



## Biomolecular Sciences MSc

Vrije Universiteit Amsterdam - Fac. der Aard- en Levenswetenschappen - M Biomolecular Sciences - 2016-2017

The aim of the Master programme Biomolecular Sciences is to equip the student with the knowledge, skills and insight required to operate as an independent professional within the field of biomolecular sciences and to be a suitable candidate for a subsequent course of study leading to a career in research. Having completed the programme, the student should have developed a critical scientific approach and an awareness of the ethical and societal aspects of biomolecular sciences.

The programme is intended for students with a research-oriented profile. It trains students with bachelors ranging from biomedical sciences and biology to (bio)chemistry, physics, mathematics and engineering, for a Master's degree at the interface between these disciplines. Also medical and veterinary doctors, dentists, pharmacists/pharmaceutical scientists can enter the programme. The focus is on the issue how molecules lead to biological function in health and disease. It therewith covers genetics, microbiology, structural biology, cell physiology, molecular biology, biochemistry, biophysics, biomathematics, genomics, bioinformatics, pharmacology, toxicology, spectroscopy, immunology and infection.

The programme offers a choice between two specializations:

- Molecular Cell Biology
- Biological Chemistry

The year schedule can be found at the FALW-website.

Further information about the MSc programme [Biomolecular Sciences](#).

A complete programme description can be found at the FALW-website.

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## Expired programme components Biomolecular Sciences

The course programme components presented in the list below will no longer be part of the examination programme in academic year 2014-2014.

### MSc Biomolecular Sciences, spec. Biological Chemistry

In this specialisation we focus on the interaction of cells, cellular structures and individual proteins with their "chemical environment". Special focus will lie on the characterization of new drug targets and tools to find small molecules as leads in the development of new medicines. Furthermore, the bioactivation of and cellular responses to drugs will get special attention.

The Masters specialisation Biological Chemistry is organized by Medicinal Chemistry and Molecular Toxicology of the Department of Chemistry and Pharmaceutical Sciences of the Faculty of Sciences (FEW).

This programme gives a thorough grounding in the subjects and methods of the Medicinal Chemistry and Molecular Toxicology as well as providing a solid preparation for one or more research internships.

Capita Selecta are offered on individual basis throughout the year.

Opleidingsdelen:

- [Supplementary specialization course](#)
- [Specialization courses: At least 6 EC of these specialization courses is required](#)
- [At least 6 EC is required of these courses](#)
- [Recommended optional courses](#)
- [Biological Chemistry: Compulsory courses](#)

### Supplementary specialization course

Vakken:

Naam	Periode	Credits	Code
<a href="#">Chemical Biology</a>	Periode 1	6.0	X_432538

### Specialization courses: At least 6 EC of these specialization courses is required

Vakken:

Naam	Periode	Credits	Code
<a href="#">Drug-induced Stress and Cellular Responses</a>	Periode 2	6.0	X_432536
<a href="#">Signal Transduction in Health and Disease</a>	Periode 2	6.0	X_432535

At least 6 EC is required of these courses

Vakken:

Naam	Periode	Credits	Code
<a href="#">Biomolecular Screening</a>	Periode 4	3.0	X_432542
<a href="#">Biophotonics I: Microspectroscopy</a>	Periode 3	3.0	AM_470629
<a href="#">Biophotonics III: Practical Training</a>	Periode 3	3.0	AM_470630
<a href="#">Molecular Pharmacology</a>	Periode 4	3.0	X_432541

Recommended optional courses

Vakken:

Naam	Periode	Credits	Code
<a href="#">AIMMS Lectures and Seminars</a>	Ac. Jaar (september)	3.0	XB_432764
<a href="#">Caput Cellular Protein Trafficking</a>	Ac. Jaar (september)	6.0	AM_470605
<a href="#">Caput Epigenetics</a>	Ac. Jaar (september)	6.0	AM_470606
<a href="#">Caput Molecular Biotechnology</a>	Ac. Jaar (september)	6.0	AM_470604
<a href="#">Caput Protein Structure as Molecular Basis of Disease</a>	Periode 5+6	6.0	AM_470120
<a href="#">Caput Structural Biology</a>	Ac. Jaar (september)	6.0	AM_470607
<a href="#">Dynamics of Biomolecules and Cells</a>	Periode 4	6.0	X_422583
<a href="#">Fundamentals of Bioinformatics</a>	Periode 1	6.0	X_405052
<a href="#">Introduction to Systems Biology</a>	Periode 1	6.0	X_428565
<a href="#">Microbial Genomics</a>	Periode 3	3.0	AM_1021
<a href="#">Project Computational Design and Synthesis of Drugs</a>	Periode 4	6.0	X_432734
<a href="#">Structural Bioinformatics</a>	Periode 4	6.0	X_405019

Biological Chemistry: Compulsory courses

Vakken:

Naam	Periode	Credits	Code
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<a href="#">Ethics in Life Sciences</a>	Periode 3	3.0	AM_470707
<a href="#">Genomes and Gene Expression</a>	Periode 1	6.0	AM_470614
<a href="#">Internship I Biological Chemistry</a>	Ac. Jaar (september)	30.0	AM_471129
<a href="#">Internship II Biological Chemistry</a>	Ac. Jaar (september)	30.0	AM_471130
<a href="#">Protein Science</a>	Periode 1	6.0	AM_470145
<a href="#">Scientific Writing in English (AM_BMOL)</a>	Periode 3+4	3.0	AM_1156
<a href="#">Thesis Based on Literature Study</a>	Ac. Jaar (september)	9.0	AM_471153

## MSc Biomolecular Sciences, spec. Molecular Cell Biology

With the Masters Biomolecular Sciences specialisation Molecular Cell Biology, students can further develop their skills and performance in molecular and cellular research and prepare themselves for an (inter) national research position. The Masters programme Molecular Cell Biology has been developed for students with a Bachelors degree in Biology or Biomedical Sciences or any other relevant Bachelor's degree (for instance Biochemistry or HLO) and is organized by the Institute for Molecular Cell Biology (IMC) of the Faculty of Earth and Life Sciences (FALW) in collaboration with the Faculty of Sciences of the VU University Amsterdam and the VU Medical Center (VUmc).

This programme gives a thorough grounding in the subjects and methods of the Department of Molecular Cell Biology (MCB), as well as providing a solid preparation for one or more research internships.

Opleidingsdelen:

- [Supplementary specialization courses: 12 EC of specialization courses required in total](#)
- [Specialization courses: At least 6 EC of these specialization courses is required](#)
- [Compulsory Choice: At least 6 EC is required of these courses](#)
- [Recommended optional Courses](#)
- [Molecular Cell Biology: Compulsory Courses](#)

**Supplementary specialization courses: 12 EC of specialization courses required in total**

Vakken:

Naam	Periode	Credits	Code
<a href="#">Developmental Biology</a>	Periode 2	6.0	AM_470613
<a href="#">Extreme Biology</a>	Periode 2	6.0	AM_470509

**Specialization courses: At least 6 EC of these specialization courses is required**

Vakken:

Naam	Periode	Credits	Code
<a href="#">Cell Structures and Functions</a>	Periode 2	6.0	AM_470615
<a href="#">Molecular Infection Biology</a>	Periode 2	6.0	AM_470657
<a href="#">Signal Transduction in Health and Disease</a>	Periode 2	6.0	X_432535

Compulsory Choice: At least 6 EC is required of these courses

Vakken:

Naam	Periode	Credits	Code
<a href="#">Biomolecular Screening</a>	Periode 4	3.0	X_432542
<a href="#">Biophotonics I: Microspectroscopy</a>	Periode 3	3.0	AM_470629
<a href="#">Biophotonics III: Practical Training</a>	Periode 3	3.0	AM_470630
<a href="#">Molecular Pharmacology</a>	Periode 4	3.0	X_432541
<a href="#">Molecular photobiology</a>	Periode 4	3.0	X_432763

Recommended optional Courses

Vakken:

Naam	Periode	Credits	Code
<a href="#">AIMMS Lectures and Seminars</a>	Ac. Jaar (september)	3.0	XB_432764
<a href="#">Caput Cellular Protein Trafficking</a>	Ac. Jaar (september)	6.0	AM_470605
<a href="#">Caput Epigenetics</a>	Ac. Jaar (september)	6.0	AM_470606
<a href="#">Caput Molecular Biotechnology</a>	Ac. Jaar (september)	6.0	AM_470604
<a href="#">Caput Protein Structure as Molecular Basis of Disease</a>	Periode 5+6	6.0	AM_470120
<a href="#">Caput Structural Biology</a>	Ac. Jaar (september)	6.0	AM_470607
<a href="#">Dynamics of Biomolecules and Cells</a>	Periode 4	6.0	X_422583
<a href="#">Fundamentals of Bioinformatics</a>	Periode 1	6.0	X_405052
<a href="#">Introduction to Systems Biology</a>	Periode 1	6.0	X_428565
<a href="#">Microbial Genomics</a>	Periode 3	3.0	AM_1021



Structural Bioinformatics	Periode 4	6.0	X_405019
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## Molecular Cell Biology: Compulsory Courses

Vakken:

Naam	Periode	Credits	Code
Ethics in Life Sciences	Periode 3	3.0	AM_470707
Genomes and Gene Expression	Periode 1	6.0	AM_470614
Internship I Molecular Cell Biology	Ac. Jaar (september)	30.0	AM_471127
Internship II Molecular Cell Biology	Ac. Jaar (september)	30.0	AM_471128
Protein Science	Periode 1	6.0	AM_470145
Scientific Writing in English (AM_BMOL)	Periode 3+4	3.0	AM_1156
Thesis Based on Literature Study	Ac. Jaar (september)	9.0	AM_471153

## AIMMS Lectures and Seminars

<b>Vakcode</b>	XB_432764 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. J.E. van Muijlwijk-Koezen
<b>Examinator</b>	dr. J.E. van Muijlwijk-Koezen
<b>Niveau</b>	400

### Doel vak

- To broaden your spectrum of the Human Life Sciences
- To practice your writing skills and capability to order and summarize a lot of new information
- To practice your scientific judgements

### Inhoud vak

The Amsterdam Institute for Molecules, Medicines and Systems (AIMMS) organizes biweekly the so-called AIMMS-seminars. Next to this, (inter)national researchers are invited for AIMMS Lectures. In this caput, you have to visit six seminars or lectures of your choice.

Summarize the content of the lecture and reflect on each of them in a written report (template available). For one of these seminars an extended report has to be made. All documents have to be uploaded on the Blackboard Course via the corresponding SafeAssignment link. Please send an e-mail to the teacher when you have uploaded a new document so it can be reviewed.

**Onderwijsvorm**

individual

**Toetsvorm**

writing reports

**Literatuur**

relevant references, suggested by the speakers

**Vereiste voorkennis**

bachelor in life sciences

**Doelgroep**

mDDS, mBMS, mMNS, mSBI

**Intekenprocedure**

standard procedure

**Overige informatie**

Please contact the coordinator in advance.

