

International Master in Biomedecine

Semester 1

	Vorlesung (UE)	Übung (UE)	ECTS
Module 1.1			6
ISB201: Gene Regulation / Transcriptomics	31		4
ISB202: Practicals in Gene Regulation (Optional)		80	4
Module 1.2			8
ISB301: Protein Structure and Function (Optional)	24	36	4
ISB302: Proteomics (Optional)	35	50	4
Module 1.3			4
ISB701: Introduction to Systems Biology	20	30	4
ISB702: Practicals in Systems Biology (Optional)	20	60	4
ISB102: Practicals in Bioinformatics (Optional)	40	53	4
Module 1.5			10
ISB811: Safety in the Laboratory	0	40	2
Module 3.2			18
ISB902: Research practical (Optional)	300		18
Module 3.4			3
Academic writing workshop (Optional)	20		3

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ISB201: Gene Regulation / Transcriptomics

Modul:	Module 1.1 (Semester 1)
ECTS:	4
Objektiv:	What is transcriptomics? How are genes regulated? How can this be measured? Epigenetic regulation, modern technologies (GWAS, microarrays, RNA-Seq), how are transcriptomic high throughput data analysed?
Course learning outcomes:	Transcriptomics Basal transcription machinery- gene regulation Epigenetic regulation Modern technologies (GWAS, microarrays, RNA-Seq) Bioinformatic analysis of transcriptomic high throughput data
Beschreibung:	Transcriptomics Basal transcription machinery- gene regulation Epigenetic regulation Modern technologies (GWAS, microarrays, RNA-Seq) Bioinformatic analysis of transcriptomic high throughput data Technologies in high throughput transcriptomics
Modalitäten:	Lecture
Sprache:	Anglais
Pflichtkurs:	Oui
Evaluation:	Exam and group presentation
Remark:	Support / Arbeitsunterlagen / Support : Lecture pdf and handouts Littérature / Literatur / Literature :



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Updated lists (papers, www sites, online courses) are supplied during the lectures and during the course

Professor: KREIS Stephanie

ISB202: Practicals in Gene Regulation

Modul: Module 1.1 (Semester 1)

ECTS: 4

Objektiv: What is transcriptomics? How are genes regulated? How can this be measured? How can gene regulation be experimentally manipulated? Epigenetic regulation, modern technologies (GWAS, microarrays, RNA-Seq), how are transcriptomic high throughput data analysed?

Course learning outcomes:

Transcriptomics
Basal transcription machinery- gene regulation
Epigenetic regulation
Modern technologies (GWAS, microarrays, RNA-Seq)
Bioinformatic analysis of transcriptomic high throughput data
Reporter gene assays
miRNA and mRNA qPCR, data analysis of qPCR
analysis of Western blot results (supplied)
critical thinking
practically planning and performing molecular biological experiments

Beschreibung:

Transcriptomics
Basal transcription machinery- gene regulation
Epigenetic regulation
Modern technologies (GWAS, microarrays, RNA-Seq)
Bioinformatic analysis of transcriptomic high throughput data
Reporter gene assays
miRNA and mRNA qPCR
analysis and interpretation of lab test results

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Modalitäten:	Practical course
Sprache:	Anglais
Pflichtkurs:	Non
Evaluation:	Course performance, practical knowledge test, and written report
Remark:	Support / Arbeitsunterlagen / Support : Script, theoretical lectures during practical courses (handouts) Littérature / Literatur / Literature : Updated lists (papers, www sites, online courses) are supplied during the lectures and during the course

ISB301: Protein Structure and Function

Modul:	Module 1.2 (Semester 1)
ECTS:	4
Objektiv:	<ul style="list-style-type: none">• Getting an overview on protein structure and function• Ability to analyse protein expression and function and to judge the interrelationship of each given protein in biological pathways• Understanding of the central role of proteins in the function of a cell
Beschreibung:	<ul style="list-style-type: none">• Basics of protein structure• Different classes of proteins• Structural proteins, Transport proteins, Membrane proteins• DNA-binding proteins• Enzymes• Protein-protein interactions• Proteins in regulatory pathways• Protein expression/synthesis• Protein trafficking• Post-translational modifications• Protein degradation• The human proteome, Proteomes of model organisms
Modalitäten:	Lectures + Practicals
Sprache:	Anglais
Pflichtkurs:	Non
Evaluation:	Written exam
Professor:	ABANKWA Daniel

