Biomolecular Sciences MSc

Vrije Universiteit Amsterdam - Fac. der Aard- en Levenswetenschappen - M Biomolecular Sciences - 2017-2018

The aim of the Master programme Biomolecualr 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, bioinformatics, pharmacy and engineering, for a Master's degree at the interface between these disciplines. The programme is focussed on the question as to how molecules lead to biological functions and how this can be examined. It therewith covers (epi)genetics, microbiology, structural biology, cell physiology, molecular biology, biochemistry, biophysics, biomathematics, genomics, bioinformatics, pharmacology, toxicology, immunology, oncology, and infection biology.

The programme offers three specializations:
• Molecular Cell Biology
• Biological Chemistry
• Molecular Bioinformatics

More information
-All compulsory courses and electives you find in the year schedule;
-A complete description of the programme you find in the Teaching and Examination Regulations;
-For more information about the programma you can contact the academic advisor (VU students only);
-As a VU student you need to register for all courses via VUnet. Only after you completed your enrollment for the study programme you can register for courses;
-More information on all the courses you find through the links below.

Inhoudsopgave

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

Vakken:

Naam	Periode	Credits	Code
Chemical Biology	Periode 1	6.0	X_432538

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

Vakken:

Naam	Periode	Credits	Code
Drug-induced Stress and Cellular Responses	Periode 2	6.0	X_432536
Signal Transduction in Health and Disease	Periode 2	6.0	X_432535

Recommended optional courses

Vakken:

Naam	Periode	Credits	Code

AIMMS Lectures and Seminars	Ac. Jaar (september)	3.0	XB_432764
Biobusiness Course	Periode 3+4	3.0	M_OBIOBUS10
Biomolecular Screening	Periode 4	3.0	X_432542
Biophotonics	Periode 3	6.0	AM_1213
Biophotonics III: Practical Training	Periode 3	3.0	AM_470630
Caput Cellular Protein Trafficking	Ac. Jaar (september)	6.0	AM_470605
Caput Epigenetics	Ac. Jaar (september)	6.0	AM_470606
Caput Molecular Biotechnology	Ac. Jaar (september)	6.0	AM_470604
Caput Protein Structure as Molecular Basis of Disease	Ac. Jaar (september), Periode 5+6	6.0	AM_470120
Caput RNA Biology	Ac. Jaar (september)	6.0	AM_1208
Caput Structural Biology	Ac. Jaar (september)	6.0	AM_470607
Dynamics of Biomolecules and Cells	Periode 4	6.0	X_422583
Fundamentals of Bioinformatics	Periode 1	6.0	X_405052
Introduction to Systems Biology	Periode 1	6.0	X_428565
Microbial Genomics	Periode 3	3.0	AM_1021
Project Computational Design and Synthesis of Drugs	Periode 4	6.0	X_432734
Structural Bioinformatics	Periode 4	6.0	X_405019

Biological Chemistry: 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 Biological Chemistry	Ac. Jaar (september)	30.0	AM_471129
Internship II Biological Chemistry	Ac. Jaar (september)	30.0	AM_471130
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

MSc Biomolecular Sciences, specialisation Molecular Bioinformatics

Opleidingsdelen:

- MSc Biomolecular Sciences, specialisation Molecular Bioinformatics year 1

MSc Biomolecular Sciences, specialisation Molecular Bioinformatics year 1

Opleidingsdelen:

- BMOL spec. MBI year 1, choose 2 courses
- Molecular Bioinformatics: Compulsory Courses Year 1

BMOL spec. MBI year 1, choose 2 courses

Vakken:

Naam	Periode	Credits	Code
Cell Structures and Functions	Periode 2	6.0	AM_470615
Drug-induced Stress and Cellular Responses	Periode 2	6.0	X_432536
Molecular Infection Biology	Periode 2	6.0	AM_470657
Signal Transduction in Health and Disease	Periode 2	6.0	X_432535

