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

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

The programme offers a choice between two specializations:

- Molecular Cell Biology
- Biological Chemistry

The year schedule can be found at the FALW-website.
Further information about the MSc programme Biomolecular Sciences.
A complete programme description can be found at the FALW-website.
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Expired programme components Biomolecular Sciences

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

Vakken:

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<thead>
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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:

- keuzecursussen jaar 1
- verplichte cursussen jaar 1
- kies een van beide cursussen
- cursussen jaar 2 (verplicht en keuze)

keuzecursussen jaar 1

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verplichte cursussen jaar 1

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kies een van beide cursussen

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cursussen jaar 2 (verplicht en keuze)

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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:
- keuzecursussen jaar 1 (nader)
- verplichte cursussen jaar 1
- Kies een van de drie cursussen
- cursussen jaar 2 (verplicht en keuze)

keuzecursussen jaar 1 (nader)

Vakken:

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<td>Biophotonics I: Microspectroscopy</td>
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verplichte cursussen jaar 1
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Kies een van de drie cursussen

Vakken:

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cursussen jaar 2 (verplicht en keuze)

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MSc Biomolecular Sciences, Optional courses (elective)

Vakken:
AIMMS Lectures and Seminars

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<td>Caput Epigenetics</td>
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<tr>
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**Doel vak**
- To broaden your spectrum of the Human Life Sciences
- To practice your writing skills and capability to order and summarize a lot of new information
- To practice your scientific judgements

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

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

**Onderwijsvorm**
Biomolecular Screening

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

**Inhoud vak**
During this course the potential of modern analytical and biological screening techniques used in bioactivity screening of bioactive proteins will be discussed. The emphasis will be on finding bioactive proteins in complex biological samples by LC-MS in combination with post-column bioassays. Protein identification strategies using bottom-up proteomics approaches will be focused on during this course. You will learn how to find biologically active proteins in complex mixtures and know how to identify these proteins by their (partial) amino acid sequence. Sample treatment and advanced sample preparation techniques will play an important part in this as well as LC-MS, bioassays and database searches with the proteomics data obtained. We will work with natural extracts such as snake venoms as our complex biological samples, which contain potential biopharmaceutical candidate proteins.
Onderwijsvorm
The course starts with a thorough explanation of the course and its contents. Then we will start with the practical work. In between the practical work, lectures will be all given that discuss in more detail and assist the practical work. Relevant literature will be provided via blackboard. All students will (besides their practical report) work on a literature assignment related to a topic in bioactivity profiling in a biopharmaceutical setting.

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

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

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

Doelgroep
Master phase practical course

Overige informatie
A lab coat is required for the practical part.

Biophotonics I: Microspectroscopy

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<td>dr. ir. Y.J.M. Bollen</td>
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<tr>
<td>Docent(en)</td>
<td>prof. dr. ir. E.J.G. Peterman, dr. ir. Y.J.M. Bollen</td>
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Doel vak
To introduce students into various spectroscopic and microscopic techniques.
Students should know the theoretical principles and the applicability in life sciences of:
- absorption spectroscopy
- fluorescence spectroscopy
- light microscopy
- fluorescence microscopy

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

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

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

Literatuur
Notes, handouts and papers

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

Overige informatie
Due to largely overlapping contents this course is NOT intended for students who have taken the FEW BSc course “Microscopische beeldvorming (X_420529)”.
Practical training in the techniques discussed here is offered in Biophotonics 3, for which Biophotonics 1 is required.

Biophotonics III: Practical Training

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</tr>
<tr>
<td>Niveau</td>
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</table>

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 Blackboard

Vertoeste 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).

