën en wetenschapscommunicatie)

c. C-Keuzevakken, goed te keuren door de voor de variant verantwoordelijke docent, met een totale studielast van 6 EC

d. Stage en verslaglegging (30 EC)

3. Vrije-keuzeruimte met een minimum omvang van 6 EC; deze moet toetsbaar en op academisch niveau worden ingevuld.

4. Een cursus met een wijsgerig karakter (3 EC) met een verplichte keuze uit:
- Evolutie en Filosofie
- Filosofie en ethiek van de moleculaire levenswetenschappen en Medische Biologie
- Wetenschap & Literatuur

Artikel 2.4 Samenstelling master opleiding (E-variant)

De masteropleiding E-variant omvat de volgende onderdelen met de daarbij vermelde studielast:

1. Opleidingsspecifieke onderdelen met een totale studielast van 54 EC:
a. Een natuurwetenschappelijke onderzoeksstage, met een omvang van 45 EC, als boven. b. Natuurwetenschappelijk masteronderwijs (9 EC). Dit omvat keuze-onderdelen uit theoretische en praktische cursussen die specifiek zijn toegespitst op het onderzoeksterrein van de Moleculaire Levenswetenschappen. Het onderwijs wordt onder andere aangeboden in de vorm van caputcolleges. Een overzicht van de hiervoor in aanmerking komende cursussen, wordt aan het begin van het studiejaar bekendgemaakt.

2. E-onderdelen met een totale studielast van 57 EC:
Een tweetal stages met een totale studielast van 57 EC, in de vorm van integrale leertrajecten.

3. Vrije-keuzeruimte met een omvang van 6 EC; deze moet toetsbaar en op academisch niveau worden ingevuld.

4. Een cursus met wijsgerig karakter (3 EC) met een verplichte keuze uit:
- Evolutie en Filosofie
- Filosofie en ethiek van de moleculaire levenswetenschappen en Medische Biologie
- Wetenschap & Literatuur

Artikel 2.5 Goedkeuring samenstelling master opleiding

De door de student gekozen samenstelling van de masteropleiding wordt vooraf ter goedkeuring voorgelegd aan de examencommissie.

Paragraaf 3 Tentamens en examens van de opleiding

Artikel 3.1 Volgorde van tentamens

1. MT-variant:
Aan de tentamens van de onderdelen Innovatiemanagement en Strategie & Marketing kan niet eerder worden deelgenomen dan nadat de tentamens Bedrijf & Maatschappij en Organisatiekunde zijn behaald.

Het afstudeerproject van de MT-variant kan niet eerder worden verricht dan nadat
- er een voldoende resultaat behaald is voor en/of vrijstelling is verleend van onderdelen van de desbetreffende masteropleiding met een studielast van tenminste 45 EC waaronder de praktische werkzaamheden in het kader van de onderzoekstage van de opleiding;
- een voldoende is behaald voor het merendeel van de vijf MT-basisvakken zoals genoemd in artikel 2.2.

2. C-variant:

Het afstudeerstage van de C-variant kan niet eerder worden verricht dan nadat:
- er een voldoende resultaat behaald is voor en/of vrijstelling is verleend van onderdelen van de desbetreffende masteropleiding met een studielast van tenminste 45 EC waaronder de praktische werkzaamheden in het kader van de onderzoekstage van de opleiding;
- een voldoende is behaald voor het merendeel van de verplichte vakken voor de variant zoals genoemd in artikel 2.3.

4. E-variant:

De stages van de E-variant kunnen niet eerder worden verricht dan nadat er een voldoende resultaat behaald is voor en/of vrijstelling is verleend van onderdelen van de desbetreffende masteropleiding met een studielast van tenminste 30 EC waaronder de praktische werkzaamheden in het kader van de onderzoekstage van de opleiding.

Artikel 3.2 Tijdvakken en frequentie tentamens

1. Tot het afleggen van de tentamens van de in de artikel 2.1 t/m 2.4 genoemde onderdelen wordt tenminste tweemaal per jaar de gelegenheid gegeven, met uitzondering van practica of het praktische gedeelte van onderdelen, welke slechts eenmaal per studiejaar kunnen worden afgelegd. Tentamens worden afgenomen aansluitend aan het onderwijs alsmede gedurende een nader te bepalen periode bij voorkeur direct voor het begin van het volgende studiejaar. De Regeling beperking tentamendeelname is hierbij van toepassing (zie appendix).

2. In afwijking van het bepaalde in het eerste lid wordt tot het afleggen van het tentamen van een onderdeel, waarvan het onderwijs in een bepaald studiejaar niet is gegeven, in dat jaar tenminste eenmaal de gelegenheid gegeven.

Artikel 3.3 Vorm van de tentamens

1. De tentamens van de onderdelen, genoemd in artikel 2 kunnen op de volgende wijze worden afgelegd:
a. schriftelijk en/of
b. praktische oefening + verslag en/of
c. computerpracticum en/of
d. computertentamen en/of
e. mondelinge presentatie.

2. Op verzoek van de student kan de examencommissie toestaan dat een tentamen op een andere wijze dan vorenbedoeld wordt afgelegd.

3. Aan studenten met een functiestoornis wordt de gelegenheid geboden de tentamens op een zoveel mogelijk aan hun individuele handicap aangepaste wijze af te leggen. De examencommissie wint zo nodig deskundig advies in alvorens te beslissen. Indien de betreffende studenten bij een tentamen bepaalde faciliteiten nodig hebben, dienen zij deze uiterlijk twee weken voor het tentamen bij de docent aan te vragen.

Artikel 3.4 Mondelinge tentamens

1. Mondeling wordt niet meer dan één persoon tegelijk getentamineerd, tenzij de examencommissie anders heeft bepaald.
2. Het mondeling afnemen van een tentamen is niet openbaar, tenzij de examencommissie of de desbetreffende examinator in een bijzonder geval anders heeft bepaald, dan wel de student daartegen bezwaar heeft gemaakt.

Artikel 3.5 Vaststelling en bekendmaking tentamenuitslag

1. De examinator stelt ter stond na het afnemen van een mondeling tentamen de uitslag vast en reikt de student een desbetreffende schriftelijke verklaring uit.

2. De examinator stelt de uitslag van een schriftelijk tentamen vast binnen 30 dagen na de dag waarop het is afgelegd, of zoveel eerder als nodig is om 10 werkdagen voor de

herkansingsdatum bekend te zijn, en verschaft de administratie van de faculteit de nodige gegevens ten behoeve van de uitreiking van het bewijsstuk omtrent de uitslag aan de student.

3. Voor een op andere wijze dan mondeling of schriftelijk af te leggen tentamen bepaalt de examencommissie tevoren op welke wijze en binnen welke termijn de student een verklaring omtrent de uitslag zal ontvangen.

4. Op de verklaring omtrent de uitslag van een tentamen wordt de student gewezen op het inzagerecht, bedoeld in artikel 3.7, eerste lid, alsmede op de beroepsmogelijkheid bij het college van beroep voor de examens.

5. De termijn waarin studenten tegen een beslissing van de examencommissie in beroep kunnen gaan bij het college van beroep voor de examens is vier weken.

Artikel 3.6 Geldigheidsduur

1. De geldigheidsduur van behaalde onderdelen is onbeperkt.

2. In afwijking van het bepaalde in het eerste lid kan de examencommissie voor een onderdeel aanvullende dan wel vervangende eisen stellen, indien naar haar oordeel de eisen met betrekking tot dat onderdeel aanzienlijk afwijken van die, gesteld ten tijde van het afleggen van het tentamen.

Artikel 3.7 Inzagerecht

1. Gedurende tenminste zes weken na de bekendmaking van de uitslag van een schriftelijk tentamen krijgt de student op zijn verzoek inzage in zijn beoordeeld werk. Tevens wordt hem op zijn verzoek tegen kostprijs een kopie verschaft van dat werk.