Molecular Bioinformatics: Compulsory Courses Year 1

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 Biological Chemistry	Ac. Jaar (september)	30.0	AM_471129
Internship I Molecular Cell Biology	Ac. Jaar (september)	30.0	AM_471127
Protein Science	Periode 1	6.0	AM_470145
Scientific Writing in English (AM_BMOL)	Periode 3+4	3.0	AM_1156

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

Vakken:

Naam	Periode	Credits	Code
Developmental Biology	Periode 2	6.0	AM_470613
Extreme Biology	Periode 2	6.0	AM_470509

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

Vakken:

Naam	Periode	Credits	Code
Cell Structures and Functions	Periode 2	6.0	AM_470615
Molecular Infection Biology	Periode 2	6.0	AM_470657
Signal Transduction in Health and Disease	Periode 2	6.0	X_432535

Recommended opional Courses

Vakken:

Naam	Periode	Credits	Code

AIMMS Lectures and Seminars	Ac. Jaar (september)	3.0	XB_432764
Biobusiness Course	Periode 3+4	3.0	M_OBIOBUS10
Biomolecular Screening	Periode 4	3.0	X_432542
Biophotonics	Periode 3	6.0	AM_1213
Biophotonics III: Practical Training	Periode 3	3.0	AM_470630
Caput Cellular Protein Trafficking	Ac. Jaar (september)	6.0	AM_470605
Caput Epigenetics	Ac. Jaar (september)	6.0	AM_470606
Caput Molecular Biotechnology	Ac. Jaar (september)	6.0	AM_470604
Caput Protein Structure as Molecular Basis of Disease	Ac. Jaar (september), Periode 5+6	6.0	AM_470120
Caput RNA Biology	Ac. Jaar (september)	6.0	AM_1208
Caput Structural Biology	Ac. Jaar (september)	6.0	AM_470607
Dynamics of Biomolecules and Cells	Periode 4	6.0	X_422583
Fundamentals of Bioinformatics	Periode 1	6.0	X_405052
Introduction to Systems Biology	Periode 1	6.0	X_428565
Microbial Genomics	Periode 3	3.0	AM_1021
Molecular photobiology	Periode 4	3.0	X_432763
Structural Bioinformatics	Periode 4	6.0	X_405019

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

Vakcode	XB_432764 ()

Periode	Ac. Jaar (september)
Credits	3.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. J.E. van Muijlwijk-Koezen
Examinator	prof. dr. J.E. van Muijlwijk-Koezen
Niveau	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 Canvas 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
written 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.

Biobusiness Course

Vakcode	M_OBIOBUS10 (311180)
Periode	Periode 3+4
Credits	3.0
Voertaal	Engels

Faculteit	VUmc
Coördinator	prof. dr. A.W. Griffioen
Examinator	prof. dr. A.W. Griffioen
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	500

Doel vak
Whether scientific discoveries get translated into novel therapeutics or diagnostics, is dependent on many issues. These include such down-to-earth factors as whether a drug can indeed be manufactured at large scale, and careful indication selection and clinical study planning. The goal of the course is to provide insight in the factors that dictate success in present-day development of therapeutics and diagnostics.

Questions that will be addressed are:
- What are the many factors involved in getting from a laboratory discovery to a novel approved medicine, from clinical and regulatory to economic issues;
- How does the pharma and biotech industry access innovation through strategic partnerships with universities and small companies;
- How do entrepreneurial universities contribute to innovation, and turn science into novel medicines and diagnostics?

After the course the students will have thorough knowledge and in-depth insight in:
- The scientific, clinical, regulatory and economic issues involved in present-day drug development;
- Which party plays which role at all stages from research to development to commercialisation;
- The keys to success in translating innovative technologies and therapeutic principles to new drugs and diagnostics.