## Biomolecular Screening

<b>Vakcode</b>	X_432542 (432542)
<b>Periode</b>	Periode 4
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. J. Kool
<b>Examinator</b>	dr. J. Kool
<b>Docent(en)</b>	dr. J. Kool
<b>Lesmethode(n)</b>	Hoorcollege, Practicum
<b>Niveau</b>	400

**Doel vak**

To learn, understand and work with modern analytical chemistry in the life sciences to identify proteins. More specifically, you will learn ways to find biologically active proteins in mixtures, purify them and finally identify them using proteomics techniques.

**Inhoud vak**

During this course the potential of modern analytical and biological screening techniques used in bioactivity screening of bioactive proteins will be discussed. The emphasis will be on finding bioactive proteins in complex biological samples by LC-MS in combination with post-column bioassays. Protein identification strategies using bottom-up proteomics approaches will be focused on during this course. You will learn how to find biologically active proteins in complex mixtures and know how to identify these proteins by their (partial) amino acid sequence. Sample treatment and advanced sample preparation techniques will play an important part in this as well as LC-MS, bioassays and database searches with the proteomics data obtained. We will work with natural extracts such as snake venoms as our complex biological samples, which contain potential biopharmaceutical candidate proteins.

### Onderwijsvorm

The course starts with a thorough explanation of the course and its contents. Then we will start with the practical work. In between the practical work, lectures will be all given that discuss in more detail and assist the practical work. Relevant literature will be provided via blackboard. All students will (besides their practical report) work on a literature assignment related to a topic in bioactivity profiling in a biopharmaceutical setting.

### Toetsvorm

The mark given for the literature report will constitute 50% of the final mark. The mark of the practical report also constitutes 50% of the final mark. This mark is given for the insights shown, motivation and other relevant issues such as presence during the course, practical course report, safety considerations and practical results obtained Both marks have to be at least 5.5.

Presence during the practical course days is obligatory.

### Literatuur

Literature to study is mainly from e-books (chapters) and from academic papers/reviews. All literature needed can be found in the course documents on BlackBoard. Tutorials will be given by the course supervisors during the practical work. All PowerPoint lectures will be placed on BlackBoard at least one day before each lecture. All PDF e-book chapters and other literature (e.g. academic research papers and reviews) can already be found on BlackBoard.

### Vereiste voorkennis

Basic knowledge of biochemistry, separation sciences and mass spectrometry.

### Doelgroep

Master phase practical course

## Biophotonics I: Microspectroscopy

<b>Vakcode</b>	AM_470629 ()
<b>Periode</b>	Periode 3
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. ir. Y.J.M. Bollen
<b>Examinator</b>	dr. ir. Y.J.M. Bollen
<b>Docent(en)</b>	prof. dr. ir. E.J.G. Peterman, dr. ir. Y.J.M. Bollen
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	400

### Doel vak

To introduce students into various spectroscopic and microscopic techniques.

Students should know the theoretical principles and the applicability in life sciences of:

- absorption spectroscopy
- fluorescence spectroscopy

- light microscopy
- fluorescence microscopy

### Inhoud vak

Optical spectroscopy and microscopy are widely used in cell biology and biophysics. In this course the principles of many of these techniques, including absorption spectroscopy, various types of fluorescence spectroscopy (e. g. polarization, FRET) and fluorescence microscopy (e. g. confocal, TIRF, lifetime imaging) are explained. Their application in modern biophysics and cell biology research is illustrated by a number of (guest) lecturers.

### Onderwijsvorm

Lectures (28 hours), group assignment (8 hours), self-study

### Toetsvorm

Written exam (75%), oral presentation by group (25%). Both parts need to be passed (with a grade of 5.5 or higher) in order to pass the course.

### Literatuur

Notes, handouts and papers

### Doelgroep

MSc students Biology, Biomolecular Sciences, Biomedical Sciences, Medical Natural Sciences, Physical Sciences, Chemistry, or related.

### Overige informatie

Due to largely overlapping contents this course is NOT intended for students who have taken the FEW BSc course "Microscopische beeldvorming (X\_420529)".

Practical training in the techniques discussed here is offered in Biophotonics 3, for which Biophotonics 1 is required.

## Biophotonics III: Practical Training

<b>Vakcode</b>	AM_470630 ()
<b>Periode</b>	Periode 3
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. ir. Y.J.M. Bollen
<b>Examinator</b>	dr. ir. Y.J.M. Bollen
<b>Docent(en)</b>	dr. ir. Y.J.M. Bollen
<b>Lesmethode(n)</b>	Practicum
<b>Niveau</b>	400

### Doel vak

To introduce students into the application of various optical techniques, mainly fluorescence spectroscopy and microscopy.

Students should be able to:

- plan and conduct experiments using optical techniques
- evaluate results on the basis of theoretical knowledge and recent literature
- present their results in short reports and one journal-style paper

### **Inhoud vak**

Optical spectroscopy and microscopy are widely used in cell biology and biophysics. In this course students will obtain hands-on experience with absorption spectroscopy, fluorescence spectroscopy (e. g. FRET and anisotropy) and fluorescence microscopy. The theory behind these techniques is already given in Biophotonics 1, which is required to enter this course. Small groups of students will prepare the experiments, discuss them with the lecturer and carry them out. The group will write a short report on each experiment and one journal-style paper.

### **Onderwijsvorm**

Experiments ( $\pm 24$  hours) are performed in small groups. Experiments need to be prepared and reports need to be written.

### **Toetsvorm**

Participation during labwork and discussion (individual; 30%); written report (per group; 70%).

### **Literatuur**

Papers and protocols that will be made available through Blackboard

### **Vereiste voorkennis**

Biophotonics: Microspectroscopy (AM\_470629) or Microscopische beeldvorming (X\_420529) are required to enter this course.

### **Doelgroep**

MSc students Biology, Biomolecular Sciences, Biomedical Sciences, Medical Natural Sciences, Physical Sciences, Chemistry or related.

### **Overige informatie**

The theoretical background of the techniques used here is discussed in Biophotonics: Microspectroscopy (AM\_470629).

## Caput Cellular Protein Trafficking

<b>Vakcode</b>	AM_470605 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.P. van Ulsen
<b>Examinator</b>	dr. J.P. van Ulsen
<b>Niveau</b>	500

### **Doel vak**

The aim of this theoretical course for master students is to study a number of recent, short and state-of-the-art review papers in the area of protein secretion and cellular protein trafficking. The students will get insight into the principles and mechanisms by which prokaryotic and eukaryotic cells target and insert proteins into membranes and target them to subcellular organelles and the extracellular environment. The course will highlight the similarities between eukaryotic and

prokaryotic organisms in the mechanisms of protein secretion and trafficking.

Furthermore the application of this knowledge and research in medical sciences and in biotechnology is addressed. The emphasis is on bacterial systems. End terms for the student:

- To know and understand the biochemical principles and molecular and cellular processes that play a role in protein targeting to biomembranes
- To know and understand the biochemical principles and the molecular and cellular processes that play a role in the insertion of membrane proteins into biomembranes
- To know and understand the biochemical principles and the molecular and cellular processes that play a role in the transport of proteins through biological membranes and into the extracellular environment.

### **Inhoud vak**

Protein trafficking in *E. coli*:

- Biogenesis of inner membrane proteins in *E. coli*.
- Targeting and assembly of periplasmic and outer membrane proteins.
- Protein translocation across membranes: secretion systems, their structure, biology, and function.

Protein trafficking in eukaryotes:

- Biogenesis of membrane proteins in organelles
- intracellular protein trafficking
- vesicle transport in the endosomal system.

### **Onderwijsvorm**

Introductory meeting with course coordinator (1h). Followed by self-study of the literature. An additional meeting for questions and discussion of the literature can be arranged upon request. Questions may also be asked via e-mail.

### **Toetsvorm**

Written exam with essay questions

### **Literatuur**

As a basis Chapters 12 and 13 of the book "Molecular Biology of the Cell", Alberts et al. Garland Science Ltd (5th edition; 2008) can be studied. The corresponding Chapters of earlier editions are also OK.

Additional reviews:

Walther DM, Rapaport D, Tommassen J. (2009) Biogenesis of beta-barrel membrane

proteins in bacteria and eukaryotes: evolutionary conservation and divergence.

Cell Mol Life Sci. 66:2789-2804

- Integration of proteins into the outer membrane of gram-negative bacteria and the outer membranes of organelles is facilitated by a conserved machinery.

Cross BC, Sinning I, Lührink J, High S. (2009) Delivering proteins for export from

the cytosol. Nat Rev Mol Cell Biol. 10:255-264

- The conserved Sec machinery in pro- and eukaryotes

Wang P, Dalbey RE. (2011) Inserting membrane proteins: the YidC/Oxa1/Alb3 machinery in bacteria, mitochondria, and chloroplasts. Biochim Biophys Acta. 1808:866-875

- Integration of proteins in the cytoplasmic membrane of bacteria and organelles

Karuppiah V, Berry JL, Derrick JP. (2010) Outer membrane translocons: structural insights into channel formation. Trends Microbiol. 19:40-48  
- Structural Biology of bacterial secretion systems

Ellis TN, Kuehn MJ. (2010) Virulence and immunomodulatory roles of bacterial outer membrane vesicles. Microbiol Mol Biol Rev. 74:81-94  
- Vesicle transport in bacteria and their role in virulence

Schmidt K, Stephens DJ. (2010) Cargo loading at the ER. Mol Membr Biol. 27:398-411  
- Vesicle transport and insertion of proteins in eukaryotes

This list may be subject to change if more up-to-date articles appear.