2. Gedurende de in het eerste lid genoemde termijn kan elke belanghebbende kennis nemen van vragen en opdrachten van het desbetreffende tentamen, alsmede zo mogelijk van de normen aan de hand waarvan de beoordeling heeft plaatsgevonden.

3. De examencommissie kan bepalen, dat de inzage of de kennisneming geschiedt op een vaste plaats en op tenminste twee vaste tijdstippen. Indien de betrokkene aantoont door overmacht verhinderd te zijn of te zijn geweest op een aldus vastgestelde plaats en tijdstip te verschijnen, wordt hem een andere mogelijkheid geboden, zo mogelijk binnen de in het eerste lid genoemde termijn.

Artikel 3.8 Vrijstelling

1. De examencommissie kan de student op diens verzoek, gehoord de desbetreffende examinator, vrijstelling verlenen van een tentamen, indien de student:
a. hetzij een qua inhoud en niveau overeenkomstig onderdeel van een universitaire of hogere beroepsopleiding heeft voltooid;
b. hetzij aantoont door werk- c.q. beroepservaring over voldoende kennis en vaardigheden te beschikken m.b.t. het desbetreffende onderdeel.

Artikel 3.9 Examen

1. Tot het afleggen van het examen wordt de gelegenheid geboden nadat de student voldoende bewijzen overlegt van door hem behaalde onderdelen van dat examen.
2 De examencommissie stelt de uitslag van het examen vast, alsmede de regelen met betrekking tot de wijze waarop de uitslag van het examen wordt vastgesteld.
3. Alvorens de uitslag van het examen vast te stellen kan de examencommissie zelf een onderzoek instellen naar de kennis van de student met betrekking tot een of meer onderdelen of aspecten van de opleiding, indien en voorzover de uitslagen van de desbetreffende tentamens haar daartoe aanleiding geven.

Artikel 3.10 Graad

1. Aan degene die het masterexamen met goed gevolg heeft afgelegd, wordt de graad "Master of Science" verleend.
2. De verleende graad wordt op het getuigschrift van het examen aangetekend.
3. Aan degene die de O-variant als bedoeld in artikel 2.1 met goed gevolg heeft afgelegd, wordt aan de mastergraad de differentiatie Onderzoek toegevoegd.
4. Aan degene die de MT-variant als bedoeld in artikel 2.2 met goed gevolg heeft afgelegd, wordt aan de mastergraad de differentiatie Management & Toepassing toegevoegd.
5. Aan degene die de C-variant als bedoeld in artikel 2.3 met goed gevolg heeft afgelegd, wordt aan de mastergraad de differentiatie Wetenschapsommunicatie toegevoegd.
6. Aan degene die de E-variant als bedoeld in artikel 2.4 met goed gevolg heeft afgelegd, wordt aan de mastergraad de differentiatie Educatie toegevoegd en wordt door het Instituut voor Leraar en School een eerstegraadse docentbevoegdheid verleend.

Paragraaf 4 Vooropleiding

Artikel 4.1 Toelatingseisen masteropleiding
1 Tot de opleiding worden, onverlet het bepaalde in artikel 4.3, toegelaten:
a. degene die het afsluitend examen van de bacheloropleiding Moleculaire Levenswetenschappen aan de RU Nijmegen heeft afgelegd.
b. degene die in het bezit is van het bewijs van toelating, dat het College van Bestuur voor het desbetreffende studiejaar afgeeft (artikel 4.2).
c. degene met een HBO-diploma HLO in een chemische of biochemische richting die voldaan heeft aan het schakelprogramma Moleculaire Levenswetenschappen van maximaal 30 EC.

Artikel 4.2 Bewijs van toelating

Voor het bewijs van toelating komt in aanmerking degene die:
a. in het bezit is van een getuigschrift dat ten minste gelijkwaardig is aan het diploma als bedoeld in artikel 4.1. onder a (en/of b),
b. of anderszins naar het oordeel van de examencommissie blijk hebben gegeven van geschiktheid voor het volgen van de opleiding,
c. en het bewijs heeft geleverd van voldoende beheersing van de Engelse taal, zoals bepaald in artikel 1.7.

Artikel 4.3 Flexibele instroom in de masteropleiding

1. De examencommissie kan, voor zover de beschikbare onderwijscapaciteit dit toelaat, besluiten dat de student die is ingeschreven voor de bacheloropleiding Moleculaire Levenswetenschappen, kan worden toegelaten tot de masteropleiding Moleculaire Levenswetenschappen (Molecular Life Science) voordat deze met goed gevolg het afsluitend examen van de bacheloropleiding Moleculaire Levenswetenschappen heeft afgelegd.
2. Toelating is alleen mogelijk, als de student voldoet aan de volgende voorwaarden:
a. er is voldoende resultaat behaald voor en / of vrijstelling verleend van de onderdelen van het bachelorexamen met een studielast van tenminste 162 EC;
b. in afwijking van het bepaalde in lid 2.a geldt voor studenten begonnen op 1 september 2002 dat toelating mogelijk is wanneer er voldoende resultaat is behaald voor en/of vrijstelling is verleend van de onderdelen van het bachelorexamen met een studielast van tenminste 150 EC;
c. De propedeuse en de ministage moeten zijn afgerond
3. De student die krachtens dit artikel is toegelaten tot de opleiding, dient uiterlijk een jaar na die toelating het afsluitend examen van de in het eerste lid bedoelde bacheloropleiding met goed gevolg te hebben afgelegd. Wanneer aan deze voorwaarde niet is voldaan wordt de student uitgesloten van deelname aan tentamens van de master opleiding totdat het afsluitend examen van genoemde bacheloropleiding met goed gevolg is afgelegd.

Paragraaf 5 Studiebegeleiding

Artikel 5.1 Studievoortgangsadministratie

1. De faculteit registreert de individuele studieresultaten van de studenten.
2. Zij verschaft elke student tenminste eenmaal per jaar een overzicht van de door hem behaalde studieresultaten

Artikel 5.2 Studiebegeleiding

De opleiding draagt zorg voor de introductie en de studiebegeleiding van de studenten, die voor de opleiding zijn ingeschreven, mede ten behoeve van hun oriëntatie op mogelijke studiewegen in en buiten de opleiding.

Paragraaf 6 Overgangs- en slotbepalingen

Artikel 6.1 Tentamens en examens voor studenten begonnen voor 1 september 2002

1. Tot 1 september 2008 wordt aan studenten die vòòr 1 september 2002 zijn begonnen, de gelegenheid geboden de tentamens alsmede het doctoraalexamen van de opleiding af te leggen, zoals vastgesteld in de onderwijs- en examenregeling die in werking trad op 1 september 2002.
2. In bijzondere gevallen kan de examencommissie aan andere studenten dan die bedoeld in het eerste lid, toestemming verlenen tentamens en examens af te leggen volgens de in het eerste lid bedoelde onderwijs- en examenregeling. Het bepaalde in het eerste lid blijft daarbij onverminderd van kracht.

Artikel 6.2 Overstap van ongedeelde opleiding naar bachelor/master structuur

Een student, als bedoeld in art. 6.1, kan onder de volgende voorwaarden deelnemen aan de opleiding krachtens deze onderwijs- en examenregeling:
a. behaalde studieresultaten kunnen worden gewaardeerd als vrijstelling voor overeenkomstige onderdelen "nieuwe stijl";
b. deelneming staat open voorzover de gefaseerde invoering van het onderwijs en de tentamens volgens deze regeling dat feitelijk toelaten.

Artikel 6.3 Vaststelling OER/ Wijzigingen
(NB: zie ook Structuurregeling artikelen 11 en 18 en Reglement UGV en FGV artikel 3.3.1.)

1. Deze regeling en wijzigingen van deze regeling worden door de decaan, na advisering door de opleidingscommissie en na instemming van de FGV, bij afzonderlijk besluit vastgesteld.
2. Een wijziging van deze regeling heeft geen betrekking op het lopende studiejaar, tenzij de belangen van de studenten daardoor redelijkerwijs niet worden geschaad.
3. Een wijziging kan voorts niet ten nadele van studenten van invloed zijn op enige andere beslissing, die krachtens deze regeling door de examencommissie is genomen ten aanzien van een student.