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ISB302: Proteomics

Modul:	Module 1.2 (Semester 1)
ECTS:	4
Objektiv:	Students trained in this course will be able to design a basic cellular experiment that involves proteomic profiling using LC-MS/MS. Students will be able to differentiate various technologies (instrumentation, enrichment strategies, protein identification and quantification) in the field of proteomics, and be able to compare their capabilities and limitations for biomedical research. Home work and quiz will focus on data interpretation using mass spectra acquired from peptides, from which students will be able to identify proteins (both by de novo sequencing and using a database search engine). We introduce reverse-phase protein array (RPPA) as a cross validation technology. Students will understand the principle of protein microarrays and be able to compare the analytical aspects of RPPA and LC-MS in phosphoproteomics.
Course learning outcomes:	Biological mass spectrometry Mass spectrometry-based proteomics Analytical strategies for proteins (enrichment, separation, identification and quantification) Phosphoproteomics Protein microarray
Beschreibung:	(1) Biological mass spectrometry and its application - Mass spectrometry - Liquid chromatography - Protein chemistry for MS-based proteomics - Peptide sequencing - Protein identification - Protein quantification - Proteome profiling and sample preparation - PTM studies - Proteomics in biomedical research - Proteomics in clinic - Proteogenomics (2) A case study of phosphoproteomics - Introduction of phosphoproteomics - Phospho-enrichment and biochemical processing (wet-lab) - LC-MS/MS (MS lab) and data analysis (3) Cross-validation of phospho signaling - Introduction of protein arrays - Protein extraction (wet-lab) - RPPA (protein lab) and data analysis
Modalitäten:	Lectures + Practicals
Sprache:	Anglais
Pflichtkurs:	Non
Evaluation:	Attendance (10%), Home Work (20%), Quiz (30%), and Report (40%)
Remark:	Support:

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Handout: A booklet prepared by lecturers will be provided.

Professor: DITTMAR Gunnar

ISB701: Introduction to Systems Biology

Modul: Module 1.3 (Semester 1)

ECTS: 4

Objektiv: Getting an overview on the elements of systems biology and its concepts

Ability to analyze biological processes by systems biology methods and concepts

Understanding of the principles of systems biology, such as topology, stoichiometrics and kinetics

Course learning outcomes:

1. Recall and apply key procedures and methods in mathematics and bioinformatics.
2. Differentiate the key principles of bottom-up systems biology.
3. Integrate basic understanding of bottom-up systems biology by designing, creating and analyzing models.

Beschreibung: Definition of systems biology

Basic concepts in systems biology

Biophysical basis of enzyme reactions

Reconstruction of biochemical networks

Metabolic networks

Basic features of the stoichiometric matrix

Topological properties

Modalitäten: Lectures

Sprache: Anglais

Pflichtkurs: Oui

Evaluation: Written exam

Remark: **Learning material:** Lecture slides, PDF-files of review articles

Professor: SAUTER Thomas

ISB702: Practicals in Systems Biology

Modul: Module 1.3 (Semester 1)

ECTS: 4

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Objektiv:	<ul style="list-style-type: none">· Build and simulate ODE and constraint based models· Analyze these models applying standard methods· Perform and document own modeling project (ideally linked to Master thesis)
Beschreibung:	<ul style="list-style-type: none">- Introduction to Matlab- Solving Exercises of ISB701 with Matlab- Numerical integration- Building ODE models (e.g. of simple motifs), Tools: ALC, Matlab Toolboxes- Parameter identification, identifiability- Sensitivity Analysis, Metabolic Control Analysis- Building constrained based models: Metabolic Flux Analysis, Flux Balance Analysis, Tool: Cobra Toolbox- Databases & SBML: models, parameters, pathways
Modalitäten:	Lectures + Practicals
Sprache:	Anglais
Pflichtkurs:	Non
Evaluation:	Protocol of work done
Professor:	SAUTER Thomas