### Doelgroep

Students of all Master's programmes within Health and Life Sciences

## Caput Epigenetics

<b>Vakcode</b>	AM_470606 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Examinator</b>	dr. J.M. Kooter
<b>Niveau</b>	500

### Doel vak

Course objectives:

At the end of the course, the student:

- is able to describe in detail the structure and composition of Chromatin, the post-translational modifications of chromatin proteins, where these modified proteins can be found in chromosomes, and how they are somatically inherited
- is able to indicate the enzymes responsible for the modifications and how they are regulated and targeted to specific genomic regions
- can recognize the dynamic nature of chromatin and epigenetic protein modifications, and is able to identify the 'readers' of the modifications and their consequences
- can describe the biochemical mechanisms of transcriptional regulation, including the process of transcription initiation, elongation and termination
- can describe the various DNA modifications, their biochemistry, and impact on genome maintenance and gene expression in somatic tissues, including brain
- can describe the epigenetic reprogramming events during mammalian embryonic development, parental imprinting, and biological consequences
- recognize cases of genetic - and epigenetic inheritance, and transgenerational inheritance

- can indicate and explain the molecular causes of human diseases, including cancer, that are due to aberrant epigenetic features and defective epigenetic mechanisms
- is able to identify phenomena that are due to environmentally-induced changes in epigenetic genome properties
- can explain the link between nutrition and epigenetic modifications
- can apply currently used experimental approaches and techniques to study epigenetics and is able to interpret the results

### **Inhoud vak**

The following topics are discussed:

- Non-Mendelian inheritance of traits
- Biochemistry of DNA methylation and de-methylation
- Composition of chromatin and chromatin remodeling
- Biochemistry of histone modifications and chromatin structure
- Somatic and gametic cell inheritance of epigenetic information
- Cellular memory and chromatin modifications by the polycomb-group proteins
- Role of DM&CM in gene expression and genome maintenance
- Role of epigenetics in cancer and other diseases
- Role of DM&CM in sex-chromosome inactivation and activation
- Parental imprinting and gene dosage compensation
- Epigenetic reprogramming events during mammalian development
- Stem cells and reprogramming
- Functions of non-coding RNAs / RNA interference in DM&CS
- Neurobiology and epigenetics
- Epigenetic effects of diet, nutrition, drugs and environmental 'factors', including toxicants and behavior
- Transgenerational effects: inheritance of epigenetic-based traits
- Does epigenetics play a role in evolution?
- Methods that are currently used to analyze DM&CM

### **Onderwijsvorm**

- No regular lectures, mostly self-study
- Studying recent review and research articles (ca 120 hr)
- Weblectures by experts (ca 10 hr)
- Discussion meetings (1-2 per week) in which the topics of the research and review articles are discussed (ca 10 hr)

### **Toetsvorm**

Written exam of open-ended questions

### **Literatuur**

- Basics: Molecular Biology of the Cell by Alberts et al., sixth edition: Chapters on DM&CM and transcriptional control of gene expression
- Recent Review and Research articles, which will be provided via Blackboard.

### **Vereiste voorkennis**

Bachelor level Biochemistry, Molecular Genetics and Molecular Biology

### **Doelgroep**

Master students: Biomolecular Sciences, Biology, Biomedical Sciences, Medical Natural Sciences, Pharmaceutical Sciences and Oncology

### **Intekenprocedure**



Email to Coordinator: [j.m.kooter@vu.nl](mailto:j.m.kooter@vu.nl)

### Overige informatie

In exceptional cases, it is possible to develop a more 'personalized' program, depending on previous courses and the knowledge of epigenetics.

Lecturer:

dr. Jan M. Kooter

## Caput Molecular Biotechnology

<b>Vakcode</b>	AM_470604 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. S. Luirink
<b>Examinator</b>	dr. S. Luirink
<b>Niveau</b>	500

### Doel vak

The aim of this theoretical course is to get insight in the principles, methods, and applications of recombinant DNA technology with respect to the broad field of medical and industrial biotechnology. To this end the students study a book.

Final attainment levels: To know and to understand the fundamental principles of modern molecular biotechnology as well as the most recent developments in that area of science. To know and to understand the newest molecular techniques and biotechnological applications of microbial and viral systems. To know and to understand the most recent biotech developments, techniques and applications in eukaryotic systems including plants, animals and humans.

### Inhoud vak

The development of molecular biotechnology; DNA, RNA, and protein synthesis; Recombinant DNA technology; Chemical synthesis, sequencing, and amplification of DNA; Bioinformatics, genomics and proteomics; Manipulation of gene expression in prokaryotes; Recombinant protein production in eukaryotic cells; Directed mutagenesis and protein engineering; Molecular diagnostics; Microbial production of therapeutic agents; Vaccines; Synthesis of commercial products by recombinant microorganisms; Bioremediation and biomass utilization; Plant-growth-promoting bacteria; Microbial insecticides; Large-scale production of proteins from recombinant microorganisms; Genetic engineering of plants: methodology; Genetic engineering of plants: applications; Transgenic animals; Regulating the use of biotechnology; Societal issues in biotechnology

### Onderwijsvorm

Initial contact with the lecturer, introduction into the book and self study. Possibly additional contact with the lecturer if required.

**Toetsvorm**

An oral exam. The candidate can indicate when he/she is ready for the exam and then an oral exam will be scheduled.

**Literatuur**

Molecular Biotechnology; principles and applications of recombinant DNA; Bernhard R. Glick and Jack J. Pasternak. ASM Press, Washington D.C. last version (4th). VU book store or library.

**Vereiste voorkennis**

A bachelor degree in biology, medical biology, biomedical sciences or biochemistry. Basic (bachelor) knowledge of cell biology, microbiology, molecular biology and molecular genetics is required.

**Doelgroep**

Masterstudents Biomolecular Sciences

**Intekenprocedure**

e-mail

**Overige informatie**

Lecturer:

S. Luirink

E-mail: [s.luirink@vu.nl](mailto:s.luirink@vu.nl)

## Caput Protein Structure as Molecular Basis of Disease

<b>Vakcode</b>	AM_470120 ()
<b>Periode</b>	Periode 5+6
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. D. Bald
<b>Examinator</b>	dr. D. Bald
<b>Niveau</b>	500

**Doel vak**

Overview of recent advances in research of molecular disease based on protein structure;

Final attainment level:

The student has insight into the relation between protein structure/ (mal-) function;

The student has insight into the relation protein (mal)- function/disease.

The student can screen and evaluate scientific literature and present a structured review of recent advances in a relevant field/topic.

**Inhoud vak**

Suggested topics are:

- Antibiotic action
- Antibiotic Resistance

- Cancer/p53
- Anti-Influenza drugs
- Tuberculosis drug targets
- Anti-aids drugs

Feel free to suggest other topics related to protein structure/function, please ask the lecturer for more information.

### Onderwijsvorm

You receive several original publications on a recent topic in protein structure/disease (see above) from the lecturer. You study these papers and collect more information (data-base search etc.) about research in the field. Finally you can either write up your results in a review-style paper or give an oral presentation.

### Toetsvorm

Oral or written presentation (choice)

### Literatuur

Literature depends on the topic chosen by the student. Literature search in self-study.

### Doelgroep

Masters students Biomolecular Sciences, Biomedical Sciences, Biology, Pharmaceutical Sciences, Medical Natural Sciences

### Intekenprocedure

Send email to Caput coordinator concerning further information and registration

### Overige informatie

This caput can be done in the period from April to June.

## Caput Structural Biology

<b>Vakcode</b>	AM_470607 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. ir. Y.J.M. Bollen
<b>Examinator</b>	dr. ir. Y.J.M. Bollen
<b>Niveau</b>	500

### Doel vak

To obtain knowledge about a topic in the field of protein structure and protein dynamics that currently attracts a lot of attention. To learn how to present and discuss scientific research.

### Inhoud vak

One of the following topics:

- Adaptation of microorganisms to extreme environments
- Prion proteins
- Fluorescent proteins

**Onderwijsvorm**

Self study, contact with lecturer is possible following an appointment

**Toetsvorm**

Oral discussion with the lecturer

**Literatuur**

A number of recent scientific papers will be provided

**Vereiste voorkennis**

See entry requirements for the specified MSc programs.

**Doelgroep**

MSc students "Biology", "Biomolecular Sciences" and "Biomedical Sciences"

**Overige informatie**

The oral discussion with the lecturer can be done in English or in Dutch.

## Cell Structures and Functions

<b>Vakcode</b>	AM_470615 ()
<b>Periode</b>	Periode 2
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. S. Luirink
<b>Examinator</b>	dr. S. Luirink
<b>Docent(en)</b>	dr. S. Luirink
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	500

**Doel vak**

The first aim of the course is to refresh and deepen the knowledge of the students in a number of selected topics of Molecular Cell Biology. These topics include the folding, modification and sorting of proteins in cells. How do proteins fold in their correct and active three-dimensional structure? How do proteins reach their correct destination in the cell (organelles, plasma membrane)? How do proteins insert and assemble in membranes, how are they translocated across membranes? How are these processes related to disease and drug development? The students will gain insight in the most recent research data and theories. Also, the students will get information on state-of-the-art methods and techniques used in this field such as fractionation of cells, determination of protein structure, proteomics, molecular interaction/crosslinking techniques and visualization of cells and cell components.

Of note, the objective is not to obtain a comprehensive overview of cell biology. After the general "refreshment" and technical part (first week), a few selected topics will be discussed in depth with guest lecturers based on primary research papers (second and third week). Related to this, the second and most important aim of the course is to learn how to read, appreciate and discuss reviews and primary research papers on various

topics.

Final attainment levels:

- General knowledge of indicated topics relevant for the course at the level of the "big" "Molecular Biology of the Cell" (Alberts et al.)
- In depth knowledge on the selected topics provided by guest lecturers
- Ability to interpret and discuss newly acquired primary literature

### **Inhoud vak**

See "form of tuition".

### **Onderwijsvorm**

In the first part of the course (one week) students will study and discuss in working groups part III (methods) and part IV (internal organization of the cell) of the book: "Molecular Biology of the Cell" (Alberts et al.). Chapter by chapter the students will be guided through the book and questions will be answered. Excursions will be organized to labs specialized in specific techniques (10 contact hours).

In the second part of the course (about two weeks; 20 contact hours) specific topics (protein trafficking, protein insertion into membranes, membrane protein function, glycosylation and quality control) will be studied and discussed with lecturers from the VU and other universities. Each lecturer will present a seminar and discuss with the students very recent research papers and developments in his/her particular area of interest. The reviews and papers will be available via blackboard before the lectures.

The third part (last week) of the course will be used to study and to prepare for the exam. The exam will be in "open book" format. There will be appr. 6 essay questions about the papers presented by the lecturers and 2 questions about the relevant topics in Alberts and cell biology techniques (presented in week 1).

### **Toetsvorm**

A written exam with essay questions in which the Alberts book and print-outs of papers discussed by the lecturers can be used (open book exam) as well as a calculator.

### **Literatuur**

Chapters from Molecular Biology of the Cell (Alberts, Johnson, Lewis, Raff, Roberts, Walter) Fifth edition, Garland Sciences.

Research papers presented by the lecturers: links available via blackboard 1 month prior to the course.

### **Vereiste voorkennis**

A bachelor degree in biology, medical biology, biomedical sciences or biochemistry. Basic (bachelor) knowledge of cell biology, microbiology, molecular biology and molecular genetics is required.

### **Doelgroep**

Master students Biomolecular Sciences

### **Overige informatie**

Maximum number of participants: 50

E-mail: [s.luirink@vu.nl](mailto:s.luirink@vu.nl)

Guest lecturers (subject to reservation) Dr. B. Kleizen, Dr. X. de Haan and Dr. P.

van der Sluijs (UU), Prof. P. Peters (Universiteit Maastricht) and Prof.