Artikel 6.4 Bekendmaking

1. De decaan draagt zorg voor een passende bekendmaking van deze regeling, van de regelen en richtlijnen die door de examencommissie zijn vastgesteld, alsmede van elke wijziging van deze stukken.
2. Elke belangstellende kan op het faculteitsbureau een exemplaar van de in het eerste lid bedoelde stukken verkrijgen.

Artikel 6.5 Inwerkingtreding

Deze regeling treedt in werking op 1 september 2007.
Aldus vastgesteld door de decaan in juli 2007.

Appendix

Gedragscode vreemde taal, als bedoeld in artikel 7.2 sub c WHW (vastgesteld door het College van Bestuur)

Binnen de RU geldt de onderstaande gedragscode

Artikel 1
Binnen de Radboud Universiteit Nijmegen kan het verzorgen van onderwijs en het afnemen van tentamens en examens in een andere taal dan het Nederlands geschieden indien de specifieke aard, inrichting of kwaliteit van het onderwijs, dan wel de herkomst van de studenten daartoe noodzaakt.

Artikel 2
Een besluit tot het gebruik van een vreemde taal wordt genomen door de decaan van de desbetreffende faculteit, na advies ingewonnen te hebben van de opleidingscommissie. De decaan neemt daarbij de volgende uitgangspunten in acht:
- De noodzaak van het gebruik van een andere taal dan het Nederlands dient vast te staan;
- Tentamens en examens kunnen op verzoek van de student in het Nederlands worden afgelegd; tentamens en examens van Engelstalige opleidingen worden in het Engels afgelegd, tenzij de examencommissie van de desbetreffende opleiding anders beslist;
- Het gebruik van een vreemde taal mag niet leiden tot verzwaring van de studielast van de opleiding;
- Het anderstalig onderwijs voldoet aan dezelfde kwaliteitseisen als het onderwijs verzorgd in het Nederlands.

Artikel 3
In de onderwijs- en examenregeling van de opleiding wordt het besluit van de decaan verwerkt.

Artikel 4
De decaan van de faculteit brengt jaarlijks het College van Bestuur verslag uit van de door hem genomen besluiten.

Opleidingscommissie

Overeenkomstig art. 9.18 WHW is er een opleidingscommissie. Deze commissie heeft tot taak:
a) advies uit te brengen over de onderwijs- en examenregeling,
b) het jaarlijks beoordelen van de uitvoering van de onderwijs- en examenregeling, en
c) het desgevraagd of uit eigen beweging advies uitbrengen aan de onderwijsdirecteur en de decaan over alle aangelegenheden betreffende het onderwijs in de opleiding.

Regeling beperking tentamendeelname

Op alle tentamens van de binnen de faculteit verzorgde opleidingen is onderstaande Regeling beperking tentamendeelname van toepassing. Deze is op 7 januari 2004 vastgesteld door de faculteitsleiding na advies van het Onderwijsmanagementteam.

- Studenten mogen maximaal 3 keer aan een tentamen deelnemen. Studenten zijn verplicht zich voor het tentamen elektronisch aan te melden via KISS tot 5 werkdagen voor het tentamen. De surveillant dient e.e.a. te controleren en bijschrijvingen op de deelnamelijst worden niet toegestaan. De docent mag slechts tentamenopgaven uitreiken aan studenten, die vooraf aangemeld zijn.
- Studenten dienen zich af te melden als ze niet deelnemen aan een tentamen:
  tot 5 werkdagen voor het tentamen in Kiss,
  daarna tot 1 werkdag voor het tentamen wordt afgenomen. Deze afmelding geschiedt uitsluitend schriftelijk/elektronisch bij de docent.
- Als een student niet deelneemt zonder zich tijdig te hebben afgemeld, verspeelt hij/zij een tentamenkans (1 van de 3).
- Indien het tentamen na 3 keer nog niet is behaald, dient de student voor iedere volgende keer dat hij/zij aan het tentamen wil deelnemen een schriftelijk verzoek in te dienen bij de examencommissie van zijn/haar opleiding.
- De studentenadministratie is verantwoordelijk voor het registreren van het aantal keren, dat een student heeft deelgenomen aan een tentamen.

- Deze regeling betreft zowel mondelinge als schriftelijke tentamens.
- Deze regeling geldt voor alle studenten van de Faculteit Natuurwetenschappen, Wiskunde en Informatica.
- Indien de student kan aantonen door overmacht verhinderd te zijn geweest deel te nemen aan het tentamen dan wel zich niet tijdig heeft kunnen afmelden, kan de examencommissie besluiten de inschrijving niet als deelname te beschouwen.
- Deze regeling treedt in werking met ingang van 1 februari 2004 voor wat betreft tentamens waarvoor studenten zich na die datum voor de eerste maal inschrijven.

Nadere regels voor de goede gang van zaken tijdens tentamens (ex art. 7.12 lid 4 WHW)

De examencommissie stelt regels vast met betrekking tot de goede gang van zaken tijdens tentamens en met betrekking tot de in dat verband te nemen maatregelen. Die maatregelen kunnen inhouden dat in geval van fraude door een student door de examencommissie, gedurende een door de examencommissie te bepalen termijn van ten hoogste één jaar, aan die student het recht wordt ontnomen een of meer daarbij aan te wijzen tentamens of examens aan de instelling af te leggen.

4.2 Regels en richtlijnen voor de examencommissie Moleculaire Levenswetenschappen

Waar in deze regels en richtlijnen sprake is van, "hij", "hem" of "zijn" wordt mede bedoeld "zij" of "haar"

artikel 1 toepassingsgebied

Deze regels en richtlijnen zijn van toepassing op de tentamens en examens in de opleiding Moleculaire Levenswetenschappen van de Radboud Universiteit Nijmegen, hierna te noemen 'de opleiding'.

artikel 2 begripsomschrijving

In deze regels en richtlijnen wordt verstaan onder:

- examenregeling: de onderwijs- en examenregeling voor de in artikel 1 genoemde opleiding, laatstelijk vastgesteld in juli 2007 door het faculteitsbestuur Natuurwetenschappen, Wiskunde en Informatica;
- examinandus: degene die zich onderwerpt aan een tentamen of examen;
- tentamen: het onderzoek naar en de beoordeling van kennis, vaardigheden en inzicht, ongeacht de vorm waarin dit onderzoek plaatsvindt;
- student: degene die als zodanig is ingeschreven voor de opleiding;
- examinator: examinator als bedoeld in artikel 7.12 lid 3 WHW.

artikel 3 samenstelling van de examencommissie

De examencommissie Moleculaire Levenswetenschappen bestaat uit tien docenten die betrokken zijn bij de opleiding Moleculaire Levenswetenschappen. De examencommissie wijst uit haar midden een voorzitter aan die belast is met de behartiging van de dagelijkse gang van zaken van de examencommissie.

artikel 4 examens

De opleiding Moleculaire Levenswetenschappen omvat het propedeutisch examen, het bachelor-examen en het master-examen. Ten behoeve van deze examens verricht de examencommissie onderzoek naar de kennis, het inzicht en de vaardigheden van de examinandus. Na afloop van het onderzoek vindt de beoordeling van de resultaten van dat onderzoek plaats.

artikel 5 taal

Conform artikel 1.8 van de bachelor OER wordt het onderwijs in de bachelorfase in het Nederlands gegeven, en conform artikel 1.7 van de master OER wordt en het onderwijs in de masterfase in het Engels gegeven. Alleen als de inhoud van de gedoceerde stof dat vereist, kan na goedkeuring van de examencommissie van deze regel afgeweken worden.