Inhoud vak
The subjects of the course will include the following:
• General aspects of how several miracle drugs have been developed (Gleevec,Herceptin, Rituxan, Avastin, anti-TNF), form early laboratory research stage to development and clinical proof-of-principle, and the economic and regulatory issues involved;
• General aspects of how certain novel diagnostic tools for staging cancers and for determining drug sensitivity have been developed (for instance for breast cancer, the mamma chip developed by Agendia);
• Impact of careful indication selection and clinical study planning in drug development;
• Regulatory issues regarding drug development, including impact of the European Clinical Trial Directive for Advanced medicinal Therapy Products;
• Examples of a number of VUmc spin-off companies and their activities in drug development and diagnostics;
• Legal and patent issues in technology transfer and partnerships between universities and pharma, biotech and devices companies.

Onderwijsvorm
There will be 24 contact hours in the form of lectures by the course coordinator and a number of invited lecturers. These will include external experts on molecular diagnostics and regulatory affairs, VUmc colleagues with presentation on their own spin-off companies, and TTO colleagues on legal and patent issues. In addition, the course consists

of independent learning on the basis of exploring literature and business reports on selected topics, with the intent of preparing a final presentation and report at the end of the course by small groups.

Toetsvorm
The course will be concluded by group presentations on studies of scientific literature and business reports on development of certain drugs and diagnostics. These will be assigned by the course coordinator, and the literature and business studies will also be summarized in short written reports, to be delivered at the end of the course.

Literatuur
There is no mandatory literature for this course. The assignments involve reading of dedicated papers and viewing of web-based lectures.

Doelgroep
This course is optional for students of the Masters Oncology and Cardiovascular Research, who have completed at least three out of the four compulsory courses of their programme. If enough places are available, students from other MSc in Life Sciences may apply.

Uitleg in Blackboard/Canvas
A CANVAS course is available for this module. Students will be enrolled automatically when they register for the module via VUnet. The lecturers will post information such as presentations slides and literature links in the course.

Intekenprocedure
Students can register for this course and examinations via vunet.vu.nl (under My study, register for courses and exams). The general VU registration rules apply. Information on registration deadlines can be found in VUnet. Please note that the general VU rules are strict, both for booking of the classes and (resit-)exams.

Overige informatie
If you have any questions or need extra information, please contact Maartje Klaassen (maartje.klaassen@vumc.nl).

Biomolecular Screening

Vakcode	X_432542 (432542)
Periode	Periode 4
Credits	3.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. J. Kool
Examinator	dr. J. Kool
Docent(en)	dr. J. Kool
Lesmethode(n)	Hoorcollege, Practicum
Niveau	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 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. Before and in between the practical work, material will be provided to the students on the theoretical background, the research topic, the techniques used, and the methodologies applied during the practical work. In case of 8 or more participants, lectures will be given to provide the needed background to perform the practical work and prepare the assignment. In case of less than 8 participants, some or all of the needed background material will be provided as self study material before the course starts. In this case, the teachers will personally assist and guide students through the background material provided and go through study material that individual students have questions about. Relevant material and literature will be provided via Canvas. All students will (besides their practical report) work on a literature assignment related to a topic on bioactivity profiling in a biopharmaceutical setting.
Teams of students (teams of two students are anticipated) will be formed for the practical research work and for the literature assignment.

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 Canvas. Tutorials will be given by the course supervisors during the practical work. All PowerPoint lectures will be placed on Canvas 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 Canvas.

Vereiste voorkennis
Basic knowledge of biochemistry, separation sciences and mass spectrometry.

Doelgroep
Master phase practical course

Biophotonics

Vakcode	AM_1213 ()
Periode	Periode 3
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. ir. Y.J.M. Bollen
Examinator	dr. ir. Y.J.M. Bollen
Docent(en)	dr. ir. Y.J.M. Bollen
Lesmethode(n)	Hoorcollege, Practicum
Niveau	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
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 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.
In addition, students will obtain hands- on experience with absorption spectroscopy, fluorescence spectroscopy (e. g. FRET and anisotropy) and fluorescence microscopy. 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
Lectures (28 hours), group assignment (8 hours), self-study, execution of experiments (±24 hours) in small groups.