## Chemical Biology

<b>Vakcode</b>	X_432538 (432538)
<b>Periode</b>	Periode 1
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	prof. dr. R. Leurs
<b>Examinator</b>	prof. dr. R. Leurs
<b>Docent(en)</b>	prof. dr. R. Leurs
<b>Lesmethode(n)</b>	Hoorcollege, Computerpracticum
<b>Niveau</b>	400

### Doel vak

To get students acquainted with modern chemical biology techniques to study proteins and the modulation of their function, with a specific emphasis on drug discovery

### Inhoud vak

In this course emphasis will be given on the interface between Chemistry and Biology. How can one understand biological processes using small molecules? How can one identify small molecules targeting new biochemical pathways, either by using modern biochemical or cellular assays or in silico using the wealth of new information from structural biology? How to detect and/or modulate DNA, RNA and protein expression and/or function with chemical probes? These are the questions that are central to this course.

### Onderwijsvorm

lectures, tutorial, consultancy sessions and case study/presentation

### Toetsvorm

Students will work in small groups on an integrated case study. Based on primary literature, background information from Comprehensive Medicinal Chemistry, interaction with "Protein Champions", students will work on a "Chemical Biology Protein Report" and oral presentation. Finally, there will be a written examination at the end of the course on the various topics presented in the course.

Final grades will be based on results of the case study (35%), case presentation and discussion (15%) and final exam (50%). Each part must at least be satisfactory (mark "6 out of 10" or higher).

### Literatuur

Selected book chapters from Comprehensive Medicinal Chemistry II, 2007, Elsevier, Editors-in-Chief: John B. Taylor and David J. Triggle (available at VU library as e-book) and primary literature.

### Vereiste voorkennis

Bachelor Pharmaceutical Sciences, Medical Natural Science, Science, Business and Innovation or Chemistry. Portal course MSc Biomolecular Science or Principles of Pharmaceutical Sciences, Signal Transduction in

Health and Disease, or equivalent for mBMS students and students with Bsc SBI or Chemistry.

With a BSc SBI or Chemistry, please contact prof. Leurs before registration on your eligibility to participate.

### Doelgroep

mBMS-BC, mCh-SBI (2nd year), mDDS-BCCA, mDDS-CMCT, mDDS-DD&S, mDDS-DDSA, mDDS-DDTF, mDDS-C-var, mDDS-E-var, mDDS-M-var, mPhys-SBI (2nd year)

### Intekenprocedure

Please register as soon as possible online.

### Overige informatie

Presence is obliged at predefined moments of the course (e.g. kick-off meeting, computer practical, presentation session, examination) for finishing the course successfully.

## Developmental Biology

<b>Vakcode</b>	AM_470613 ()
<b>Periode</b>	Periode 2
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	prof. dr. R.E. Koes
<b>Examinator</b>	prof. dr. R.E. Koes
<b>Docent(en)</b>	dr. R.F.G. Toonen, prof. dr. R.E. Koes
<b>Lesmethode(n)</b>	Hoorcollege, Werkcollege, Werkgroep, Deeltoets extra zaalcapaciteit
<b>Niveau</b>	500

### Doel vak

The development of a single cell, the fertilized egg cell, into a complex organism with all its tissue and organs in the right place is one of the most intriguing phenomena in biology. Whereas disciplines like molecular and cell biology aim to unravel the molecular mechanisms of a single cell, developmental biology aims to understand how such mechanisms make cells work together in a coherent way to form an entire organism. The overall aim of this course is to provide insight into these molecular mechanisms, such as the regulation of the expression of master genes and cell-to-cell signaling pathways underlying plant and animal development.

Final attainment levels:

- the student has a basic understanding of morphological events that take place during embryogenesis in animals
- the student can describe and distinguish key-concepts in development, such as (i) pattern formation (ii) determination of cell fate, (ii) differentiation and link that to general phenomena known in molecular biology, such as gene regulation, epigenetic phenomena, cell-signalling etc.
- The student can describe the (dis)similarities in the development of animals as different as fruitflies and vertebrates, in terms of morphological events and underlying molecular mechanisms.

- The student can explain the paradox that development of organisms with very different morphologies is governed by deeply conserved genes, and understands the molecular evidence for the current ideas.
- The student acquires experience in the critical analysis and discussion of experimental data as presented in research papers and the presentation of such data for a large(r) audience.

### **Inhoud vak**

The first two weeks will be shared with the MSc course Developmental Neurobiology of the Vertebrate Brain. The first week consists of lectures on general developmental biology. For the second week one of two

paths can be chosen: (1) Development of the brain or (2) Plant development. The first part of the course finishes with a written "mid term exam"

In the third and the fourth week the focus shift to specific "hot topics" and research. Three or four masterclasses will be given by invited speakers/researchers that will give an overview of their own research field and discuss their (recent) experimental results.

Furthermore, students (couples) will choose 2-3 recent research papers on a hot topic of their interest that they will study in depth to prepare for a small masterclass at the end of week 4 in which they outline the current status of the chosen subject, and present (and critically evaluate) the latest experimental data. Students can freely choose papers on plant or animal development. This ensures that everyone can follow his/her own preference for animal or plant biology and that, in the end, everyone gets a broad view on what is currently going on in (plant or animal) developmental biology.

Specific issues that we will address in the first two weeks are:

- General key-concepts in development, such as pattern formation, segmentation, determination of cell fate, with emphasis on the experimental evidence on which our current knowledge is based
- Research strategies that are widely used in developmental biology.
- Molecular mechanisms that govern the development of embryos in insects (*Drosophila*) and vertebrates
- Elementary aspects of stem cell biology and "reprogramming" of differentiated cells into stem cells
- Evolutionary aspects: how can it be that deeply conserved genes govern the development of organisms with entirely different bodyplans, like fruitflies and vertebrates, or weed plants and trees.
- Late events in embryogenesis, the formation of organs (organogenesis). This will be entirely focused on development of the brain (for students taking the path Brain development)
- Early (embryogenesis) and late events (development of flowers and leaves) in the development of plants. What are similarities and differences with the development of animals?

In the last two weeks we will focus in depth on research concerning particular "topics that are currently "hot" in developmental biology.

Subjects that will be covered by invited speakers are:

- Development and functioning of stem cells and stem cell niches in the intestine.
- Role of Hox genes in the segmentation and later development of vertebrates
- Molecular mechanisms that govern pattern formation in plants

Subjects that will be covered in the masterclasses given by student depends on the choices that are made during the course and are,



therefore, not entirely predictable beforehand. Some of the subjects that will almost certainly be covered are:

- Reprogramming of differentiated cells into stems cells and dangers/possibilities for use of such cells in therapy
- Intercellular movement of proteins like transcription factors, which were hitherto always believed to act only in the cells where they are synthesized

### Onderwijsvorm

Lectures and masterclasses (~ 58 hrs).  
Self study (~ 55 hrs)

### Toetsvorm

Written exam (50%)  
Oral presentations and (written) abstract (40%)  
Active participation to discussions during masterclasses (10%)

### Literatuur

There is no specific handbook. You might find it useful to consult, on occasion, a handbook (any) to refresh your memory on some basic cellular processes, like gene regulation, signaling and so on, if that is necessary.

Handouts, incl. PowerPoint files of lectures, pdf files of relevant review and research papers will be provided via the Blackboard site.

### Vereiste voorkennis

Basic knowledge (level 1/2) of molecular biology in particular mechanisms underlying regulation of gene expression, cell-signalling. General affection for molecular biology is recommended

### Doelgroep

Master students: Biomolecular Sciences, Biology, Biomedical Sciences

## Drug-induced Stress and Cellular Responses

<b>Vakcode</b>	X_432536 (432536)
<b>Periode</b>	Periode 2
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. J.N.M. Commandeur
<b>Examinator</b>	dr. J.N.M. Commandeur
<b>Docent(en)</b>	J.C. Vos, dr. J.N.M. Commandeur
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	500

### Doel vak

At the end of this theoretical course, the students are aware of the latest insights of cellular stress responses which can occur after exposure of cells to reactive drugs and/or reactive drug metabolites.

### Inhoud vak

Exposure of tissues to high levels of drugs and/or drug metabolites in some cases can trigger various biochemical responses. Interaction with sensor proteins can lead to adaptative stress responses which will

protect the cell against further damage. If these adaptative stress responses are insufficient, interaction with critical proteins may lead to cell death or exaggerated, fatal pharmacological responses. The following aspects will be studied in the course drug-induced stress and cellular signaling:

- (types of) adverse drug reactions
- role of biotransformation and drug transport in adverse drug reactions,
- reversible and irreversible interactions of toxic drugs with biological macromolecules,
- cellular adaptation to exposure to reactive intermediates and reactive oxygen species;
- cellular and molecular mechanisms leading to toxic effects,
- genetic toxicology and chemical carcinogenesis,
- role of mitochondria in necrosis and apoptosis,
- impairment of cell proliferation and tissue repair,
- immune-mediated toxicity.

### Onderwijsvorm

Lectures and self study.

### Toetsvorm

Written exam

### Literatuur

Boelsterli, Mechanistic Toxicology: The Molecular Basis of How Chemicals Disrupt Biological Targets 2nd ed, CRC Press, 2007 (ISBN 0849372720).

Recent literature will be provided

### Vereiste voorkennis

Bachelor Pharmaceutical Sciences, Biomedical Sciences , Medical Natural Sciences, Medical Biology or equivalent

### Doelgroep

Master students Drug Discovery and Safety and Biomolecular Sciences

### Intekenprocedure

Registration by VU-Net

## Dynamics of Biomolecules and Cells

<b>Vakcode</b>	X_422583 ()
<b>Periode</b>	Periode 4
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	prof. dr. J.T.M. Kennis
<b>Examinator</b>	prof. dr. J.T.M. Kennis
<b>Docent(en)</b>	prof. dr. J.T.M. Kennis
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	400

### Doel vak

Life is, by its very definition, a dynamic quantity. In this course an overview is given of dynamic processes that take place in biomolecules, membranes and cells in relation to biological functionality, and the biophysical methods that are applied to study them.

### Inhoud vak

The significance of small movements to large-scale and slow reorganizations are being discussed as well the experimental techniques employed.

- DNA processing and dynamics (techniques: optical tweezers, AFM, tethered particle motion, magnetic tweezers). DNA structure and stability, DNA/RNA polymerase, DNA architectural proteins, DNA repair.
- Protein dynamics (techniques: ultrafast spectroscopy, Infrared and Raman spectroscopy, single-molecule fluorescence). Photoactive proteins, light-driven enzymes, Motor proteins, optogenetics.
- Membrane dynamics and remodeling (techniques AFM, single molecule, electron microscopy). Photosynthesis, crowding and membrane protein diffusion, Neuroimaging.
- superresolution microscopy

### Onderwijsvorm

Lectures, guest lectures, literature essay, oral literature presentation

### Toetsvorm

- Essay (literature or research proposal)
- Oral literature presentation
- written Exam

### Literatuur

Notes, handouts and papers.