artikel 6 beoordeling door examencommissie dan wel examinator

Naar elk van de tentamens behorende bij een examen wordt het onderzoek verricht en wordt het resultaat daarvan beoordeeld door de examencommissie, voor zover zij daartoe niet één of meer examinatoren heeft aangewezen.

artikel 7 toelating tot het afleggen van tentamens van het bachelor-examen Moleculaire Levenswetenschappen

1. Voor toelating tot het afleggen van onderdelen van het propedeutisch examen Moleculaire Levenswetenschappen dient de student in bezit te zijn van:
A. een VWO diploma met profiel N&G of N&T;
B. of een propedeutisch diploma van een HBO opleiding die aansluit op een N&G of N&T profiel conform artikel 5.2 bachelor OER;
C. of een toelating tot de opleiding via een colloquium doctum; dit vereist een toelatingsonderzoek conform artikel 7.19 van de wet, met als eisen:
1. wiskunde op niveau eindexamen VWO wiskunde B1
2. natuurkunde op niveau eindexamen VWO natuurkunde 1
3. scheikunde op niveau eindexamen VWO scheikunde 1
4. biologie op niveau eindexamen VWO biologie 1
5. Nederlands op niveau eindexamen VWO wat betreft tekstbegrip en stelvaardigheid
6. Engels op niveau eindexamen VWO wat betreft tekstbegrip
D. of een Duits Arbitur diploma met een van de volgende instroomeisen: 1. Leistungskurs Scheikunde met daarnaast Biologie en Wiskunde tot minimaal de 11e klas 2. Leistungskurs Natuurkunde met daarnaast Biologie en wiskunde tot minimaal de 11e klas E. Het College van Bestuur kan daarnaast personen die in het bezit zijn van een al dan niet in Nederland verworven diploma toegang verlenen tot de bachelor-opleiding Moleculaire Levenswetenschappen, indien dat diploma tenminste gelijkwaardig is aan het propedeutisch getuigschrift Moleculaire Levenswetenschappen. Het College van Bestuur kan deze toegang afhankelijk stellen van het met goed gevolg afleggen van de toets Nederlands, afgenomen door de Interuniversitaire werkgroep Toelatingsexamen Nederlands, dan wel door andere erkende instanties, na goedkeuring door de examencommissie Moleculaire Levenswetenschappen.

2. De toelating tot het afleggen van post-propedeutische onderdelen van het bachelor-examen Moleculaire Levenswetenschappen wordt aan een student verleend:
A. indien hij het propedeutische examen Moleculaire Levenswetenschappen met goed gevolg heeft afgelegd, dan wel is vrijgesteld door de examencommissie van het afleggen van het propedeutische examen Moleculaire Levenswetenschappen;
B. ofwel indien de som van de studiepunten, behorende bij de tentamens voor de propedeuse-onderdelen waarvoor de hem uitgereikte uitslagverklaringen tenminste "6,0" luiden, tenminste 45 EC bedraagt; Indien in het eerste studiejaar minder dan 45 EC zijn behaald, kunnen postpropedeutische onderdelen uitsluitend met toestemming van de examencommissie worden gevolgd.
C. In alle overige gevallen wordt de student geen toelating tot het afleggen van post-propedeuse onderdelen van het bachelor-examen Moleculaire Levenswetenschappen verleend.
D. In bijzondere gevallen kan de examencommissie afwijken van het bepaalde in het voorgaande lid.

artikel 8 toelating tot afleggen van tentamens van het master-examen Moleculaire Levenswetenschappen

1. De toelating tot het afleggen van onderdelen van de master-examen Moleculaire Levenswetenschappen wordt een student verleend, indien hij:
A. het bachelor-examen Moleculaire Levenswetenschappen met goed gevolg heeft afgelegd, dan wel is vrijgesteld door de examencommissie van het afleggen van het bachelor-examen Moleculaire Levenswetenschappen;
B. dan wel in het bezit is van het propedeutisch examen Moleculaire Levenswetenschappen en de som van de studiepunten, behorende bij de tentamens voor de postpropedeuse-onderdelen waarvoor de hem uitgereikte uitslagverklaringen tenminste "6,0" luiden, tenminste 102 EC bedraagt en waarbij in elk geval de ministage moet zijn afgerond;

2. Toelating wordt eveneens verleend aan een student die in het bezit is van:
A. een bachelor-diploma (universitair of HBO) anders dan dat in de Moleculaire Levenswetenschappen, op voorwaarde dat deze bachelor-opleiding aansluit op een N&G of N&T profiel.
B. en indien er ter beoordeling van de examencommissie logischerwijs van uit gegaan mag worden dat hij na een speciaal voor hem opgesteld schakelprogramma van maximaal 30 EC een niveau heeft bereikt overeenkomend met dat van een bachelor in de Moleculaire Levenswetenschappen.
C. en indien de vakken uit dit schakelprogramma met tenminste 6.0 zijn afgesloten.

D. De examencommissie kan een student toestemming verlenen om tijdens het doorlopen van het schakelprogramma, te starten met onderdelen van de master Moleculaire Levenswetenschappen. De student die krachtens dit artikel is toegelaten tot de opleiding, dient uiterlijk een jaar na die toelating het schakelprogramma van maximaal 30 EC met goed gevolg te hebben afgerond.

3. In alle overige gevallen wordt de student geen toelating tot het afleggen van onderdelen van het master-examen Moleculaire Levenswetenschappen verleend.

4. In bijzondere gevallen kan de examencommissie afwijken van het bepaalde in het voorgaande lid.

artikel 9 aanmelding tentamen

1. Jaarlijks wordt (bij aanvang van het nieuwe studiejaar) een gedetailleerde lijst bekend gemaakt van de data en tijdstippen waarop gedurende dat studiejaar de tentamens kunnen worden afgelegd.

2. Deelneming aan een schriftelijk tentamen vindt niet plaats dan na deugdelijke en tijdige aanmelding bij de facultaire studentenadministratie.

3. Als tijdige aanmelding geldt een elektronische opgave tenminste 5 werkdagen voor het tijdstip waarop het desbetreffende tentamen of deeltentamen zal worden afgenomen.

4. Afmelding van deelname aan een tentamen kan tot uiterlijk 5 werkdagen voor de tentamendatum elektronisch gebeuren, en daarna tot 1 werkdag voor het tentamen wordt afgenomen uitsluitend schriftelijk/elektronisch bij de docent.

5. De student wordt geacht te hebben deelgenomen aan een tentamen als deze zich heeft aangemeld voor dit tentamen en zich niet (tijdig) heeft afgemeld.

6. Een student mag zich niet meer dan drie maal inschrijven voor een bepaald tentamen. Om daarna alsnog aan het tentamen deel te kunnen nemen, dient de student een met redenen omkleed verzoek in te dienen bij de examencommissie. Deze zal na overleg met de betrokken examinator besluiten onder welke voorwaarden de student alsnog tot het tentamen kan worden toegelaten. In zijn algemeenheid zal de examencommissie geen toestemming geven om zich voor een vijfde maal voor een tentamen in te schrijven, met name als het om een propedeuse-onderdeel gaat.

artikel 10 goedkeuring en vrijstellingsverzoek

1. Voor invulling van stage-onderdelen en de vrije ruimte is tevoren goedkeuring vereist van de examencommissie. Alvorens het bachelor examen kan worden aangevraagd is goedkeuring van het totale bachelor pakket vereist. Alvorens het master-examen kan worden aangevraagd is goedkeuring van de examencommissie vereist voor het totale pakket.

2. De examencommissie beslist binnen vier weken na ontvangst van een verzoek, academische vakanties niet meegerekend. De examencommissie kan de beslissing voor ten hoogste een maand verdagen. Van de verdaging wordt voor afloop van in bovenstaande zin genoemde termijn schriftelijk mededeling gedaan aan de student. Indien de examencommissie niet binnen de eventueel verdaagde termijn heeft beslist, wordt geacht goedkeuring te zijn verleend.