Toetsvorm
Written exam (individual, 50%), oral presentation by group (10 %), written report (per group, 40%). All parts need to be graded 5.5 or higher in order to pass the course.

Literatuur
Papers, hand-outs, reader and protocols will be made available online.

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 followed the FEW Minor “Biomedische beeldvorming”.

Biophotonics III: Practical Training

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

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

Vakcode	AM_470605 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. J.P. van Ulsen
Examinator	dr. J.P. van Ulsen
Niveau	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
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 traffiscking 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 assay 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, Luirink 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

Vakcode	AM_470606 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. J.M. Kooter
Examinator	dr. J.M. Kooter
Niveau	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:
• Basics of DNA methylation and Chromatin Modifications (DM & CM)
• Other types of DNA modification than 5-methyl cytosine
• Biochemistry and dynamics of DNA methylation and de-methylation
• Biochemistry of DNA histone modifications, chromatin and chromosome structure
• Role of DM & CM in gene expression and genome maintenance
• Cellular memory and chromatin modifications by the polycomb-group proteins
• Epigenetic reprogramming events during mammalian development

• Stem cells and reprogramming
• Sex-chromosome inactivation and activation
• Parental imprinting and gene dosage compensation
• Functions of non-coding RNAs in DM & CM
• Neurobiology and epigenetics
• Role of epigenetics in cancer and other diseases
• Epigenetic effects of nutrition, drugs, toxins, environmental 'factors', behaviour and stress
• Transgenerational effects: inheritance of epigenetic-based traits
• Does epigenetics play a role in evolution?
• Methods that are currently used to analyze DM & CM

Onderwijsvorm
- Self-study
- Studying recent review and research articles (ca 120 hr)
- Weblectures by experts (ca 10 hr)
- Meetings with lecturer (1-2 a week), addressing questions and problems (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, provided via CANVAS.

Vereiste voorkennis
Bachelor level Biochemistry, Molecular Genetics and Molecular Biology

Doelgroep
Master students: Biomolecular Sciences, Biology, Biomedical Sciences and Oncology

Intekenprocedure
Email to Coordinator: j.m.kooter@vu.nl

Overige informatie
Depending on previous courses and specific interests is it possible to develop a more 'personalized'
program of the course, thereby focusing on selected biological phenomena involving epigenetic mechanisms.

Lecturer:
dr. Jan M. Kooter

Caput Molecular Biotechnology

Vakcode	AM_470604 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen

Coördinator	dr. S. Luirink
Examinator	dr. S. Luirink
Niveau	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

Caput Protein Structure as Molecular Basis of Disease

Vakcode	AM_470120 ()
Periode	Ac. Jaar (september), Periode 5+6
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. D. Bald
Examinator	dr. D. Bald
Niveau	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 RNA Biology

Vakcode	AM_1208 ()
Periode	Ac. Jaar (september)
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. J.M. Kooter
Examinator	dr. J.M. Kooter
Niveau	500

Doel vak
Study goals:
The student is able to:
- describe the various classes of RNAs in eukaryotic cells generated by RNA Pol I, II, and III
- explain the functions of the various RNA classes and the significance of 3D structure
- describe and explain the mechanisms of catalytic RNAs, also in connection with the 'RNA-world' hypothesis
- describe the various ways and regulation of RNA processing, including the abundant alternative splicing in higher eukaryotes
- explain the tight connection between transcription and RNA processing
- indicate how nuclear and organellar RNAs are edited and explain what the functions are of this editing
- explain how RNA transport occurs and how it is regulated
- review the various proteins associated with RNAs and explain their functions
- describe the mechanisms and regulation of RNA degradation and the biological significance of differences in RNA half-life
- explain the functions of short- and long non-protein encoding RNAs, illustrated with examples
- describe the connection between non-coding RNAs and epigenetics
- interpret the phenotypic consequences, developmental defects and diseases that are due to 'RNA-defects'
- apply the various techniques that are used to detect and examine RNAs and determine their function