Business and Innovation in Life Science

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Inhoud vak
This course has expired

Doelgroep
Master Bio molecular Sciences (BMS), Chemistry, Drug Discovery & Safety and Oncology

Caput Cellular Protein Trafficking
Doel vak
The aim of this theoretical course for master students is to study a number of recent, short and state-of-the-art review papers in the area of protein secretion and cellular protein trafficking. The students will get insight into the principles and mechanisms by which prokaryotic and eukaryotic cells target and insert proteins into membranes and target them to subcellular organelles and the extracellular environment. The course will highlight the similarities between eukaryotic and prokaryotic organisms in the mechanisms of protein secretion and trafficking.
Furthermore the application of this knowledge and research in medical sciences and in biotechnology is addressed. The emphasis is on bacterial systems. End terms for the student:
- To know and understand the biochemical principles and molecular and cellular processes that play a role in protein targeting to biomembranes
- To know and understand the biochemical principles and the molecular and cellular processes that play a role in the insertion of membrane proteins into biomembranes
- To know and understand the biochemical principles and the molecular and cellular processes that play a role in the transport of proteins through biological membranes and into the extracellular environment.

Inhoud vak
Protein trafficking in E. coli:
- Biogenesis of inner membrane proteins in E. coli.
- Targeting and assembly of periplasmic and outer membrane proteins.
- Protein translocation across membranes: secretion systems, their structure, biology, and function.
Protein trafficking in eukaryotes:
- Biogenesis of membrane proteins in organelles
- Intracellular protein trafficking
- Vesicle transport in the endosomal system.

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

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

- The conserved Sec machinery in pro- and eukaryotes

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

- Structural Biology of bacterial secretion systems

- Vesicle transport in bacteria and their role in virulence

- 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

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Doel vak
Course objectives:
At the end of the course, the student:
- is able to describe in detail the structure and composition of Chromatin, the post-translational modifications of chromatin proteins, where these modified proteins can be found in chromosomes, and how they are somatically inherited
- is able to indicate the enzymes responsible for the modifications and how they are regulated and targeted to specific genomic regions
- can recognize the dynamic nature of chromatin and epigenetic protein modifications, and is able to identify the ‘readers’ of the modifications and their consequences
- can describe the biochemical mechanisms of transcriptional regulation, including the process of transcription initiation, elongation and termination
- can describe the various DNA modifications, their biochemistry, and impact on genome maintenance and gene expression in somatic tissues, including brain
- can describe the epigenetic reprogramming events during mammalian embryonic development, parental imprinting, and biological consequences
- recognize cases of genetic - and epigenetic inheritance, and transgenerational inheritance
- can indicate and explain the molecular causes of human diseases, including cancer, that are due to aberrant epigenetic features and defective epigenetic mechanisms
- is able to identify phenomena that are due to environmentally-induced changes in epigenetic genome properties
- can explain the link between nutrition and epigenetic modifications
- can apply currently used experimental approaches and techniques to study epigenetics and is able to interpret the results

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

Onderwijsvorm
- No regular lectures, mostly self-study
- Studying recent review and research articles (ca 120 hr)
- Weblectures by experts (ca 10 hr)
- Discussion meetings (1-2 per week) in which the topics of the research and review articles are discussed (ca 15 hr)

Toetsvorm
Written exam

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

Vereiste voorkennis
Bachelor level Biochemistry, Molecular Genetics and Molecular Biology

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

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

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

Caput Molecular Biotechnology

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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
A written exam with essay questions.

Literatuur

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

Overige informatie
E-mail: s.luirink@vu.nl

Caput Protein Structure as Molecular Basis of Disease

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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 2016.

Caput Structural Biology

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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

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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 primary research papers (second and third week). Related to this, the second and most important aim of the course is to learn how to read, appreciate and discuss reviews and primary research papers on various topics.

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

Inhoud vak
See "form of tuition".

Onderwijsvorm
In the first part of the course (one week) students will study and discuss in working groups part III (methods) and part IV (internal organization of the cell) of the book: "Molecular Biology of the Cell" (Alberts et al.). Chapter by chapter the students will be guided through the book and questions will be answered. Excursions will be organized to labs specialized in specific techniques (10 contact hours)
In the second part of the course (about two weeks; 20 contact hours) specific topics (protein trafficking, protein insertion into membranes, membrane protein function, glycosylation and quality control) will be studied and discussed with lecturers from the VU and other universities. Each lecturer will present a seminar and discuss with the students very recent research papers and developments in the particular area of interest. The reviews and papers will be available via blackboard before the lectures.
The third part (last week) of the course will be used to study and to prepare for the exam. The exam will be in "open book" format. There will be 6 questions about the papers presented by the lecturers (presented in week 2 and 3) and 2 questions about the relevant topics in Alberts and cell biology techniques (presented in week 1).