3. Een verzoek om vrijstelling van een tentamen of examen wordt schriftelijk en met redenen omkleed ingediend bij de examencommissie.

4. De examencommissie beslist binnen 3 maanden na ontvangst van een dergelijk vrijstellingsverzoek.

5. De beslissing goedkeuring te onthouden of een vrijstellingsverzoek niet toe te kennen wordt niet genomen, nadat de student in de gelegenheid is gesteld te worden gehoord. Een onthouding

van goedkeuring wordt onverwijld en met redenen omkleed via de examencommissie aan de student medegedeeld.

artikel 11 orde tijdens een tentamen

1. De examencommissie zorgt, dat ten behoeve van de schriftelijke examinering surveillanten worden aangewezen, die erop toezien dat het tentamen of deeltentamen in goede orde verloopt. De examencommissie kan deze zorg opdragen aan de desbetreffende examinator.

2. De examinandus is verplicht zich op verzoek van of vanwege de examencommissie te legitimeren met behulp van zijn collegekaart.

3. De examinandus is verplicht de aanwijzingen van de examencommissie c.q. de examinator, die voor de aanvang van het tentamen zijn gepubliceerd, alsmede aanwijzingen die tijdens het tentamen en onmiddellijk na afloop daarvan worden gegeven, op te volgen.

4. Volgt de examinandus een of meer aanwijzingen als bedoeld in het voorgaande lid niet op, dan kan hij door de examencommissie c.q. de examinator worden uitgesloten van de verdere deelname aan het desbetreffende tentamen. De uitsluiting heeft tot gevolg dat er geen uitslag wordt vastgesteld van dat tentamen en dat de examinandus wordt uitgesloten van deelneming aan dat tentamen in hetzelfde studiejaar. Voordat de examencommissie c.q. de examinator een besluit tot uitsluiting neemt, stelt zij de examinandus in de gelegenheid te worden gehoord.

5. De tentamenopgaven mogen door de examinandus na afloop van het tentamen worden meegenomen zo de aard van de opgaven dit toelaat.

artikel 12 fraude

1. Onder fraude wordt verstaan het handelen of nalaten van een examinandus dat erop is gericht het vormen van een juist oordeel omtrent zijn kennis, inzicht en vaardigheden geheel of gedeeltelijk onmogelijk te maken.

2. In geval van fraude tijdens het afleggen van een tentamen kan de examencommissie de examinandus uitsluiten van verdere deelname aan het tentamen gedurende het desbetreffende studiejaar. Alvorens een beslissing te nemen stelt de examencommissie de examinandus en de examinator c.q. de surveillant in de gelegenheid te worden gehoord.

3. De beslissing inzake uitsluiting wordt genomen naar aanleiding van door de examinator of surveillant geconstateerde fraude.

4. In spoedeisende gevallen kan de examinator een voorlopige beslissing tot uitsluiting nemen op grond van zijn constatering of, indien van toepassing, een mondeling verslag van de surveillant. Desgevraagd draagt de examinator er zorg voor dat, binnen een redelijke termijn, het verslag van de geconstateerde fraude op schrift wordt gesteld en in afschrift aan de examinandus wordt verstrekt.

5. De examinandus kan aan de examencommissie verzoeken de uitsluiting ongedaan te maken.

6. Voordat de examencommissie een beslissing neemt op een verzoek, als bedoeld in het vijfde lid, stelt zij de examinandus en de examinator in de gelegenheid te worden gehoord.

7. Een uitsluiting heeft tot gevolg, dat geen uitslag wordt vastgesteld voor het in het tweede lid bedoelde tentamen en dat de examinandus wordt uitgesloten van deelneming aan dat tentamen in hetzelfde studiejaar.

artikel 13 tentamenopgaven

De vragen en opgaven van het tentamen gaan de tevoren bekend gemaakte bronnen waaraan de tentamenstof is ontleend, niet te buiten. Deze bronnen worden voor de aanvang van het onderwijs dat op het tentamen voorbereidt, in hoofdzaak bekend gemaakt. Uiterlijk een maand voor het afnemen van het tentamen wordt de omvang van de stof definitief bekend gemaakt.

artikel 14 beoordeling tentamen

Ingeval in hetzelfde tentamen al dan niet terzelfder tijd door meer dan één examinator het onderzoek wordt verricht en het resultaat daarvan wordt beoordeeld, ziet de examencommissie erop toe, dat die examinatoren beoordelen aan de hand van dezelfde normen.

artikel 15 cijfers

De cijfers die voor de beoordeling van de tentamens uitsluitend gebruikt mogen worden, zijn: 10,0; 9,5; 9,0; 8,5; 8,0; 7,5; 7,0; 6,5; 6,0; 5,0; 4,0; 3,0; 2,0; 1,0; 0. Hierbij is tenminste een 5,50 vereist voor afronding tot 6,0.

artikel 16 uitslagverklaring tentamen

Nadat een tentamen is afgenomen, wordt door de examencommissie of de door haar aangewezen examinator via het facultaire bureau examens een daarop betrekking hebbende verklaring uitgereikt, waaruit de uitslag blijkt, de zogenaamde uitslagverklaring.

artikel 17 meer malen afleggen tentamen

Indien een tentamen meer dan eenmaal is afgelegd, neemt de examencommissie bij de vaststelling van de uitslag van het tentamen alleen de bij de laatste gelegenheid voor dat tentamen afgegeven uitslagverklaring in beschouwing.

artikel 18 Geldigheidsduur van tentamens

Indien een cursus uit verschillende onderdelen bestaat waarvoor deelcijfers worden gegeven bijvoorbeeld een practicum, dan vervallen die deelcijfers na twee jaar als dan nog niet het gehele examenonderdeel met een voldoende is afgetekend

artikel 19 vaststelling uitslag examen

1. De student wordt de gelegenheid geboden tot het aflegen van een examen, nadat hij de vereiste bewijzen van door hem behaalde tentamens van onderdelen van de opleiding heeft overlegd.

2. De examencommissie stelt de uitslag van het examen vast bij gewone meerderheid van stemmen.

3. Staken de stemmen, dan is de examinandus afgewezen.

4. Indien een tentamen meer dan eenmaal is afgelegd, neemt de examencommissie bij de vaststelling van de uitslag van het examen alleen de bij de laatste gelegenheid voor dat tentamen afgegeven uitslagverklaring in beschouwing.

5. Men is geslaagd voor het **propedeutisch examen** Moleculaire Levenswetenschappen:
a. indien de uitslagverklaringen van de tentamens van alle propedeuse-onderdelen tenminste "6,0" luiden;
b. dan wel indien de uitslagverklaring van één van deze tentamens "5,0" luidt en compensatie plaatsvindt doordat tenminste eenmaal de uitslagverklaring "8,0" of hoger luidt, en de uitslagverklaringen van de overige tentamens tenminste "6,0" luiden, of doordat tenminste tweemaal de uitslagverklaring "7,0" of hoger luidt, en de uitslagverklaringen van de overige tentamens tenminste "6,0" luiden.
c. In alle overige gevallen is de geëxamineerde afgewezen voor het propedeutisch examen Moleculaire Levenswetenschappen.
d. In bijzondere gevallen kan de examencommissie afwijken van het bepaalde in het voorgaande lid.

6. Men is geslaagd voor het **bachelor-examen** Moleculaire Levenswetenschappen:
a. indien de propedeuse behaald is en de uitslagverklaringen van de tentamens van alle post-propedeutische bachelor-onderdelen tenminste "6,0" luiden;
b. dan wel indien de propedeuse behaald is en de uitslagverklaring van het tentamen van één van de postpropedeutische onderdelen "5,0" luidt en compensatie plaatsvindt doordat tenminste eenmaal de uitslagverklaring "8,0" of hoger luidt, en de uitslagverklaringen van de overige tentamens tenminste "6,0" luiden, of doordat tenminste tweemaal de uitslagverklaring "7,0" of hoger luidt, en de uitslagverklaringen van de overige tentamens tenminste "6,0" luiden; bij uitzondering moet de uitslagverklaring van de ministage tenminste 6,0 bedragen.
c. In alle overige gevallen is de geëxamineerde afgewezen voor het bachelor-examen Moleculaire Levenswetenschappen.
d. In bijzondere gevallen kan de examencommissie afwijken van het bepaalde in het voorgaande lid.