### Vereiste voorkennis

BSc. Physics, BSc. Medical Natural Sciences, BSc Chemistry or comparable

### Doelgroep

mMNS-PoL, mPhys-LSBP, mPhys-PLH

## Ethics in Life Sciences

<b>Vakcode</b>	AM_470707 ()
<b>Periode</b>	Periode 3
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	prof. dr. J.T. de Cock Buning
<b>Examinator</b>	prof. dr. J.T. de Cock Buning
<b>Docent(en)</b>	prof. dr. J.T. de Cock Buning, dr. J.F.H. Kupper, P. Klaassen MA
<b>Lesmethode(n)</b>	Hoorcollege, Werkgroep
<b>Niveau</b>	400

### **Doel vak**

To provide a toolbox of ethical instruments to analyze properly moral problems related (to one's own) research in the life sciences and beyond

- To acquire conceptual knowledge of the central concepts in applied philosophy and professional ethics
- To be able to execute an ethical reflection on issues related to one's own life science specialization and to open it for an impartial and constructive discussion
- To conduct, as a team based project, a moral dialogue
- To acquire the necessary skills to handle ethical issues in an accountable manner, as a professional academic beyond one's own inclinations and prejudgments
- To show a respectful and accountable attitude in dealing with group dynamics during the work groups and project.

### **Inhoud vak**

Researchers in life sciences generate the knowledge that builds the future of our society. Therefore, professional academics should be accountable for their decisions, experimental designs and presentation of results. In this short course, the principles of justification will be illustrated with cases of technology ethics and medical ethics. The way an ethical review committee on animal research works, is simulated by a role play exercise on an actual research protocol. Finally, as a group training project, an ethical dialogue is prepared and executed in confrontation with another team.

### **Onderwijsvorm**

Ethics in the Life Sciences is a fulltime course of four weeks (3 ECTS). The total study time is 80 hours.

The different elements have the following study time:

- Lectures: 13 hours
- Work groups: 17 hours
- Group assignment: 24 hours
- Exam: 2 hour
- Moral dialogue: 4 hours
- Self working (reading in the first week ): 20 hours

Please note that attendance to the work group meetings is compulsory. Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to apply the theory of the lectures in the assignments of the workgroups, and to pass the exam.

### **Toetsvorm**

- Degree of intellectual participation in the workgroups (10%)
- exam (50%)
- written and verbal execution of the ethical dialogue (40%)

All three elements have to be passed

### **Literatuur**

Available on Blackboard

### **Vereiste voorkennis**

Bsc Biology, Biomedical Sciences, Psychology with profile Biological Psychology or Neuropsychology

### **Doelgroep**

Compulsory course in all FALW Master programmes, except Health Sciences and Neuro Sciences

## Overige informatie

Lectures in English, Most of the work groups are in Dutch. Non Dutch speaking students will be placed in English work groups. All presentations and plenary discussions in English.

In order to maximize the experience of differences in values and preferences, and to increase meaningful ethical inquiry we will place you randomly in the workgroups. Placement will be communicated after the introduction lecture.

## Extreme Biology

<b>Vakcode</b>	AM_470509 ()
<b>Periode</b>	Periode 2
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. ir. A.H. de Boer
<b>Examinator</b>	dr. ir. A.H. de Boer
<b>Docent(en)</b>	dr. ir. A.H. de Boer, dr. D. Bald
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	500

### Doel vak

At the end of this course, the student will be able to describe and explain various aspects of adaptation to extreme environments:

- how cellular structures (e.g. membranes) and individual molecules (proteins/DNA) are affected by physical parameters like temperature, pH, salt, pressure and radiation.
- how nature has solved these problems: what are the general and condition-specific adaptations to extreme conditions,
- what are the limits for life, and its relevance to the development of life on Earth and other planets,
- how can we exploit knowledge on nature's extreme adaptations: what are its industrial, medical and societal applications
- how to write and present a research proposal on an extremophile topic of choice

### Inhoud vak

Extreme life is nearer to you than you may think; consider for instance your stomach with a pH of 2. First life on Earth evolved under extreme conditions, at high temperature and without oxygen. Also nowadays extreme conditions can easily develop, for example as the result of drought/salinization and permanent extreme environments are abundant, like the Artics and Antartics. Thus, organisms need to and often can adapt to extreme conditions. The biology of living under extreme environmental conditions (in short extreme biology) has increasingly attracted attention in recent years. Reasons for this interest are diverse: apart from scientific curiosity, understanding how life functions under extreme conditions contributes to a better understanding of evolution of life on earth, and the potential for life on other planets, it is of medical importance (cryobiology, sensor technology, enzyme technology), deals with major societal concerns (pollution, climate change) and leads to industrial applications (novel enzymes with new applications).

The key question in extreme biology is how extremophiles have adapted their enzymes/membranes/DNA structures etc. that serve the same function as those of 'normal' organisms, but operate under very different physical constraints. The course will focus on life forms (mainly microorganisms and plants and some examples from animal and human life) that have developed in environments that we do not experience as 'normal'. 'Normal' relates to environmental factors like temperature, water, oxygen, pressure, radiation, pH, salinity etc. Environments that are extreme with respect to these factors are e.g. hot springs, ice, deep sea, deserts, acidic/alkaline or saline waters or sites polluted by industry. The course will deal with:

- Identification and description of extreme environments, and the most important physical parameters that form a limitation for biological processes.
- Understanding why and how physical parameters affect specific biological processes.
- Describing strategies developed by extremophiles to protect membranes, protein structures and DNA.
- Examples of possible applications of extreme biology in science, industry, medicine, agriculture etc.
- You will apply this knowledge to write a research proposal on a subject of choice that relates to extreme biology.

### Onderwijsvorm

The course consists of lectures, workshops and presentations. Lecturers will present and discuss specific topics and recent reviews and research papers will be available for the students. Learning how to write your own research proposal will be an important part of the course. Each student will choose an extremophile topic of his/her choice and submit/defend a research proposal at the end of the course.

### Toetsvorm

Written exam with essay questions (50%), Journal Club presentations (10%) and Research Proposal (40%). Grades for all parts must be 5.5 or higher.

### Literatuur

Selected review and research articles.

### Vereiste voorkennis

Bsc Biology, Biomedical Sciences

### Doelgroep

Master students Biomolecular Science, Biology, Ecology and Biomedical Sciences with an interest in the extra-ordinary forms of life.

## Fundamentals of Bioinformatics

<b>Vakcode</b>	X_405052 (405052)
<b>Periode</b>	Periode 1
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. ir. K.A. Feenstra
<b>Examinator</b>	dr. ir. K.A. Feenstra
<b>Docent(en)</b>	dr. ir. K.A. Feenstra

<b>Lesmethode(n)</b>	Hoorcollege, Deeltoets extra zaalcapaciteit, Computerpracticum
<b>Niveau</b>	400

### Doel vak

Interested in Bioinformatics?

Or you want to find out how biology can make an exciting application domain?

Or you want to learn how what more you could do with your data, and with less effort? Enter here to start!

Fundamentals of Bioinformatics (FoB) is the starting course of the Bioinformatics master. It aims to give a broad overview of important topics relevant to the field, with a focus on current open problems. Students will be made aware of these open problems during practical sessions that aim to let the student 'stumble upon' these problems by themselves. Based on their background, students will be assigned to separate classes where they will be working to fill gaps in their background knowledge in programming and/or biology.

Goals:

- To make the students aware of gaps in their own background knowledge.
- The student will be aware of the major issues, methodology and available algorithms in bioinformatics.
- To work together in a group of diverse backgrounds.
- To gain hands-on experience in scripting and handling basic mathematical equations as a means of solving bioinformatics problems.
- To develop a basic understanding of major concepts in genomics and molecular cell biology that are relevant to current topics in bioinformatics.

### Inhoud vak

Theory:

- Evolution, Genomes, Sequences, Blast/PSI-Blast, Semantic Web, Multi-omics, Next-generation Sequencing

Practical:

- Exercises during/in between lectures
- Project in groups to solve a major bioinformatics problem. The groups will be composed to include each of the three major background areas: bioinformatics, biology and computer science. Success of the group project will depend on the level of cooperation!

### Onderwijsvorm

- 12 Lectures (two hour lecture in the morning, two days per week)
- 12 Computer practicals (two hour sessions following the morning lectures, two days per week), partially supervised.
- Project work

### Toetsvorm

- [30%] Programming or Biology classes
- [30%] Project and group work
- [40%] Oral or written exam (depending on number of course students) to assess:

Exercises

Project results (individual)

Lecture topics

## Literatuur

- course material (slides, scientific papers) on bb.vu.nl
- Marketa Zvelebil and Jeremy O. Baum Understanding Bioinformatics Garland Science 2008 ISBN-10: 0-8153-4024-9

## Aanbevolen voorkennis

Bachelor in any science discipline (including medicine), or strong programming background.

An interest in algorithmic approaches to biological problems.

## Doelgroep

mAI, mBio, mCS, mMNS

## Genomes and Gene Expression

<b>Vakcode</b>	AM_470614 ()
<b>Periode</b>	Periode 1
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Examinator</b>	dr. J.M. Kooter
<b>Docent(en)</b>	dr. J.M. Kooter
<b>Lesmethode(n)</b>	Hoorcollege, Werkgroep, Deeltoets extra zaalcapaciteit
<b>Niveau</b>	400

## Doel vak

Course objectives:

The student should be able, at the molecular level, to

- describe the composition of eukaryotic and prokaryotic genomes and identify and indicate the function of the different sequences
- explain and dissect the process of transcription initiation, - elongation and - termination, and how these processes are regulated, mainly in eukaryotes
- describe in detail the structure and composition of chromatin, the post-translational modifications of histone proteins, the enzymatic machinery involved and their control
- distinguish between general and the various types of specific transcription factors, and explain their collaboration to induce or repress gene expression
- describe the various forms of DNA modification, their biochemistry, and impact on genome maintenance and gene expression in various somatic tissues
- describe the epigenetic reprogramming during mammalian embryonic development, parental imprinting, and differentiation
- explain how non-protein encoding RNAs can affect gene expression
- explain the various types of RNA processing and post-transcriptional regulation of gene expression and design experiments to study these processes
- apply currently-used experimental approaches and techniques to perform gene specific and genome-wide expression studies

## Inhoud vak



To achieve the course objectives, the following topics will be discussed:

- Genome structure, Transcriptional regulation and Epigenetic mechanisms:
- Genome organization: coding versus non-coding sequences
- Composition and biochemistry of basic transcription machinery
- General and specific transcriptional regulators and their regulation
- Transcription initiation, elongation and termination
- Identification and function of regulatory sequences: promoters, enhancers, suppressors, boundaries
- Epigenetics: Chromatin structure and histone modifications: writers-readers-erasers
- Epigenetics: DNA modifications (e.g. methylation) and their biochemical properties
- Epigenetic reprogramming during mammalian development
- Monoallelic gene expression and its importance for embryonic development and other biological processes
- 3D Nuclear structure and long range DNA interactions
- Transcriptional regulation and chromatin changes in stem cells, during differentiation, and development
- Cellular memory: establishing and maintenance of differentiation status
- Regulatory networks: the various ways by which regulators themselves are regulated
- Short and long non-coding RNAs and the mechanism by which they affect gene expression
- Experimental approaches and Techniques to study gene expression, differentiation and homeostasis

Post-transcriptional regulation

- integration of transcriptional and post-transcriptional control
- RNA processing, including alternative splicing, and its regulation
- Nucleo-cytoplasmic RNA transport
- RNA stability and degradation pathways
- RNA interference (siRNAs)
- Translation regulation and RNA degradation by micro(mi)RNAs
- RNA-editing and its biological importance
- Experimental approaches and Techniques to study post-transcriptional regulation of gene expression

### **Onderwijsvorm**

- Lectures and interactive meetings, including lectures by guest speakers who are working in a particular field of research that is discussed in the course (ca 45 hr).
- Weblectures by experts (ca 5 hr)
- Self study (ca 100 hr)

### **Toetsvorm**

There are 2 sub-exams:

- First exam is half way the course and consists of Multiple Choice question and accounts for 40% of the final mark
- Second exam is at the end of the course and consists of open questions and accounts for 60% of the final mark. For the second exam, knowledge of the first part is needed. Resit of a sub-exam is not allowed.