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

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

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

Doelgroep
Master students Biomolecular Sciences
Overige informatie
Maximum number of participants: 50
E-mail: s.luirink@vu.nl
Guest lecturers (subject to reservation) Prof. I. Braakman and Dr. P. van der Sluijs (UU), Prof. P. Peters (Universiteit Maastricht) and Prof. T. Sixma (NKI); Prof. C. De Koster and Dr. B. Distel (UvA); Dr. M. Wilhelmus (VUMC)

Chemical Biology

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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 (e.g. SPR, FRET, BRET, High-content & High resolution analysis), 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

**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 of Chemistry.

**Doelgroep**
mBMS-BC, mCh-SBI (2nd year), mDDS-BCCA, mDDS-CMCT, mDDS-DD&S, mDDS-DDSA, mDDS-DSTF, 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

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**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-
- 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 will be covered in the masterclasses given by student depends on the choices that are made during the course and are, therefore, not entirely predictable beforehand. Some of the subjects that will almost certainly be covered are:
- Reprogramming of differentiated cells into stem cells and dangers/possibilities for use of such cells in therapy
- Intercellular movement of proteins like transcription factors, which were hitherto always believed to act only in the cells where they are synthesized

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

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

Literatuur
There is no specific handbook. You might find it useful to consult, on occasion, a handbook (any) to refresh your memory on some basic cellular processes, like gene regulation, signaling and so on, if that is necessary.
Handouts, incl. PowerPoint files of lectures, pdf files of relevant review and research papers will be provided via the Blackboard site.

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

Doelgroep
Master students: Biomolecular Sciences, Biology, Biomedical Sciences

Drug-induced Stress and Cellular Responses

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Doel vak
At the end of this theoretical course, the students are aware of the latest insights of cellular stress responses which can occur after exposure of cells to reactive drugs and/or reactive drug metabolites.
Inhoud vak
Exposure of tissues to high levels of drugs and/or drug metabolites in some cases can trigger various biochemical responses. Interaction with sensor proteins can lead to adaptative stress responses which will protect the cell against further damage. If these adaptative stress responses are insufficient, interaction with critical proteins may lead to cell death or exaggerated, fatal pharmacological responses. The following aspects will be studied in the course drug-induced stress and cellular signaling:
• (types of) adverse drug reactions
• role of biotransformation and drug transport in adverse drug reactions,
• reversible and irreversible interactions of toxic drugs with biological macromolecules,
• cellular adaptation to exposure to reactive intermediates and reactive oxygen species;
• cellular and molecular mechanisms leading to toxic effects,
• genetic toxicology and chemical carcinogenesis,
• role of mitochondria in necrosis and apoptosis,
• impairment of cell proliferation and tissue repair,
• immune-mediated toxicity.

Onderwijsvorm
Lectures and self study.

Toetsvorm
Written exam

Literatuur

Vereiste voorkennis
Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology Pharmaceutical Sciences, Medical Natural Science Biomolecular Science portal course, or equivalent

Doelgroep
mDDS, mBMS

Dynamics of Biomolecules and Cells

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**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.
- 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**

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To provide a toolbox of ethical instruments to analyze properly moral problems related (to one’s own) research in the life sciences
• To acquire conceptual knowledge of the central concepts in applied philosophy and professional ethics
• To challenge an ethical reflection on one own’s life science specialization and to open it for an impartial and constructive discussion
• To exercise a team based project to enter prepare and execute 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

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 small group training project, an ethical dialogue is prepared and executed together 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
• Presentation: 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%) has to be passed
• written and verbal execution of the ethical dialogue (40%)

Literatuur
Available on Blackboard

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

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

Overige informatie
Lectures in English, part of the workgroups are in Dutch. All presentations and plenary discussions in English.
In order to maximize the experience of differences in values and
preferences, and this increase meaningful ethical inquiry we will place
you randomly in the workgroups. Placement will be communicated after the
introduction lecture.