7. Men is geslaagd voor het **master-examen** Moleculaire Levenswetenschappen:
a. indien de uitslagverklaringen van de tentamens van alle onderdelen van de masterfase tenminste "6,0" luiden;
b. dan wel indien de uitslagverklaring van het tentamen van één van deze onderdelen "5,0" luidt en compensatie plaatsvindt doordat tenminste eenmaal de uitslagverklaring "8,0" of hoger luidt, en de uitslagverklaringen van de overige tentamens tenminste "6,0" luiden, of doordat

tenminste tweemaal de uitslagverklaring "7,0" of hoger luidt, en de uitslagverklaringen van de overige tentamens tenminste "6,0" luiden; daarbij moeten alle onderzoeks -en beroepsstages beoordeeld zijn met tenminste 6.0.
c. In alle overige gevallen is de geëxamineerde afgewezen voor het master-examen Moleculaire Levenswetenschappen.
d. In bijzondere gevallen kan de examencommissie afwijken van het bepaalde in het voorgaande lid.

artikel 20 judicium

Aan de uitslag van een examen kan door de examencommissie een judicium worden toegevoegd. De toe te kennen judicia luiden: "met genoegen", "met lof", en "met de hoogste lof".

1. Voor het propedeutisch examen (60 EC) hanteert de examencommissie als richtlijn voor toekenning van een bepaald judicium de volgende criteria, rekening houdend met de totale lijst van resultaten:

"met genoegen (bene meritum)" bij een gemiddelde van tenminste een 7,0 **"met lof (cum laude)"** bij een gemiddelde van tenminste 8,0 **"met de hoogste lof (summa cum laude)"** bij een gemiddelde tenminste een 9,0

Voor alle judicia geldt dat voor elke 5,0 op de cijferlijst het judicium met een categorie wordt verlaagd.

2. Voor het bachelor examen hanteert de examencommissie als richtlijn voor toekenning van een bepaald judicium de volgende criteria, rekening houdend met de totale lijst van resultaten:

"met genoegen (bene meritum)" bij een gemiddelde van tenminste een 7,0 **"met lof (cum laude)"** bij een gemiddelde van tenminste 8,0 **"met de hoogste lof (summa cum laude)"** bij een gemiddelde tenminste een 9,0

Voor alle judicia geldt dat voor elke 5,0 op de cijferlijst het judicium met een categorie wordt verlaagd.

3. Bij het master-examen komt de student in aanmerking voor het predikaat:

"met genoegen (bene meritum)", indien de gemiddelde beoordeling van alle examenonderdelen tenminste 7,0 bedraagt, én het praktisch werk & verslag van de beide verplichte stages gemiddeld beoordeeld zijn met tenminste 7,5. **"met lof (cum laude)"**, indien de gemiddelde beoordeling van alle examenonderdelen tenminste 8,0 bedraagt, én het praktisch werk & verslag van de beide verplichte stages gemiddeld beoordeeld zijn met tenminste 8,5. **"met de hoogste lof (summa cum laude)"**, indien de gemiddelde beoordeling van alle examenonderdelen tenminste 9,0 bedraagt, én het praktisch werk & verslag van de beide verplichte stages gemiddeld beoordeeld zijn met tenminste 9,0.

4. Judicia worden op het getuigschrift van het examen aangetekend.

artikel 21 wijziging regels en richtlijnen

Geen wijzigingen in deze regeling vinden plaats die van toepassing zijn op het lopende studiejaar, tenzij de belangen van studenten hierdoor redelijkerwijs niet worden geschaad.

artikel 22 onvoorzien

In gevallen waarin deze "regels en richtlijnen van de examencommissie Moleculaire Levenswetenschappen " niet voorzien danwel twijfel bestaat over de interpretatie ervan, beslist het faculteitsbestuur.

artikel 23 inwerkingtreding

Deze regels en richtlijnen treden in werking op 1 september 2007. Deze regels en richtlijnen zijn van toepassing voor studenten met jaar van aankomst vanaf 2007.

Aldus vastgesteld door de examencommissie, met advies vanuit de opleidingscommissie, voor de opleiding moleculaire levenswetenschappen in 2007

5 Appendices

5.1 Important names and addresses

Faculty of Sciences
Toernooiveld 1, 6525 ED Nijmegen
tel.: 024-3616161

Director of education for Molecular Sciences
prof.dr. A. Kentgens (Arno), (untill August 1, 2007)
tel.: 3652078
e-mail: arnok@nmr.ru.nl

Director of education for Molecular Life Science
Dr. A.P.R. Theuvenet (Lex)
tel.: 3652013
e-mail: a.theuvenet@science.ru.nl

Study coordinator & student advisor Molecular Life Science
mw. drs. T.T.U. Nguyen (Uyen)
kamer HG 01.062
tel.: 3653028
e-mail: u.nguyen@science.ru.nl

Student advisor studying abroad/internationalization officer
dr. L. Laarhoven (Luc-Jan)
room HG01.061
tel.: 3653434
e-mail: l.laarhoven@science.ru.nl

Secretary institute of education for Molecular Sciences
mrs. E. Meijer (Ine)
room HG 01.060
tel.: 3653446
e-mail: secromw@science.ru.nl

Chairman of the examination board (excie) Molecular Life Science
prof.dr. J. van Zoelen (Joop)
tel.: 3652707
e-mail: vzoelen@science.ru.nl

Chairman of the education committee (OLC) of Molecular Life Science
dr. P. Willems (Peter)
tel.: 3614589
e-mail: p.willems@ncmls.ru.nl

Board of Education for Molecular Sciences
prof.dr. A. Kentgens (Arno), director of education of the Institute for Molecular Sciences
prof.dr. F. Rutjes (Floris), director of education in chemistry
dr. A. Theuvenet (Lex), director of education in molecular life sciences
dr. J. van Opstal (John), director of education in natural science
Anne Colder, student-assessor
secretary: dr. L. Laarhoven (Luc-Jan), e-mail: l.laarhoven@science.ru.nl

Committee of advise for Molecular Sciences
Tim van Dulmen, Thanja Lamberts and ..... , (students)
dr. W. Boelens (Wilbert), mrs.prof.dr. L. Buydens (Lutgarde) and dr. N. Dam (Nico, (lecturers)
dr. L. Laarhoven (Luc-Jan), mrs.drs. U. Nguyen (Uyen) en mrs. W. Philipse (Wilma), (study coordinators),
secretary: dr. L. Laarhoven (Luc-Jan), e-mail: l.laarhoven@science.ru.nl

Education committee of Molecular Life Science (OLC) mailto:olc.mlw@student.ru.nl
dr. P. Willems (Peter), chairman
dr. F. van Delft (Floris), vice-chairman
prof. dr. G. Pruijn (Ger)
dr. P. Klaren (Peter)
Y. Bleijenberg (Yorick)
E. Leunissen (Liz)
J. Kerssemakers (Jules)
A. Konijnenberg (Albert)
secretaris: mw. drs. U. Nguyen (Uyen), e-mail: u.nguyen@science.ru.nl

Examination board of Molecular Life Science
prof.dr. J. van Zoelen (Joop), voorzitter
dr. C. van Gelder (Celia)
dr. H. Heus (Hans)
dr. C. Logie (Colin)
dr. J. Fransen (Jack)
dr. G. Bosman (Giel)
dr. W. Boelens (Wilbert)
prof.dr. F. Rutjes (Floris)
prof.dr. G. Martens (Gerard)
Secretaris: mw. drs. U. Nguyen (Uyen), secretaris, e-mail: u.nguyen@science.ru.nl

Coordinator international affairs for Molecular Sciences
dr. L. Laarhoven (Luc-Jan)
room HG01.061
tel.: 3653434
e-mail: l.laarhoven@science.ru.nl

VCMW Sigma
room HG00.150, tel: 3653441
e-mail: sigma@science.ru.nl

G-mi
periodical of VCMW Sigma
e-mail: gmi@science.ru.nl

Student Counsel of the Faculty of Science (FSR) fsr@science.ru.nl
Jos Groenewegen (informatics)
Ralph Jaspers (biology)
Yvette Krijnen (chemistry)
Thijs Kruijen (molecular life science)
Daan Speth (biology)
Lennert van Tilburg (physics and astronomy)

Counsel room for students
room HG 00.150
open: Monday, Tuesday and Thursday: 12.30 - 13.30 hr.
For complaints on education, faculty and facilities. During opening hours a student-member of the FSR or one of the OLC's will be present.