Inhoud vak
See Study Goals.
By studying the subjects of the book and research and review articles you will become familiar with all aspects of RNAs, from their synthesis and processing, up to their cellular function. In addition to the

well-known mRNAs, tRNAs and rRNAs, many small and long non-coding RNAs have been discovered. From the majority of these RNAs, the function is unknown including the way they are processed (alternative splicing), their bases modified, catalytic properties and with which proteins they interact. So, their is a whole RNA-world to be discovered, which seems as rich as the protein-world. Given the central role of RNAs in cells, it is not surprising that various human diseases are due to the aberrant synthesis, regulation and functioning of RNAs, a subject that will also be covered.

Onderwijsvorm
Mainly Selfstudy, and regular meetings with the lecturer, 1-2 times a week.

Toetsvorm
Written exam, consisting of open questions

Literatuur
- Book: Molecular Biology of RNA by David Elliot & Michael Ladomery, Oxford Press, ISBN 978-0-19-928837-3
- Research and review articles from the CANVAS site

Vereiste voorkennis
A solid background in molecular biology and understanding of gene expression

Doelgroep
Masterstudents Biomolecular Sciences, Biomedical Sciences, and Oncology

Intekenprocedure
Via VUnet and Coordinator, dr. JM Kooter

Overige informatie
Course can be taken throughout the year except for the months September and October

Caput Structural Biology

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

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

Doel vak
The first aim of the course is to refresh and deepen the knowledge of the students in a number a 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 reviews and 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 cell biology 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 Canvas before the lectures.
The third part (last week) of the course will be used to study and to prepare for the exam.

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. 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).

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 Canvas 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

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.
T. Sixma (NKI), Dr. S. Piersma (VUmc), Dr. P. van Ulsen (VU)

Chemical Biology

Vakcode	X_432538 (432538)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. J.E. van Muijlwijk-Koezen
Examinator	prof. dr. J.E. van Muijlwijk-Koezen
Docent(en)	dr. M.H. Siderius, prof. dr. R. Leurs, dr. J. Kool, prof. dr. J.E. van Muijlwijk-Koezen
Lesmethode(n)	Hoorcollege, Computerpracticum
Niveau	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. van Muijlwijk 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

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

Vakcode	X_432536 (432536)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. J.N.M. Commandeur
Examinator	dr. J.N.M. Commandeur
Docent(en)	J.C. Vos, dr. J.N.M. Commandeur
Lesmethode(n)	Hoorcollege
Niveau	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,
• role of mitochondria in necrosis and apoptosis,
• impairment of cell proliferation and tissue repair,
• immune-mediated toxicity.

Onderwijsvorm
Lectures, assignment and self study.

Toetsvorm
Written exam and assignment

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

Vakcode	X_422583 ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. ir. I. Heller
Examinator	dr. ir. I. Heller
Docent(en)	prof. dr. J.T.M. Kennis
Lesmethode(n)	Hoorcollege

Niveau	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

Vakcode	AM_470707 ()
Periode	Periode 3
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	P. Klaassen MA
Examinator	P. Klaassen MA
Docent(en)	dr. J.F.H. Kupper, P. Klaassen MA, A.R. Gilmoor
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	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 owns 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 Canvas

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

Vakcode	AM_470509 ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. ir. A.H. de Boer
Examinator	dr. ir. A.H. de Boer
Docent(en)	prof. dr. H.V. Westerhoff, dr. ir. A.H. de Boer, dr. D. Bald, dr. ir. T.F.M. Roelofs
Lesmethode(n)	Hoorcollege
Niveau	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 search, study and present an original research article on an extremophile topic of choice

Inhoud vak
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, pollution and permanent extreme environments are abundant, like the (Ant)artics, geothermal vents, hot pools etc. Thus, organisms are adapted or need to 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 (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, nuclear waste etc. Extremes are also encountered in daily life, like lichens on trees during hot summer days, Helicobacter pylori in the acid environment of the stomach etc. 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 study and present an original research article on a subject of choice that relates to extreme biology and write a short overview of that topic.