Evolving Networks

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Doel vak

Biological systems consist of complex networks of interacting metabolites, molecules, cells, organisms and populations. We often assume that these networks are highly tuned to perform specific functions. But is that assumption justified? Can we investigate whether a signal transduction network is shaped by natural selection to perform a specific function optimally? Evolutionary experiments with microorganisms and detailed analysis of infection diseases have shown that they are extremely flexible, and can change functions very quickly by mutation or by incorporating large quantities of foreign DNA. In a similar manner, cancer cells carry many mutations, and are selected to perform functions that promote uncontrolled growth in a body.

In this course we will investigate the relationship between interactions in molecular, metabolic and cellular networks, and the presumed function of these networks. On the one hand we will discuss the exciting recent studies that yield detailed views on the mechanisms of mutation and selection in microbial and cancer cell populations and on the other hand we will discuss why particular forms of networks are selected, by trying to understand the relation between network properties, functions, and ultimately fitness.

Inhoud vak

- Microevolution in medical, industrial and laboratory setting
- Fitness landscapes and selection in populations
- Predicting optimal network structures by using models, and testing these predictions
- Cancer development from a micro-evolutionary and systems perspective
- Structure and function of signalling networks

Onderwijsvorm

Lectures, computer practicals, and assignments.

Toetsvorm

Assessment will take place by practical assignments (20%) and a written exam (80%).
Literatuur
An online reader will be provided.

Doelgroep
Master students with a background in Biology, Biomedical Sciences or Biinformatics, with an interest in systems biology.

Extreme Biology

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

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

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

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

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

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

**Literatuur**
Selected review and research articles.

**Vereiste voorkennis**
Bsc Biology, Biomedical Sciences

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

**Fundamentals of Bioinformatics**
**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 him/her self. Based on their background, students will be assigned to separate classes where they will be working to fill gaps in their background knowledge in programming and/or biology.

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

**Inhoud vak**

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

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

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

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

**Literatuur**
- course material (slides, scientific papers) on bb.vu.nl
Aanbevolen voorkennis
Bachelor in any science discipline (including medicine), or strong
programming background.
An interest in programming and biological problems.

Doelgroep
mAI, mBio, mCS, mMNS

Genomes and Gene Expression

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

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

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

Toetsvorm
There are 2 sub-exams:
- First exam is half way the course and consists of Multiple Choice question and accounts for 40% of the final mark
- Second exam is at the end of the course and consists of open questions and accounts for 60% of the final mark. For the second exam, knowledge of the first part is needed. Resit of a sub-exam is not allowed.

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

Vereiste voorkennis
Basic concepts in Molecular Biology, Genetics, and Biochemistry
**Doelgroep**
Master students: Biomolecular Sciences, Biology, Biomedical Sciences, Pharmaceutical Sciences, Oncology, and Medical Natural Sciences.

**Intekenprocedure**
Enrollment through studentportal: Vunet.vu.nl

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

**Internship I Biological Chemistry**

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**Internship I Molecular Cell Biology**

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**Internship II Biological Chemistry**

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**Internship II Molecular Cell Biology**

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Introduction to Systems Biology

Doel vak
Introduction to Systems Biology is the starting course of the Bioinformatics and Systems Biology master (together with Fundamentals of Bioinformatics). It aims to give a broad overview of important topics relevant to the field of Systems Biology, 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. Based on their background, students will be assigned to deficiency classes where they will be working to fill gaps in their background knowledge in mathematics, programming and/or biology.