Office of administration and exams for students
open: Monday-Thursday: 13.00-16.00 hr, Friday: 09.00-12.00 hr
room HG 00.134
tel.: 3652247/3753392

Student affairs office
Comeniuslaan 6, tel.: 3612345
for more information: Vademecum 2007/2008

5.2 Overview of the master program

variant	1st Master year		2nd Master year	
O	**Practical component** (45 ec): • Research + report (35 ec) • Theoretical component (4 ec) • Master thesis (6 ec)	**Master education** (15 ec): • Philosophy course (3 ec) • Scientific master courses (12 ec)	**Practical component** (45 ec): • Research + report • (35 ec) • Theoretical component (4 ec) • Master thesis (6 ec)	**Master education** (15 ec): • 9 ec of examinable courses on academic as well as scientific level. • 6 ec of examinable courses on academic level.
MT	**Practical component** (45 ec): • Research + report (35 ec) • Theoretical component (4 ec) • Master thesis (6 ec)	**Master education** (12 ec): • Philosophy course (3 ec) • Scientific master courses (9 ec)	**MT- components** (57 ec): • 5 mandatory MT-courses (25 ec) • 1 elective MT-course (5 ec) • Graduation MT-project (27 ec)	**Master education** (6 ec): • 6 ec of examinable courses on academic level.
C	**Practical component** (45 ec): • Research + report (35 ec) • Theoretical component (4 ec) • Master thesis (6 ec)	**Master education** (12 ec): • Philosophy course (3 ec) • Scientific master courses (9 ec)	**C- components** (57 ec): • 7 mandatory C-courses (21 ec) • Elective C-part (6 ec) • Graduation C-project (30 ec)	**Master education** (6 ec): • 6 ec of examinable courses on academic level.
E	**Practical component** (45 ec): • Research + report (35 ec) • Theoretical component (4 ec) • Master thesis (6 ec)	**Master education** (12 ec): • Philosophy course (3 ec) • Scientific master courses (9 ec) •	**E- components** (57 ec): • 2 traineeships offered by the Institute for Leraar & School including courses on teaching skills	**Master education** (6 ec): • 6 ec of examinable courses on academic level.

5.3 Overview of Research departments

Department	Contact	e-mail	website
Analytical Chemistry	Prof. L. Buydens	L.Buydens@science.ru.nl	www.cac.science.ru.nl
Applied Biology	Dr. K. Dechering	k.dechering@science.ru.nl e.piek@science.ru.nl	www.celbi.science.ru.nl
Human Genetics*	Dr. B. Franke	b.franke@antrg.umcn.nl	www.humangenetics.nl
Organimal Animal Physiology	Prof. Dr. G. Flik	gertflik@science.ru.nl	www.organphy.science.ru.nl
Bioinformatics	Dr. C. van Gelder	c.vangelder@cmbi.ru.nl	www2cmbi.ru.nl
Biochemistry UMCN	Prof. J.J. de Pont Dr. P. Willems	J.dePont@ncmls.ru.nl p.willems@ncmls.ru.nl g.bosman@mcnls.ru.nl	www.ncmls.ru.nl
Biophysics	Prof. S. Gielen	stan@mbfys.ru.nl	www.ru.nl/mbphysics
Biophysics chemie	Prof. S. Wijmenga	S.Wijmenga@science.ru.nl	www.ru.nl/physchem
Biomolecular Chemistry FNWI	Prof. G. Pruijn	g.pruijn@ncmls.ru.nl	www.bioch.science.ru.nl
Cell Biology FNWI	Prof. J. van Zoelen	vzoelen@science.ru.nl	www.celbi.science.ru.nl
Cell Biology of the Plant	Prof. T. Mariani	mariani@science.ru.nl	www.expbot.science.ru.nl
Cell Biology UMCN	Prof. B. Wieringa	b.wieringa@ncmls,ru.nl	www.ncmls.ru.nl
Cellular Animal Physiology	Prof. E. Roubos	roubos@science.ru.nl	www.celanphy.science.ru.nl
Cell Physiology	Prof. R. Bindels	r.bindels@ncmls.ru.nl j.hoenderop@ncmls.ru.nl	www.ncmls.eu/celfys
Central Hematology Laboratory*	Dr.B. van der Reijden	B.vanderreijden@chl.azn.nl	www.umcn.nl/overhetumc
Dermatology*	Dr. J. Schalkwijk	J.Schalkwijk@derma.umcn.nl	www.umcn.nl
Evolutional Microbiology	Dr. J. Hackstein	J.Hackstein@science.ru.nl	
Experimental Botanic/Plant Genetics	Dr. J. Peters	jl.peters@science.ru.nl t.gerarts@science.ru.nl	www.expbot.science.ru.nl
Pharmacology & Toxicology	Prof. F. Russel	f.russel@ncmls.ru.nl	www.ncmls.ru.nl
FC Donders Centre for Cognitive Neuroimaging*	Dr. G. Fernandez	f.fernandez@fcdonders.ru.nl sandra.heemskerk @fcdonders.ru.nl tildie.stijns@fcdonders.ru.nl	www.fcdonders.ru.nl
Immunology & Nephrology*	Dr. J. van der Vlag	j.vandervlag@ncmls.ru.nl	
Clinical Biochemistry	Prof. R. Wevers	r.wevers@cukz.umcn.nl	
Laboratory for Pediatrics & Neurology	Prof. R. Wevers	r.wevers@cukz.umcn.nl	
Medical Microbiology/ Parasitology*	Dr. W. Roeffen	w.roeffen@ncmls.ru.nl	www.ncmls.ru.nl/mmb/ medicalmicrobiolog.asp
Medical Microbiology/Virology	Dr. W. Melchers Dr. F. van Kuppeveld	w.melchers@ncmls.ru.nl f.vankuppeveld@ncmls.ru.nl	www.ncmls.ru.nl/
Microbiology FNWI	Dr. H. op den Camp	H.opdenCamp@science.ru.nl	www.microbiology.science.ru.nl
Molecular Animal Physiology	Prof. G. Martens	g.martens@ncmls.ru.nl	
Molecular Biology	Prof. H. Stunnenberg	h.stunnenberg@ncmls.ru.nl	www.ncmls.nl/molbio/home.asp
Nijmegen Centre for Mitochondrial Disorders	Prof. J. Smeitink Dr. L. Nijtmans	j.smeitink@cukz.umcn.nl l.nijtmans@cukz.umcn.nl	www.ncmd.nl
Organic Chemistry	Prof. R. Nolte	D.vanderwey@science.ru.nl	www.orgchem.science.ru.nl
Pathology	Prof. G. van Muijen	g.muijen@pathol.umcn.nl j.jeuken@pathol.umcn.nl	
Reumatology*	Dr. P. van der Kraan	p.vanderkraan@reuma.umcn.nl	www.umcn.nl
Tumor Immunology Laboratory*	Prof. C. Figdor	TIL_secret@ncmls.ru.nl	www.ncmls.ru.nl
Urology	Prof. L Kiemeney	B.kiemeney@epib.umnc.nl secruro@uro.umcn.nl	
*Permission of the examination board is required			