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. Students will choose an extremophile topic of his/her choice, present a selected research paper and write a short overview of that topic.

Toetsvorm
Written exam with essay questions (75%), Journal Club presentation plus short overview (25%). 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

Vakcode	X_405052 (405052)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. ir. K.A. Feenstra

Examinator	dr. ir. K.A. Feenstra
Docent(en)	dr. ir. K.A. Feenstra, prof. dr. J. Heringa, dr. D. Molenaar, dr. S. Abeln
Lesmethode(n)	Hoorcollege, Deeltoets extra zaalcapaciteit, Computerpracticum
Niveau	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
Feedback (theoretical and practical) will be given during the project and computer practical sessions.

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

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

Aanbevolen voorkennis
An interest in algorithmics approaches to biological problems.

Doelgroep
mAI, mBio, mCS, mMNS

Genomes and Gene Expression

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

Transcriptional regulation and Epigenetic mechanisms:
• Genome content and organization: coding versus non-coding sequences
• Composition and biochemistry of basic transcription machinery
• General and specific transcriptional regulators, their functions and modes of regulation
• Transcription initiation, elongation and termination
• Identification and function of regulatory sequences: promoters, enhancers, boundaries
• Properties and regulation of RNA polymerase II
• Chromatin structure and histone modifications: writers-readers-erasers concept
• The various DNA modifications, their biochemical properties, and role in gene expression
• 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
• 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
- Interactive Lectures, including lectures by guest speakers (ca 45 hr).
- Web-lectures by experts (ca 5 hr)
- Self study (ca 100 hr)

Toetsvorm
There are 2 partial exams:
- First exam is halfway the course and consists of ~70-80 Multiple Choice question and accounts for 40% of the final mark
- Second exam is at the end of the course and consists mainly of open questions and accounts for 60% of the final mark.
For the second exam, knowledge of the first part is needed. An

insufficient grade for the first can be compensated by a sufficiently high grade for the second and vice versa.
Resit of a partial-exam is not allowed. Pass with >5.5.

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 CANVAS 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

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

Inhoud vak
All information about the internship can be found in the ‘Manual for Internships of the MSc Biomolecular Sciences programme’, which is available from the CANVAS ‘Biomolecular Sciences’ community site.

Internship I Molecular Cell Biology

Vakcode	AM_471127 ()
Periode	Ac. Jaar (september)
Credits	30.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. J.M. Kooter
Niveau	600

Inhoud vak
All information about the internship can be found in the ‘Manual for Internships of the MSc Biomolecular Sciences programme’, which is available from the CANVAS ‘Biomolecular Sciences’ community site.

Internship II Biological Chemistry

Vakcode	AM_471130 ()
Periode	Ac. Jaar (september)
Credits	30.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. J.M. Kooter
Niveau	600

Inhoud vak
All information about the internship can be found in the ‘Manual for Internships of the MSc Biomolecular Sciences programme’, which is available from the CANVAS ‘Biomolecular Sciences’ community site.

Internship II Molecular Cell Biology

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

Inhoud vak
All information about the internship can be found in the ‘Manual for Internships of the MSc Biomolecular Sciences programme’, which is available from the CANVAS ‘Biomolecular Sciences’ community site.

Introduction to Systems Biology

Vakcode	X_428565 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. D. Molenaar
Examinator	dr. D. Molenaar
Docent(en)	prof. dr. B. Teusink, dr. D. Molenaar, prof. dr. F.J. Bruggeman

Lesmethode(n)	Hoorcollege, Werkgroep, Deeltoets extra zaalcapaciteit, Werkcollege
Niveau	400

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

Goals:
- 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 that are relevant to current topics in systems biology.
- To gain hands-on experience in basic modelling as a means of solving systems biology problems.
- To repair gaps in background knowledge.