### **Literatuur**

- Book: 'Gene Control' 2nd edition, by David Latchman, Garland Science
- Research and Review articles on specific topics, illustrating the latest developments in the field (from Blackboard site)

- PPT - lecture notes

### Vereiste voorkennis

Basic concepts in Molecular Biology, Genetics, and Biochemistry

### Doelgroep

Master students: Biomolecular Sciences, Biology, Biomedical Sciences, Pharmaceutical Sciences, Oncology, and Medical Natural Sciences.

### Intekenprocedure

Enrollment through studentportal: Vunet.vu.nl

### Overige informatie

Compulsory portal course for MSc students Biomolecular Sciences, all differentiations.

## Internship I Biological Chemistry

<b>Vakcode</b>	AM_471129 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	30.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Examinator</b>	dr. H.S. van Walraven
<b>Niveau</b>	600

## Internship I Molecular Cell Biology

<b>Vakcode</b>	AM_471127 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	30.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Examinator</b>	dr. H.S. van Walraven
<b>Niveau</b>	600

## Internship II Biological Chemistry

<b>Vakcode</b>	AM_471130 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	30.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Examinator</b>	dr. H.S. van Walraven
<b>Niveau</b>	600

## Internship II Molecular Cell Biology

<b>Vakcode</b>	AM_471128 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	30.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Niveau</b>	600

## Introduction to Systems Biology

<b>Vakcode</b>	X_428565 ()
<b>Periode</b>	Periode 1
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. D. Molenaar
<b>Examinator</b>	dr. D. Molenaar
<b>Docent(en)</b>	prof. dr. B. Teusink, dr. D. Molenaar, prof. dr. F.J. Bruggeman
<b>Lesmethode(n)</b>	Hoorcollege, Werkgroep, Werkcollege
<b>Niveau</b>	400

### Doel vak

Introduction to Systems Biology is the starting course of the Bioinformatics and Systems Biology master (together with Fundamentals of Bioinformatics).

### Topics:

- The two branches of systems biology
- Data structure, geometrical mapping, PCA, distance metrics, clustering
- Cellular composition, diffusion, time scales, rates
- Mass-action, mass balances, reactions, equilibria, stable/unstable steady states equilibrium binding, affinity, conformational change, ultrasensitivity, transduction cascades, autoregulation, mutual inhibition/activation, bistability, feed-forward loops, steady state metabolism, regulation of metabolism and regulation by demand

Depending on their background, students will also be assigned to deficiency classes where they will be working to fill gaps in their background knowledge in mathematics, programming and/or biology.

### Goals:

- To repair gaps in background knowledge.
- To make the student acquainted with the major approaches and methodology in systems biology (to be studied in more detail in the master)
- To develop a basic understanding of biological concepts in genomics and cell biology that are relevant to current topics in systems

biology

- To work together in a group of diverse backgrounds
- To gain hands-on experience in basic modelling as a means of solving systems biology problems

### Inhoud vak

Theory:

- Design principles of biological networks, basic modeling approaches, evolution

Practical:

- Exercises during/in between lectures in which methods of systems biology will be applied to several topics.

### Onderwijsvorm

- Lectures (two hour lecture in the morning, two days per week)
- Computer- and modelling practicals
- Deficiency classes in biology, mathematics and/or programming

### Toetsvorm

- 30% Mathematics, Programming or Biology deficiency classes
- 60% Final exam of the Systems Biology subjects

### Literatuur

A course syllabus will be provided

### Aanbevolen voorkennis

Mathematics at highschool level

### Doelgroep

Students with a bachelor degree in Biology, Bioinformatics, Mathematics, Physics or similar background

## Microbial Genomics

<b>Vakcode</b>	AM_1021 ()
<b>Periode</b>	Periode 3
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	prof. dr. R. Kort
<b>Examinator</b>	prof. dr. R. Kort
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	500

### Doel vak

1. After the lecture series the students obtained insight in:

- The historical development of microbiological sciences
- Techniques to explore the human microbiome
- Human – Microbe interactions in Health and Disease
- Metabolic strategies of microorganisms
- Interventions with probiotics, prebiotics and synbiotics

2. Students have gained experience on thinking and writing about the impact of microbes on either our environment, human health, or

industrial applications.

### **Inhoud vak**

During 10 lectures, the enormous diversity of microbial life will become evident. The lectures will include a number of ways to explore microbial life forms associated with our body, in particular related to health and disease. Applications of our knowledge on the human microbiota for diagnostics, prognostics and interventions will be discussed.

10 lectures (obligatory) including a 4-5 p. perspective

### **Onderwijsvorm**

10 lectures (obligatory) including a 4-5 p. perspective

### **Toetsvorm**

Each student will write a perspective (approximately 4-5 pages) for of one of the 10 lectures; the abstract will contain a 1 page summary of the lecture, and 3 pages on the relevance of the microbiological topic for society (with particular emphasis on human health). The selected lecture will be announced after the final lecture.

### **Literatuur**

Selected papers:

Kort R, Caspers M, van de Graaf A, van Egmond W, Keijsers B, Roeselers G. Shaping the oral microbiota through intimate kissing. *Microbiome*. 2014 Nov;17;2:41.

Budding AE, Grasman ME, Lin F, Bogaards JA, Soeltan-Kaersenhout DJ, Vandembroucke-Grauls CM, van Bodegraven AA, Savelkoul PH. IS-pro: high-throughput molecular fingerprinting of the intestinal microbiota. *FASEB J*. 2010 Nov;24(11):4556-64

Borgdorff H, Tsvitshivadze E, Verhelst R, Marzorati M, Jurriaans S, Ndayisaba GF, Schuren FH, van de Wijgert JH. Lactobacillus-dominated cervicovaginal microbiota associated with reduced HIV/STI prevalence and genital HIV viral load in African women. *ISME J*. 2014 Sep;8(9):1781-93.

Dutilh BE. Metagenomic ventures into outer sequence space. *Bacteriophage*. 2014 Dec 15;4(4):e979664.

Belzer C, Gerber GK, Roeselers G, Delaney M, DuBois A, Liu Q, Belavusava V, Yeliseyev V, Houseman A, Onderdonk A, Cavanaugh C, Bry L. Dynamics of the microbiota in response to host infection. *PLoS One*. 2014 Jul 11;9(7):e95534.

### **Vereiste voorkennis**

Molecular Biology

### **Aanbevolen voorkennis**

### Doelgroep

MSc Students BioMolecular Sciences

### Overige informatie

Venue: Artis de Volharding

<http://www.artis.nl/ontdek-artis/artis-a-z/monumenten-z/de-volharding/>

Announcement of lecture series:

<http://www.micropia.nl/nl/ontdek/verdiep-je-in-de-microbiologie/the-huma>

Lecture topics and speakers:

Microbiome in Health and Disease

Monday Jan 4 (10.00 – 12.00 u)

Prof. Remco Kort (TNO, VUA). Introduction into the human microbiome.

<https://www.linkedin.com/pub/remco-kort/14/547/403>

Dries Budding, MD (VUMC). Man and Microbe: a delicate superorganism

<https://www.linkedin.com/pub/dries-budding/5/956/78>

Tuesday Jan 5 (10.00 u – 12.00 u)

Dr. Douwe Molenaar (VUA). Dealing with big data of the microbiota.

[http://www.ibi.vu.nl/sysbio/doku.php/people/douwe\\_molenaar](http://www.ibi.vu.nl/sysbio/doku.php/people/douwe_molenaar)

Dr. Evgeni Levin-Tsivtsivadze (TNO). Microbial ecology in health and disease: a machine learning approach.

<http://www.learning-machines.com/>

Friday Jan 8 (10.00 u – 12.00 u)

Dr. Bas Dutilh (UU). Metagenomic ventures into outer sequence space.

<https://www.linkedin.com/in/dutilh>

Dr. Guus Roeselers (TNO). Microbial ecology of the gastro-intestinal tract.

<https://www.linkedin.com/in/roeselers>

Monday Jan 11 (10.00 – 12.00)

Prof. Eddy Smid (WUR). The best foods are made by microbes.

<https://www.linkedin.com/pub/eddy-j-smid/9/338/9a8>

Prof Wilbert Bitter (VUMC) Die hard with a vengeance, strategy of mycobacterial pathogens.

<http://www.aimms.vu.nl/en/people/b/bitter.aspx>

Tuesday Jan 12 (10.00 – 12.00)

Prof. Janneke van de Wijkert (University of Liverpool, Institute of Infection and Global Health). Microbial ecology of bacterial vaginosis.

<https://www.linkedin.com/pub/janneke-van-de-wijkert/7/195/2a0>

Prof. Gregor Reid (Canadian Centre for Human Microbiome and Probiotic Research, Lawson Health Research Institute). Fermented milk as a delivery vehicle for probiotics in Africa.

## Molecular Infection Biology

<b>Vakcode</b>	AM_470657 ()
<b>Periode</b>	Periode 2
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen

<b>Coördinator</b>	prof. dr. W. Bitter
<b>Examinator</b>	prof. dr. W. Bitter
<b>Docent(en)</b>	prof. dr. W. Bitter
<b>Lesmethode(n)</b>	Hoorcollege, Practicum
<b>Niveau</b>	600

### **Doel vak**

To understand how the interaction of a pathogen with its host is studied (in vitro studies, use of alternative in vivo models, different approaches of mutant screening)

To understand the variation within microbial pathogens and the effect this variation has on host adaptation.

To understand what virulence factors are and how they are regulated by the pathogen.

To apply the acquired knowledge to interpret scientific literature and scientific hypotheses regarding pathogen-host interactions.