Goals:
- To make the students aware of gaps in their own background knowledge.
- To make the student acquainted with the major issues, concepts and methodology in systems biology (to be studied in more detail in the master)
- To develop a basic understanding of major biological concepts in genomics and cell biology that are relevant to current topics in systems biology
- To work together in a group of diverse backgrounds
- To gain hands-on experience in basic modeling as a means of solving systems biology problems

Inhoud vak
Theory:
- Design principles of biological networks, basic modeling approaches, evolution
Practical:
- Exercises during/in between lectures in which methods of systems biology will be applied to several topics.
Onderwijsvorm
- Lectures (two hour lecture in the morning, two days per week)
- Computer practicals
- Modeling practicals
- Deficiency classes in biology, mathematics and/or programming

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

Literatuur
A course syllabus will be provided

Aanbevolen voorkennis
Highschool mathematics

Doelgroep
Students with background in Biology, Bioinformatics, Mathematics, Physics

Microbial Genomics

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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 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:


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

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](https://www.linkedin.com/in/dutilh)
Dr. Guus Roeselers (TNO). Microbial ecology of the gastro-intestinal tract.
[https://www.linkedin.com/in/roeselers](https://www.linkedin.com/in/roeselers)

Monday Jan 11 (10.00 – 12.00)
Prof. Eddy Smid (WUR). The best foods are made by microbes.
Prof Wilbert Bitter (VUMC) Die hard with a vengeance, strategy of mycobacterial pathogens.

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](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 Biology Techniques

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**Doel vak**
To introduce students into the application of basic techniques, primarily DNA cloning and PCR, to express (mutant) genes.
Inhoud vak
Theoretical background on DNA cloning and gene expression.
Laboratory practical work involving, e.g.:
(1) generation and expression of mutant/human cytochrome P450 in E. coli,
(2) cloning and testing of novel gene reporters for stress-response in S. cerevisiae,
(3) cloning of fusion genes for cell biological purposes in S. cerevisiae, or
(4) cloning for aiming at overexpression of particular genes in S. cerevisiae.

Onderwijsvorm
Laboratory work, lectures, tutorials.

Toetsvorm
Laboratory work, assignments, written report.

Literatuur
Manual and protocols available on Blackboard.

Vereiste voorkennis
The course "Genomes and Gene Expression"

Doelgroep
mBMS

Overige informatie
Maximum number of students is 24.

Molecular Infection Biology

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Doel vak
To understand how the interaction of a pathogen with its host is studied (in vitro studies, use of alternative in vivo models, different approaches of mutant screening).
To understand the variation within microbial pathogens and the effect this variation has on host adaptation.
To understand what virulence factors are and how they are regulated by the pathogen.
To apply the acquired knowledge to interpret scientific literature and scientific hypotheses regarding pathogen-host interactions.
Inhoud vak

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

Onderwijsvorm

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

contact hours:
lectures: 18
Literature Workshop: 17
Practicum: 30-40

Toetsvorm

written exam (50% of final mark and should be minimally 5,5)
literature discussion (workshop, 30% of final mark)
practicum (20% of final mark)

Literatuur

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

Vereiste voorkennis

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

Doelgroep

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

Overige informatie

Guest lectures:
Dr. Peter van der Ley, RIVM Bilthoven, molecular techniques used for vaccine development
Dr. Lia van der Hoek, AMC Amsterdam, identification of novel viral pathogens

Molecular Pharmacology

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

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

Onderwijsvorm
Practical course

Toetsvorm
Report

Vereiste voorkennis
Participation in BMS Portal courses is required.

Doelgroep
BMS master students with deficiencies and a limited amount of DDS Masterstudents (to be selected by course coordinator)

Intekenprocedure
Registration via VuNet

Overige informatie
This course is open for only 24 students.

Molecular photobiology
**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 (AM_BMOL)

**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**

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

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

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

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

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

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

Mason: Volume 4 of Comprehensive Medicinal Chemistry II: Computer-Assisted Drug Design (Mason (Ed.).
http://www.sciencedirect.com/science/referenceworks/9780080450445

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

These books are accessible through UBVU at all VU computers. The same holds true for articles and the Reaxys search engine (vide infra). When at home, turn on the VU-proxy (http://www.ub.vu.nl/nl/faciliteiten/thuis-werken/index.asp) and accessibility to all these items is maintained.
The following book (Clayden) is not an eBook accessible through UBVU, but it contains useful background literature on organic chemistry. All students that received their FAR BSc degree at the VU possess this book. It is suggested by us that such students could consider lending this book to others if necessary.