ISB102: Practicals in Bioinformatics

Modul:	Module 1.3 (Semester 1)
ECTS:	4
Objektiv:	<p>Getting an overview on mathematical methods and computational methods that are central to systems biology</p> <p>Ability to use Mathematics: matrix operations, simple ordinary differential equations, basic of parameter estimation, statistical analysis methods for microarray analysis</p> <p>Bioinformatics: introduction to Linux, command line usage (Linux) and scripting. Various programming languages useful for mathematical and statistical tools (Matlab and R), basic file handling and data pre-processing (Python and shell scripts).</p> <p>Understanding of Mathematics: basic linear algebra, basic matrix operations, ordinary differential equations, testing statistical hypothesis in context of large datasets</p> <p>Bioinformatics: basic programming concepts applicable to writing scripts, accessing databases, steps involved in analyzing large biological datasets applied on microarray analysis</p>
Beschreibung:	<p>The course is intended as an introduction to methods that will be needed to analyze systems biology datasets. Both mathematics and computational biology parts aim to supply the student with the basic skill set that will be expanded in the following Systems Biology courses. The course has three parts: in the first part, the students will revise mathematics and receive homework to practice derivation and integration of functions, basic linear algebra and handling of ordinary differential equations. The second part focuses on basic programming skills and useful (sometimes needed) shell scripting, so that students get tasks to write a simple script</p>

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to manipulate a text files, to pre-process data either by python programming or shell scripting and to compute a mathematical operation on a dataset. In the third part, the students will follow demonstrations of microarray data analysis and analyze a dataset in practice using both command-line and online web applications.

Modalitäten:	Lectures + Practicals
Sprache:	Anglais
Pflichtkurs:	Non
Evaluation:	graded homework
Remark:	Lecture slides, PDF-files of review articles, Book: Systems biology in practice (selected parts), Klipp et al Wiley-VCH

ISB811: Safety in the Laboratory

Modul:	Module 1.5 (Semester 1)
ECTS:	2
Objektiv:	Getting an overview on working in a bioscience laboratory Ability to design and perform experiments in modern bioscience Understanding of the safety regulations in a bioscience laboratory
Beschreibung:	Safety regulations in bioscience Sterile working Ordering reagents Preparing solutions Designing and organizing experiments Analysis of data Presentation of research results
Modalitäten:	40 h instructions and demonstrations, 25 h independent study
Sprache:	Anglais
Pflichtkurs:	Oui
Remark:	Learning material Instruction hand-outs, PDF-files of method articles Teaching methods and assessment Obligatory attendance, summary protocol
Professor:	SALSMANN Alexandre

ISB902: Research practical

Modul:	Module 3.2 (Semester 1)
ECTS:	18
Sprache:	Anglais
Pflichtkurs:	Non
Professor:	SCHWAMBORN Jens Christian

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Academic writing workshop

Modul: Module 3.4 (Semester 1)

ECTS: 3

Course learning outcomes: Learning outcomes
Students will be able to:

- become aware of how their writing process can become more effective and efficient.
- evaluate their own texts for communicative adequacy and style.
- structure their texts to ensure communicative effectiveness.
- integrate sources appropriately and distinguish their own viewpoint

Beschreibung: This course uses participants' own work to understand and improve upon the key elements of academic writing. These workshops will use both participants' own work and example texts to present and analyse key features of English academic writing. Students will examine and discuss texts and complete exercises to help them acquire the knowledge and techniques to revise their own writing and the confidence to embark upon their dissertation. The focus will be on establishing the foundations for successful academic writing and will use constructive peer review of current or previous written work to improve students' awareness of written communicative effectiveness. As a result of the interactive and needs-driven format, the exact content of workshops will depend on participants' texts and their own issues with academic writing. However, key content that will be covered is as follows:

- optimising the efficiency and effectiveness of your writing process;
- using an academic style and register;
- effective paragraphing;
- taking a stance and constructing an argumentative thread;
- confidently and accurately integrating sources into your writing;
- structuring your writing for coherence; and
- identifying and correcting common English language errors in academic writing.

Sprache: Anglais

Pflichtkurs: Non

Evaluation: Active participation in the workshops
Completion of extension activities
Provision of peer feedback (both orally and in written form) (Re)writing your own paper

Remark: Note
This is not a language course.
As the workshops are based on participants' own writing, only students who have already written – or are currently writing – an extended piece of writing (e.g. a paper or report) in English for their MA can participate.
To make this course most effective, you will be required to submit a paper before the first session (deadline: 17 February). Please register on Moodle to submit your paper in time. If you experience



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problems registering, please email languagecentre@uni.lu
Bibliography
Handouts and relevant reading material will be posted on Moodle.

Professor:

SKIPP Jennifer