### **Inhoud vak**

The recent explosion in genomic data of both microbes and eukaryotic hosts and the continuous progress in molecular biology allows a detailed analysis of the molecular interactions between a pathogen and its host. This knowledge is necessary because we are continuously exposed to new emerging pathogens and the resurgence of old plagues and need new vaccines and anti-microbial compounds. However, which technique should and could be used for a specific problem and how to interpret conflicting outcomes using different experimental strategies? This course aims to provide a thorough understanding and practical experience of molecular biology as it applies to infectious agents. The course covers the application of molecular biology to studying the basic biology of pathogenic bacteria and viruses (their virulence factors, taxonomy and genetic typing) and the genetic susceptibility of the host to infection. It aims to equip students with the specialised knowledge and skills necessary to assess primary literature on medical microbiology.

### **Onderwijsvorm**

The course has three different parts: lectures, practicum and workshop. In the latter part students will discuss with each other opposing views on controversial topics in medical microbiology that recently appeared in the literature.

contact hours:

lectures: 18

Literature Workshop: 17

Practicum: 30-40

### **Toetsvorm**

written exam (50% of final mark and should be minimally 5,5)

literature discussion (workshop, 30% of final mark)

practicum (20% of final mark)

### **Literatuur**

Reader will be available one week before the start of the course.

### **Vereiste voorkennis**

Bachelor's course 'Infectieziekten' and 'Immunologie' or an equivalent course in Microbiology and Molecular Biology with practical skills of

handling microorganisms safely

### Doelgroep

Students with a keen interest to study the interaction between a pathogen and its host, from a practical as well as a theoretical point of view

### Overige informatie

Guest lectures:

Dr. Peter van der Ley, RIVM Bilthoven, molecular techniques used for vaccine development

Dr. Lia van der Hoek, AMC Amsterdam, identification of novel viral pathogens

## Molecular Pharmacology

<b>Vakcode</b>	X_432541 (432541)
<b>Periode</b>	Periode 4
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. M.H. Siderius
<b>Examinator</b>	dr. M.H. Siderius
<b>Docent(en)</b>	dr. M.H. Siderius
<b>Lesmethode(n)</b>	Hoorcollege, Practicum
<b>Niveau</b>	400

### Doel vak

This course aims to teach the BMS students the basic laboratory techniques in Molecular Pharmacology. This course is suited only for students without prior experience.

### Inhoud vak

Practical course aimed to train BMS Masterstudents with deficiencies in Mol. Pharmacology techniques (Receptor-Ligand binding studies, ELISA, BRET, Mammalian cell transfections, Reporter gene assays)

### Onderwijsvorm

Practical course

### Toetsvorm

Report

### Vereiste voorkennis

Participation in BMS Portal courses is required.

### Intekenprocedure

Registration via VuNet

## Molecular photobiology

<b>Vakcode</b>	X_432763 ()
<b>Periode</b>	Periode 4
<b>Credits</b>	3.0



<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	prof. dr. R. Croce
<b>Examinator</b>	prof. dr. R. Croce
<b>Docent(en)</b>	prof. dr. R. Croce
<b>Lesmethode(n)</b>	Hoorcollege, Practicum
<b>Niveau</b>	400

### Doel vak

To introduce students to multidisciplinary research in molecular photobiology, integrating a set of different techniques of molecular biology, biochemistry and biophysics.

Students should be able to:

- plan and conduct experiments using different techniques
- Perform a research program
- evaluate the results on the basis of theoretical knowledge and literature
- present (and critically discuss) the results in the form of a journal article

### Inhoud vak

During this course the students will perform a research program focused on the study of photoactive proteins involved in the photosynthetic process. Pigment-proteins will be purified from plants or overexpressed in *E. coli* and reconstituted in vitro. A series of mutants will also be prepared/analyzed. The pigment-proteins complexes will be studied with a large set of biochemical and spectroscopic techniques (both steady-state and time-resolved). The data will be analyzed in detail and the results of the different experiments integrated to obtain information about the properties of the complexes and the effect of specific mutations.

### Onderwijsvorm

Laboratory work Lectures Tutorials

### Toetsvorm

Lab work (50%), written report (30%) and oral discussion of the results (20%).

### Literatuur

Course Manual. Literature and study material will be provided by the teacher before the start of the course.

### Doelgroep

Master students in biomolecular sciences

### Overige informatie

The course is very intense with at least 7 days full time in the lab (9-17).

## Project Computational Design and Synthesis of Drugs

<b>Vakcode</b>	X_432734 ()
<b>Periode</b>	Periode 4
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels

<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. C. de Graaf
<b>Examinator</b>	dr. C. de Graaf
<b>Docent(en)</b>	dr. M. Wijtmans, dr. C. de Graaf, dr. D.P. Geerke
<b>Lesmethode(n)</b>	Hoorcollege, Practicum
<b>Niveau</b>	400

### Doel vak

To gain insight and experience in the molecular modeling tools that enable (rational) drug design and to examine and plan efficient routes to synthesize conceived ligands.

### Inhoud vak

In the post-genome era, an overwhelming amount of data describing the molecular characteristics of the targets is becoming available. For example, the structure of many proteins is being determined using X-Ray analysis and NMR techniques. Furthermore, high-throughput screening results in massive amounts of data that reveal the molecular properties of the ligands that are able to have interaction with the drug targets. In this project, several techniques that can help to translate this data into novel ligands will be discussed and applied. Specific topics include crystal structure analysis, the building of homology models, docking of ligands, calculating binding free energy and affinity of ligands for the protein, de novo structure generation, and pharmacophore modeling. These techniques generate ideas for novel compounds. Because a design that cannot be synthesized is by definition a useless design, the synthetic feasibility is a key and integral part of the design process. Therefore, it is important to be able to define a synthetic pathway for the preparation of the designed compounds. In this project, this aspect will be covered by lectures on the concept of retrosynthesis and on the incorporation of some biologically relevant moieties, such as heteroaromatic scaffolds and known affinity-increasers. An online retrosynthetic demonstration with a search engine sets the stage for a case study. For a specific design, a versatile and robust synthesis route has to be defined. A thorough literature search, in combination with detailed study of the reactions involved will result in a report that describes the suggested chemistry in detail.

### Onderwijsvorm

Project basis: including lectures, tutorials, self study, assignments and group-work on a case-study.

Teachers: Dr. C. de Graaf, Dr. M. Wijtmans, Dr. D.P. Geerke, Prof. Dr. De Esch.

### Toetsvorm

Written exam (50%), case study report (50%). Both the exam and the case study report should be passed.

### Literatuur

Two eBooks contain several chapters of literature. These two books are:

Mason: Volume 4 of Comprehensive Medicinal Chemistry II: Computer-Assisted Drug Design (Mason (Ed.).

<http://www.sciencedirect.com/science/referenceworks/9780080450445>

Hoffmann: Elements of Synthesis Planning (Hoffmann (Ed))  
<http://www.springerlink.com/content/j81646>

These books are accessible through UBVU at all VU computers. The same holds true for articles and the Reaxys search engine (vide infra). When at home, turn on the VU-proxy (<http://www.ub.vu.nl/nl/faciliteiten/thuis-werken/index.asp>) and accessibility to all these items is maintained.

The following book (Clayden) is not an eBook accessible through UBVU, but it contains useful background literature on organic chemistry. All students that received their FAR BSc degree at the VU possess this book. It is suggested by us that such students could consider lending this book to others if necessary.

Clayden: Clayden, Organic Chemistry, Oxford University Press, 2001.

In the remainder of the guide, a distinction is made between integral literature and background literature.

Integral literature represents literature that is considered integral to the topic and hence is exam material.

Background literature either constitutes material for certain assignments or offers a wider or alternative discussion of the topic that an interested student can read at his/her own leisure. Background literature is not exam material.

#### **Vereiste voorkennis**

Knowledge of basic organic chemistry.

#### **Doelgroep**

mDDS-BCCA, mDDS-CMCT, mDDS-DD&S, mDDS-DDSA, mDDS-DDTF, mDDS-C-var, mDDS-E-var, mDDS-M-var

## Protein Science

<b>Vakcode</b>	AM_470145 ()
<b>Periode</b>	Periode 1
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. D. Bald
<b>Examinator</b>	dr. D. Bald
<b>Docent(en)</b>	dr. M.H. Siderius, dr. J.N.M. Commandeur, dr. D. Bald, dr. ir. K.A. Feenstra, prof. dr. M.J. Smit, dr. D.P. Geerke, prof. dr. ir. E.J.G. Peterman
<b>Lesmethode(n)</b>	Hoorcollege, Werkgroep
<b>Niveau</b>	400

#### **Doel vak**

The student:

1. knows and understands principles of protein structure, dynamics, regulation, inhibition, interaction and engineering
2. can explain protein function based on protein structure and the properties of amino acid residues.
3. can predict the function of (parts of ) a protein based on understanding of its molecular properties

4. knows and understands the principle of current methods for protein investigation (e.g. overproduction, purification, interaction, engineering)
5. can analyze the strong and weak points of Protein Science techniques and can correlate an open question with a suitable technique.
6. can analyze experiments in Protein Science and design new experiments.

### **Inhoud vak**

We will start with a repetition of protein structure and function. Subsequently, we will focus on methods in protein science and also on more specialized properties of proteins important in fundamental research, biomedicine or biotechnology. Finally we will deal with case studies on selected proteins.

Lecture topics include:

Protein Structure, Protein Function, Protein Dynamics, Molecular Machines, Control of Protein Function, Protein inhibition, Antibiotic action, Development of antibiotics and antibiotic resistance, Protein over-expression and purification, Protein Interaction, Protein Engineering,

Molecular Modeling and docking

Case studies:

GPCRs as drug target, Cytochrome P450, Chaperones as Protein folding machines,

Molecular Modeling/docking.

### **Onderwijsvorm**

Lectures (30 h) accompanied by work (paper) discussions (6 h) and self study

(individual or in small groups) to prepare for the lectures and to discuss the material presented in lectures/accompanying papers.

### **Toetsvorm**

Written exam (100%)

### **Literatuur**

No special book required. Useful may be "Protein Structure and Function" by Petsko/Ringe. You can also use any Biochemistry textbook (e.g. Voet and Voet) for repetition. You will receive material (reviews and original articles on relevant topics). Examples of scientific literature: Lee et al. Nature 2010, Bax et al. Nature 2010, and Kumar Exp. Opin. Drug Metab 2010.

### **Doelgroep**

Masters students Biomolecular Sciences, Biomedical Sciences, Biology, Pharmaceutical Sciences and Medical Natural Sciences

### **Overige informatie**

Visiting lecturer: Dr. Anil Koul, Tibotec J&J

## **Scientific Writing in English (AM\_BMOL)**

<b>Vakcode</b>	AM_1156 ()
<b>Periode</b>	Periode 3+4
<b>Credits</b>	3.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen

<b>Coördinator</b>	M. van den Hoorn
<b>Examinator</b>	M. van den Hoorn
<b>Lesmethode(n)</b>	Werkgroep
<b>Niveau</b>	400

### Doel vak

The aim of this course is to provide Master's students with the essential linguistic know-how for writing a scientific article in English that is well organized, idiomatically and stylistically appropriate and grammatically correct.