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**

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**Doel vak**
The student:
1. knows and understands principles of protein structure, dynamics, regulation, inhibition, interaction and engineering
2. can explain protein function based on protein structure and the properties of amino acid residues.
3. can predict the function of (parts of) a protein based on understanding of its molecular properties
4. knows and understands the principle of current methods for protein investigation (e.g. overproduction, purification, interaction, engineering)
5. can analyze the strong and weak points of Protein Science techniques and can correlate an open question with a suitable technique.
6. can analyze experiments in Protein Science and design new experiments.
Inhoud vak
We will start with a repetition of protein structure and function. Subsequently, we will focus on methods in protein science and also on more specialized properties of proteins important in fundamental research, biomedicine or biotechnology. Finally we will deal with case studies on selected proteins.

Lecture topics include:
- Protein Structure, Protein Function, Protein Dynamics, Molecular Machines, Control of Protein Function, Protein inhibition, Antibiotic action, Development of antibiotics and antibiotic resistance, Protein over-expression and purification, Protein Interaction, Protein Engineering,
- Molecular Modeling and docking

Case studies:
- GPCRs as drug target, Cytochrome P450, Chaperones as Protein folding machines,
- Molecular Modeling/docking.

Onderwijsvorm
Lectures (30 h) accompanied by work (paper) discussions (6 h) and self study (individual or in small groups) to prepare for the lectures and to discuss the material presented in lectures/accompanying papers.

Toetsvorm
Written exam (100%)

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

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

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

Protein Sciences Techniques

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Doel vak
Practice advanced protein science methods that you can apply to answer a wide range of biochemical, biomedical and biotechnical questions.

Final attainment:
The student understands advanced practical approaches for investigation of proteins and can interpret experimental results.

The student is able to apply current methods for protein over-expression, purification, protein labelling, as well as for investigation of protein/protein or protein/drug interaction.

Inhoud vak
We will start with a brief repetition of the theoretical background of current protein science techniques. Subsequently, we will focus on application of selected techniques in the lab.
Techniques/practical include:
Over-expression of proteins;
Advanced chromatography methods for protein purification;
Surface Plasmon Resonance Sensing (Biacore) for protein/protein or protein/drug interaction;
Functionalized Micro-beads for affinity interaction/labeling.

Onderwijsvorm
Laboratory practical (16h) accompanied by a lecture (4h) and self-study to prepare for the practical, evaluate experimental results and write reports.

Toetsvorm
Active participation in the practical (50%), written reports (50%). A minimal grade of 5.5 for each part is needed to pass the course.

Literatuur
You will receive a course material with background information and experimental protocols.

Vereiste voorkennis
Participation in the portal course Protein Science (470145) is required.

Doelgroep
Master students Biomolecular Sciences, Biomedical Sciences, Biology, Pharmaceutical Sciences and Medical Natural Sciences

Overige informatie
Maximal number of participants is 32. A lab coat is required for the practical.

Scientific Writing in English

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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 idiomerically 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 how 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
**Onderwijsvorm**
Scientific Writing in English is an eight-week course and consists of 4 contact hours during the first week and 2 contact hours a week for the rest of the course. 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 or Results, Discussion) and get a pass mark for all writing assignments;
- Students provide elaborate peer feedback;
- Students attend all sessions;
- Students are well prepared for each session (i.e. do all homework assignments);
- Students actively participate in class;
- Students do not plagiarise or self-plagiarise.

**Literatuur**

**Doelgroep**
This course is only open to students of the following Master's programmes of the Faculty of Earth and Life Sciences: MSc Biology, Health Sciences, Ecology, Biomolecular Sciences, Biomedical Sciences, Neurosciences, Global Health, Hydrology, and Management, Policy Analysis and Entrepreneurship in Health and Life Sciences.