5.4 The Academic year

From September 1, 2007, until August 31, 2008

First day: September 3, 2007
Last day: July 11, 2008

Period 1: September 3 until November 9, 2007
Period 2: November 12, 2007 until February 1, 2008
Period 3: February 4 until April 18, 2008
Period 4: April 21 until July 11, 2008

Autumn holiday: October 22 until 26, 2007 (not for third year students)
Christmas holiday: December 24, 2007 until January 4, 2008
Spring holiday: February 4 until 8, 2008
Good Friday: March 21, 2008
Easter Monday: March 24, 2008
May holiday: April 28 until May 5, 2008 (including Queens Day and Liberation Day)
White Monday: May 12, 2008
Resit examination period: August 18 until 29, 2008

5.5 List of lecturers

Angenent, Prof. dr. ir. G.C.	gerco.angenent@wur.nl	52761	HG02.338
Boelens, Dr. W.C.	w.boelens@ncmls.ru.nl	16753	NCMLS 3.93
Boer, Dr.ir. P. de	p.deboer@obgyn.umcn.nl	10869	GG 10 01.128
Born, Drs. J.G. van den	R.vandenBorn@science.ru.nl	52269	HG02.814
Broek, Drs. J.G.J. van den	j.vandenbroek@science.ru.nl	53346	HG00.109
Buydens, Prof. dr. L.M.C.	l.buydens@science.ru.nl	53192	HG02.721
Camp, Dr. H.J.M. op den	h.opdencamp@science.ru.nl	52657	HG02.407
Cornelissen, Dr. J.J.L.M.	j.cornelissen@science.ru.nl	52381	HG03.016
Dankbaar, Prof. dr. B.	b.dankbaar@fm.ru.nl	52681	HG02.809
Dankelman, Drs. I.E.M.	i.dankelman@science.ru.nl	52150	HG02.827
Deen, Dr. P.M.T.	p.deen@ncmls.ru.nl	17347	NCMLS
Delft, Dr. F.L. van	f.vandelft@science.ru.nl	52373	HG03.022
Dolstra, Dr. H.	h.dolstra@chl.umcn.nl		
Drenthen, Drs. M.A.M.	m.drenthen@science.ru.nl	52730	HG02.826
Dresen, H.M.	l.dresen@science.ru.nl	52188	HG02.831
Elemans, Dr. J.A.A.W.	j.elemans@science.ru.nl	52185	HG03.020
Feiters, Dr. M.C.	m.feiters@science.ru.nl	52016	HG03.021
Flik, Prof. dr. G.	g.flik@science.ru.nl	53242	HG02.014
Gelder, Dr. R. de	r.degelder@science.ru.nl	52842	HG03.009

Gerats, Prof. dr. A.G.M.	t.gerats@science.ru.nl	52910	HG02.337
Hest, Prof. dr. ir. J.C.M. van	j.vanhest@science.ru.nl	53204	HG03.015
Heuvel, Dr. L.P.W.J. vanden	b.vandenheuvel@cukz.umcn.nl	17983	
Jenks, Dr. B.G.	b.jenks@science.ru.nl	53335	HG02.021
Jetten, Prof. dr. ir. M.S.M.	m.jetten@science.ru.nl	52941	HG02.406
Kentgens, Prof. dr. A.P.M.	a.kentgens@nmr.ru.nl	52078	HG03.343
Keulartz, Prof. dr. F.W.J.	j.keulartz@science.ru.nl	52851	HG02.823
Klaren, Dr. P.H.M.	p.klaren@science.ru.nl	53245	HG02.011
Kraan, Dr. P. van der	p.vanderkraan@ncmls.ru.nl	16568	NCMLS
Kuppeveld, Dr. F. van	F.vanKuppeveld@ncml.ru.nl	17574	NCMLS
Leenaars, Dr. ir. P.P.A.M.	m.leenaars@cdl.umcn.nl	19379	M220.00.027
Leeuw, A.L.M. de	t.deleeuw@amd.ru.nl	19656	
Lekkerkerk, Ir. L.J.	h.lekkerkerk@fm.ru.nl	11931	TvA1 01.35
Logie, C.	c.logie@ncmls.ru.nl	10525	NCMLS 3.93
Lowik, Dr. D.W.P.M.	d.lowik@science.ru.nl	52382	HG03.016
Lubsen, Dr. N.H.	n.lubsen@ncmls.ru.nl	16850	NCMLS 3.89
Luthy, Prof. dr. C.H.	luethy@phil.ru.nl	15750	E16.04a
Mariani, Prof. dr. C.	c.mariani@science.ru.nl	52773	HG02.310
Martens, Prof. dr. G.J.M.	g.martens@ncmls.ru.nl	10564	NCMLS 6.95
Masereeuw, Mw dr. R.	r.masereeuw@ncmls.ru.nl	13730	NCMLS 7.030
Meekes, Dr. H.L.M.	h.meekes@science.ru.nl	53200	HG03.625
Meijer, Prof. dr. E.W.	b.meijer@science.ru.nl	52331	HG03.018
Minnaar, Drs. R.A.	r.minnaar@fm.ru.nl	11765	TvA1 02.24
Moerman, W.P.	w.moerman@amd.ru.nl	16434	
Muijen, Dr. G.N.P. van	g.vanmuijen@pathol.umcn.nl	14399	GG 24 o.30
Nolte, Prof. dr. R.J.M.	r.nolte@science.ru.nl	52143	HG03.025
Pruijn, Prof. dr. G.J.M.	g.pruijn@ncmls.ru.nl	16847	NCMLS
Roubos, Prof. dr. E.W.	e.roubos@science.ru.nl	52360	HG02.024
Rowan, Prof. dr. A.E.	a.rowan@science.ru.nl	52323	HG03.020
Rutjes, Prof. dr. F.P.J.T.	f.rutjes@science.ru.nl	53202	HG03.024
Schaftenaar, Dr. G.	g.schaftenaar@cmbi.ru.nl	19674	NCMLS 0.18
Schalkwijk, Prof.dr. J.	J.Schalkwijk@ncmls.ru.nl	14094	NCMLS
Souren, Dr. A.F.M.M.	a.souren@science.ru.nl	52269	HG02.814
Stunnenberg, Prof. dr. ir. H.G.	h.stunnenberg@ncmls.ru.nl	10524	NCMLS 3.95
Swart, Dr. G.W.M.	g.swart@ncmls.ru.nl	14266	NCMLS 8.38
Theuvenet, Dr. A.P.R.	a.theuvenet@science.ru.nl	52013	HG02.205
Torensma, Dr. R.	r.torensma@ncmls.ru.nl	10544	NCMLS
Veenstra, Dr. G.J.C.	g.veenstra@ncmls.ru.nl	10541	NCMLS 3.87
Vissers, Dr. G.A.N.	g.vissers@science.ru.nl	52686	HG02.830
Vlieg, Prof. dr. E.	e.vlieg@science.ru.nl	53070	HG03.628
Vlieg, Prof. dr. J. de	j.devlieg@organon.com		
Vos, Drs. ing. P.M.	p.vos@fm.ru.nl	13026	
Vriend, Prof. dr. G.	g.vriend@cmbi.ru.nl	19521	NCMLS 0.27
Welters, Drs. R.P.M.M.	r.welters@honours.ru.nl	11354	
Wieringa, Prof. dr. B.	b.wieringa@ncmls.ru.nl	14287	NCMLS
Wijmenga, Prof. dr. S.S.	sybrenw@science.ru.nl	53384	HG03.345
Willems, Dr. P.H.G.M.	p.willems@ncmls.ru.nl	14589	NCMLS 7.39
Wit, Prof. dr. J. de	j.dewit@science.ru.nl	52684	HG02.809
Zwart, Prof. dr. H.A.E.	h.zwart@science.ru.nl	52038	HG02.808

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