Inhoud vak
Theoretical 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

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

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

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

Toetsvorm
30% Mathematics, Programming or Biology conversion 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

Vakcode	AM_1021 ()
Periode	Periode 3
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	prof. dr. R. Kort
Examinator	prof. dr. ir. R. Kort
Lesmethode(n)	Hoorcollege
Niveau	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 containing a 1 page summary of the lecture, and 3 pages on the relevance of the microbiological topic for society (with particular emphasis on human heath). The selected lecture will be announced after the final lecture.

Literatuur
Selected papers:

Kort R, Caspers M, van de Graaf A, van Egmond W, Keijser 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, Vandenbroucke-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, Tsivtsivadze 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
General and Molecular Microbiology

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
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 Wijgert (University of Liverpool, Institute of Infection and Global Health). Microbial ecology of bacterial vaginosis.
https://www.linkedin.com/pub/janneke-van-de-wijgert/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

Vakcode	AM_470657 ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	prof. dr. W. Bitter
Examinator	prof. dr. W. Bitter
Docent(en)	prof. dr. W. Bitter
Lesmethode(n)	Hoorcollege, Practicum
Niveau	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 photobiology

Vakcode	X_432763 ()
Periode	Periode 4
Credits	3.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. R. Croce
Examinator	prof. dr. R. Croce
Docent(en)	prof. dr. R. Croce
Lesmethode(n)	Hoorcollege, Practicum
Niveau	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

Vakcode	X_432734 ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. I.J.P. de Esch
Examinator	prof. dr. I.J.P. de Esch
Docent(en)	dr. M. Wijtmans, dr. D.P. Geerke
Lesmethode(n)	Hoorcollege, Practicum
Niveau	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 heteroatoromatic 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

Vakcode	AM_470145 ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. D. Bald
Examinator	dr. D. Bald
Docent(en)	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
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	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 proprties of amino acid residues.
3. can predict the function of (parts of) a protein based on undestanding 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 (36 h) accompanied by work (paper) discussions (8 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)

Vakcode	AM_1156 ()
Periode	Periode 3+4
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	M. van den Hoorn
Examinator	M. van den Hoorn
Lesmethode(n)	Werkgroep
Niveau	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 and on Canvas.
- A VUnet registration for this course automatically gives access to the corresponding Canvas site. Group registration only takes place via Canvas (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 Canvas, 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 Canvas matters concerning this course, please contact canvas.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

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

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

Vakcode	X_405019 (405019)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. ir. K.A. Feenstra
Examinator	dr. ir. K.A. Feenstra
Docent(en)	dr. ir. K.A. Feenstra, dr. S. Abeln
Lesmethode(n)	Hoorcollege, Practicum
Niveau	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 you exam through exercises and paper discussions during the lectures

Literatuur
- course material on bb.vu.nl
- Marketa Zvelebil and Jeremy O. Baum. Understanding Bioinformatics. Garland Science 2008 ISBN-10: 0-8153-4024-9

Vereiste voorkennis
Bachelor in any science discipline (including medicine), with an interest in applying algorithmic approaches to molecular structures in biology.
Some experience with programming (preferably python). 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, and willing to put in the extra effort - when in doubt please contact the coordinator.

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.

Thesis Based on Literature Study

Vakcode	AM_471153 ()
Periode	Ac. Jaar (september)
Credits	9.0
Voertaal	Engels
Faculteit	Fac. der Aard- en Levenswetenschappen
Coördinator	dr. J.M. Kooter
Niveau	600

Inhoud vak
Information about the Literature thesis can be found in the ‘Manual for the Literature Study of the MSc Biomolecular Sciences programme’, which is available from the CANVAS ‘Biomolecular Sciences’ community site.