At the end of the course students

- know how to structure a scientific article;
- know what the information elements are in parts of their scientific article;
- know how to produce clear and well-structured texts on complex subjects;
- know how to cite sources effectively;
- know how to write well-structured and coherent paragraphs;
- know how to construct effective sentences;
- know what collocations are and how to use them appropriately;
- know how to adopt the right style (formal style, cohesive style, conciseness, hedging)
- know how to avoid the pitfalls of English grammar;
- know how to use punctuation marks correctly;
- know what their own strengths and weaknesses are in writing;
- know how to give effective peer feedback.

Final texts may contain occasional spelling, grammatical or word choice errors, but these will not distract from the general effectiveness of the text.

### Inhoud vak

The course will start with a general introduction to scientific writing in English. Taking a top-down approach, we will then analyse the structure of a scientific article in more detail. As we examine each section of an article, we will peel back the layers and discover how paragraphs are structured, what tools are available to ensure coherence within and among paragraphs, how to write effective and grammatically correct sentences and how to choose words carefully and use them effectively.

Topics addressed during the course include the following:

- Structuring a scientific article
- Considering reading strategies: who is your readership? How do they read your text? What do they expect? How does that affect your writing?
- Writing well-structured and coherent paragraphs
- Composing effective sentences (sophisticated word order, information distribution).
- Arguing convincingly – avoiding logical fallacies
- Academic tone and style: hedging – why, how, where?
- Using the passive effectively
- Understanding grammar (tenses, word order, etc.)
- Understanding punctuation
- Referring to sources: summarising, paraphrasing, quoting (how and when?)
- Avoiding plagiarism
- Vocabulary development: using appropriate vocabulary and collocations

## Onderwijsvorm

Scientific Writing in English is an eight-week course and consists of 2 contact hours a week. Students are required to spend at least 6 to 8 hours of homework per week. They will work through a phased series of exercises that conclude with the requirement to write several text parts (Introduction, Methods or Results section, Discussion and Abstract). Feedback on the writing assignments is given by the course teacher and by peers.

## Toetsvorm

Students will receive the three course credits when they meet the following requirements:

Students hand in three writing assignments (Introduction, Methods, Discussion)

Students get a pass mark for all writing assignments;

Students provide elaborate peer feedback (Introduction, Methods, Discussion, Abstract);

Students attend at least 7 out of 8 sessions;

Students are well prepared for each session (i.e. do all homework assignments);

Students participate actively in class;

Students do not plagiarise or self-plagiarise.

Writing assignments:

1. If students have a BSc thesis in a traditional thesis form (e.g., 20+ pages) and written in English, they may use this for the writing assignments.
2. If students have a BSc thesis in a traditional form (e.g., 20+ pages) written in another language than English, they may use this for the writing assignments.
3. If students have written a paper or report in English that's not already in article form, they may use this for the writing assignment.
4. If students are working on their MSc thesis or internship report when taking Scientific Writing in English, they may use this for the writing assignments. They will have to notify their supervisor to make sure that they won't be accused of self-plagiarism.
5. If students cannot or do not wish to use any of the above-mentioned texts for the writing assignments (1-4), they are expected to do a limited Literature Review on a topic in their field of research, using at least 5 articles.

Students are not allowed to use the following texts for the writing assignments:

1. A BSc thesis written in English that's already in article form.
2. A MSc thesis written in English that's already in article form (and that has already been marked).
3. An internship report written in English that's already in article form (and that has already been marked).
4. A paper or report written in English that's already in article form.

## Literatuur

Effective Scientific Writing: An Advanced Learner's guide to Better English, 4th edition (February 2016) (A. Bolt & W. Bruins, ISBN 978 90 8659 617 1). VU bookstore: €27.95.

## Doelgroep

This course is only open to students of the two-year Master's programmes of the Faculty of Earth and Life Sciences. These students are only eligible to the course if they have already conducted scientific research (e.g. for their Bachelor's thesis) or if they will be working on a research project when taking Scientific Writing in English.

### Overige informatie

- To do well, students are expected to attend all lessons. Group schedules are to be found at [rooster.vu.nl](http://rooster.vu.nl) and on Blackboard.
- A VUnet registration for this course automatically gives access to the corresponding Blackboard site. Group registration only takes place via Blackboard (general groups: registration by students following FALW programmes offering this course; groups assigned to specific studies: registration through programme and course coordinator).
- Make sure Scientific Writing in English does not overlap with another course.
- If you have registered for a group in Blackboard, you are expected to attend all sessions (eight). If you decide to withdraw from the course, do so in time in VUnet. This will avoid a 'fail' on your grade list for not taking part in this course and allows other students to fill in a possible very wanted group spot.
- For specific Blackboard matters concerning this course, please contact [blackboard.beta@vu.nl](mailto:blackboard.beta@vu.nl).
- Full time students with their main registration at VU will be given preferential treatment for placement in this course. For secondary students proof of enrollment is not a guarantee of placement.

## Signal Transduction in Health and Disease

<b>Vakcode</b>	X_432535 (432535)
<b>Periode</b>	Periode 2
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	prof. dr. M.J. Smit
<b>Examinator</b>	prof. dr. M.J. Smit
<b>Docent(en)</b>	dr. ir. A.H. de Boer, dr. M.H. Siderius, prof. dr. M.J. Smit, prof. dr. ir. A.H. de Boer
<b>Lesmethode(n)</b>	Hoorcollege
<b>Niveau</b>	500

### Doel vak

At the end of this theoretical course, the students are aware of the latest insights of cellular signal transduction in both healthy and pathological conditions.

### Inhoud vak

This course will link human genetic variation (somatic and inherited mutations) to the development of disease and will focus on pathological signaling, mutant signaling proteins in disease and possible treatment of resulting disease (small compounds, biologicals, gene therapy). Modern pharmacological concepts, including constitutive receptor activity, receptor regulation, allosteric modulation and dimerization will be addressed in light of signal transduction in health and disease. A special focus will be on signal transduction resulting in pathologies

such as Alzheimer, Parkinson's disease, inflammatory diseases and cancer.

### Onderwijsvorm

Lectures, self-study.

Students will do a case study in groups on a signaling pathway linked to disease. Molecular mechanisms underlying pathology will be addressed and presented. Therapeutic targets within this signaling pathway will be proposed and discussed.

### Toetsvorm

Assignment and presentation, written exam.

### Literatuur

'Cell signaling', Authors: Wendell Lim, Bruce Mayer, Tony Pawson

ISBN: 9780815342441

Format: Paperback

Publication Date: June 15, 2014

Papers available on Blackboard

### Aanbevolen voorkennis

Bachelor Biology, Medical Biology, Pharmaceutical Sciences, Medical Natural Sciences, Biomolecular Science portal course or equivalent

### Doelgroep

mBMS-BC, mDDS-BCCA, mDDS-CMCT, mDDS-DD&S, mDDS-DDSA, mDDS-DDTF, mDDS-C-var, mDDS-E-var, mDDS-M-var, mMNS-MCD, mMNS-MPy

## Structural Bioinformatics

<b>Vakcode</b>	X_405019 (405019)
<b>Periode</b>	Periode 4
<b>Credits</b>	6.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Faculteit der Exacte Wetenschappen
<b>Coördinator</b>	dr. ir. K.A. Feenstra
<b>Examinator</b>	dr. ir. K.A. Feenstra
<b>Docent(en)</b>	dr. ir. K.A. Feenstra, dr. S. Abeln
<b>Lesmethode(n)</b>	Hoorcollege, Practicum
<b>Niveau</b>	400

### Doel vak

Why Structural Bioinformatics?

Generally speaking, the function of a protein is determined by its three dimensional structure, and therefore structural information is crucial for understanding the working of proteins. However, experiments, prediction and simulation of protein structures remain difficult. This course will provide you an overview of existing computational techniques, to validate, simulate, predict and analyse protein structures. More importantly, it will provide practical knowledge about how and when to use such techniques.

Goals:

- Being able to evaluate protein structures with knowledge of their



experimental source and validation techniques

- Being able to compare different protein structures, and evaluate similarity
- Learning how and when to use structure prediction methods
- Being able to create scripts that connect different Structural Bioinformatics methods.
- Being able to compare different simulation techniques for biological macro-molecules, and be able to analyse the simulated data computationally.
- Reading and understanding scientific papers in the field of Structural Bioinformatics.

### **Inhoud vak**

Theory:

- Protein and DNA structure sources
- Experimental methods
- Structure validation
- Protein fold prediction (from homology modelling to ab initio prediction)
- Structural classification and structural alignment
- Protein folding and energetics
- Molecular Dynamics & Monte Carlo simulation
- Function from structure

Practical:

- Obtaining geometric features from PDB files
- Homology modelling with Modeller
- Protein interaction as a 'computational experiment' (simulation).

### **Onderwijsvorm**

13 Lectures (2 two-hour lectures per week)

12 computer practicals (2 two-hour sessions per week)

Feedback (theoretical and practical) will be given during the computer practical sessions.

### **Toetsvorm**

The final grade for this course will consist of 50% practical work and 50% theoretical assessment.

Practical Assignments: (50%)

- (1) Obtaining geometric features from PDB files
- (2) Homology modelling with Modeller (including structural alignment)
- (3) Protein interaction as a 'computational experiment' (simulation).

Theoretical: (50%)

- Oral or written exam (depending on number of course students).
- As part of the exam a research paper on a Structural Bioinformatics topic needs to be analysed in detail.
- You will be prepared for your exam through exercises and paper discussions during the lectures

### **Literatuur**

- course material on [bb.vu.nl](http://bb.vu.nl)

- Marketa Zvelebil and Jeremy O. Baum. Understanding Bioinformatics. Garland Science 2008 ISBN-10: 0-8153-4024-9

### **Aanbevolen voorkennis**

Bachelor in any science discipline (including medicine).

Basic scripting skills (e.g. Python or Pearl) and an interest in

biological problems. Note that at the start of the course a small scripting practical will be given, this means that in practice students without scripting experience can follow the course if they are motivated to learn during the course.

### Doelgroep

mAI, mBio, mCS, mPDCS, mMNS, mBMOL, mNS, mBIO

### Overige informatie

- Compulsory course for students in Bioinformatics Profile of MSc Bioinformatics & Systems Biology (mBIO).

- Optional course for mAI, mCS, mPDCS, mMNS, mBMOL, mNS, mBIO Bachelor in any science discipline (including medicine).

## Thesis Based on Literature Study

<b>Vakcode</b>	AM_471153 ()
<b>Periode</b>	Ac. Jaar (september)
<b>Credits</b>	9.0
<b>Voertaal</b>	Engels
<b>Faculteit</b>	Fac. der Aard- en Levenswetenschappen
<b>Coördinator</b>	dr. J.M. Kooter
<b>Examinator</b>	dr. H.S. van Walraven
<b>Niveau</b>	600