This course is an alternative for students who are not able to attend Scientific Writing in English in their designated group (this is not applicable for students Hydrology).

**Intekenprocedure**
Students should register on time by sending an e-mail to onderwijsbureau.beta@vu.nl, selfregistration in VUnet is not possible. Please note that this course will only go through with a minimum of 18 participants and maximum of 24. Students are advised to consult their schedule carefully, since overlap may occur.

If you are registered for a group in VUnet, you are expected to attend all sessions (eight). If you decide to withdraw from the course, please do so in time. This all 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.

**Overige informatie**
- To do well, students are expected to attend all lessons. Group schedules are to be found at rooster.vu.nl and on Blackboard.
- If you (expect to) miss a session, please inform the group trainer as
soon as possible. If you miss a session without notification, you may not be able to finish the course.
- For any questions concerning this course, please contact onderwijsbureau.beta@vu.nl.

### Scientific Writing in English (AM_BMOL)

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#### 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
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- 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 4 contact hours during the first week and 2 contact hours a week for the rest of the course. 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 or Results, Discussion) and get a pass mark for all writing assignments;
- Students provide elaborate peer feedback;
- Students attend all sessions;
- Students are well prepared for each session (i.e. do all homework assignments);
- Students actively participate in class;
- Students do not plagiarise or self-plagiarise.

Literatuur

Doelgroep
Students Biomolecular Sciences

Intekenprocedure
Since this course starts at August 31st, you have to sign in for the course before this date (despite other communication on VUnet).

Important: each group has a minimum of 18 and maximum of 24 participants, so students should register on time through VUnet to ensure a place in one of the (designated) groups. If you have registered for a group in VUnet, you are expected to attend all sessions (eight). If you decide to withdraw from the course, please do so in time. 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.
Each semester, one or more open/general groups also take place (with a minimum of 18 participants), for which students may register instead of the designated group for their master programme. Students are advised to consult their schedule carefully, since overlap may occur. For more information, please check course code AM_471023.

**Overige informatie**
- To do well, students are expected to attend all lessons. Group schedules are to be found at rooster.vu.nl and on Blackboard.
- If you (expect to) miss a session, please inform the group trainer as soon as possible. If you miss a session without notification, you may not be able to finish the course.
- For any questions concerning this course, please contact onderwijsbureau.beta@vu.nl.

**Signal Transduction in Health and Disease**

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**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 receptor/protein family linked to disease. Molecular mechanisms underlying pathology will be addressed and presented.

**Toetsvorm**
Assignment and presentation, written exam.
Structural Bioinformatics

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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 simulation, &Monte Carlo simulation
• Function from structure

Practical:
• Obtaining geometric features from PDB files
• Homology modelling with Modeller
• Protein interaction as a ‘computational experiment’ (simulation).

Onderwijsvorm

13 Lectures (2 two-hour lectures per week)
12 computer practicals (2 two-hour sessions per week)
Feedback (theoretical and practical) will be given during the computer practical sessions.

Toetsvorm

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

Practical Assignments: (50%)
1. Obtaining geometric features from PDB files
2. Homology modelling with Modeller (including structural alignment)
3. Protein interaction as a ‘computational experiment’ (simulation).

Theoretical: (50%)
• Oral or written exam (depending on number of course students).
• As part of the exam a research paper on a Structural Bioinformatics topic needs to be analysed in detail.
• You will be prepared for your exam through exercises and paper discussion during the lectures.

Literatuur
- course material on bb.vu.nl

Aanbevolen voorkennis
Bachelor in any science discipline (including medicine). Basic scripting skills (e.g. Python or Perl) and an interest in biological problems. Note that at the start of the course a small scripting practical will be given, this means that in practice students without scripting experience can follow the course if they are motivated to learn during the course.

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

Overige informatie
- Compulsory course for students in Bioinformatics Profile of MSc Bioinformatics & Systems Biology (mBIO).
Optional course for mAI, mCS, mPDCS, mMNS, mBMOL, mNS, mBIO

Thesis Based on Literature Study

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