International Master in Biomedecine

Semestre 1

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

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Semestre 1

ISB201: Gene Regulation / Transcriptomics

Module:	Module 1.1 (Semestre 1)
ECTS:	4
Objectif:	What is transcriptomics? How are genes regulated? How can this be measured? Epigentic regulation, modern technologies (GWAS, microarrays, RNA-Seq), how are transcriptomic high trhoughput data analysed?
Course learning outcomes:	Transcriptomics Basal transcritpion machinery- gene regulation Epigentic regulation Modern technologies (GWAS, microarrays, RNA-Seq) Bioinformatic analysis of transcriptomic high trhoughput data
Description:	Transcriptomics Basal transcritpion machinery- gene regulation Epigentic regulation Modern technologies (GWAS, microarrays, RNA-Seq) Bioinformatic analysis of transcriptomic high trhoughput data Technologies in high throughput transcriptomics
Modalité d'enseignement:	Lecture
Langue:	Anglais
Obligatoire:	Oui
Evaluation:	Exam and group presentation
Remarque:	Support / Arbeitsunterlagen / Support : Lecture pdf and handouts Littérature / Literatur / Literature :

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

Professeur: KREIS Stephanie

ISB202: Practicals in Gene Regulation

Module: Module 1.1 (Semestre 1)

ECTS: 4

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

Course learning outcomes:

Transcriptomics

Basal transcritpion machinery- gene regulation

Epigentic regulation

Modern technologies (GWAS, microarrays, RNA-Seq)

Bioinformatic analysis of transcriptomic high trhoughput data

Reporter gene assays

miRNA and mRNA qPCR, data analysis of qPCR

anaylsis of Western blot results (supplied)

critical thinking

practically planning and performing molecular biological experiments

Description:

Transcriptomics

Basal transcritpion machinery- gene regulation

Epigentic regulation

Modern technologies (GWAS, microarrays, RNA-Seq)

Bioinformatic analysis of transcriptomic high trhoughput data

Reporter gene assays

miRNA and mRNA qPCR

anaylsis and interpretation of lab test results

Modalité d'enseignement:	Practical course
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Course performance, practical knowledge test, and written report
Remarque:	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

Module:	Module 1.2 (Semestre 1)
ECTS:	4
Objectif:	• Solid knowledge of how proteins function as 'molecular machines' • Understand general 'rules' and common principles in protein activity regulation • Understand the generic architecture of proteins and protein mediated processes (enzyme catalysis, signalling) • Learn about the evolutionary principles that are exploited to create the diversity of proteins • Apply knowledge to the difficult question of drug discovery
Description:	In the main lecture we will use a mix of classical theory- and methods-focused lectures, flipped classroom teaching, Kahoot-formative testing and exercises to provide you with an intensive training in modern protein biology. We will start by reviewing basics of chemistry that apply to protein biochemistry and repeat the fundamentals from amino acids to secondary structures. Next we have a look at the basic building blocks of proteins, domains, and learn how these combine to form new functional entities. Then we look at how proteins react as enzymes and with each other, how they are modified, and which factors determine how fast they react. In the fourth section, we look at how major signalling pathways function on the protein-structural level, before we in the fifth section look at drug discovery. We learn about basics in drug discovery and will apply our knowledge from all the sections in group exercises to formulate steps necessary in drug discovery. These theoretical sections are supported by method focused lectures, where we learn about common tools in protein biochemistry. This includes, the structure and application of antibodies e.g. in Western blotting, bio/physical techniques to study protein-protein interactions in vitro and in cells, basics of protein structure determination and common assays in drug discovery.

Additional lectures and exercises will introduce you to the use of protein databases and computational protein structure analysis.

In an accompanying seminar you will elaborate a presentation on a protein science topic and present it to the class.

Last but not least, you will gather hands on experience in a practical that will introduce you to basic techniques of protein biochemistry, such as Western blotting.

Modalité d'enseignement: Lectures + Practicals

Langue: Anglais

Obligatoire: Non

Evaluation: Final written exam (11/ 20)

Two Quick Tests during the lecture (2/20)

Report and contribution to practical (TP) (6/20)

Seminar presentation (1/20)

Remarque: How proteins work (Mike Williamson) Garland Science, ISBN-10: 9780815344469

https://www.amazon.com/How-Proteins-Work-Mike-Williamson/dp/0815344465/

Professeur: ABANKWA Daniel, LETELLIER Elisabeth, MANOHARAN Ganesh Babu

ISB302: Proteomics

Module: Module 1.2 (Semestre 1)

ECTS: 4

Objectif: 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

Description:	(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
Modalité d'enseignement:	Lectures + Practicals
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Attendance (10%), Home Work (20%), Quiz (30%), and Report (40%)
Remarque:	Support: Handout: A booklet prepared by lecturers will be provided.
Professeur:	DITTMAR Gunnar

ISB701: Introduction to Systems Biology

Module:	Module 1.3 (Semestre 1)
ECTS:	4
Objectif:	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, stochiometrics 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.

Description:	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
Modalité d'enseignement:	Lectures
Langue:	Anglais
Obligatoire:	Oui
Evaluation:	Written exam
Remarque:	**Learning material:** Lecture slides, PDF-files of review articles
Professeur:	SAUTER Thomas

ISB702: Practicals in Systems Biology

Module:	Module 1.3 (Semestre 1)
ECTS:	4
Objectif:	· 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)
Description:	- 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
Modalité d'enseignement:	Lectures + Practicals
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Protocol of work done

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Professeur: SAUTER Thomas

ISB102: Practicals in Bioinformatics

Module: Module 1.3 (Semestre 1)

ECTS: 4

Objectif: Getting an overview on mathematical methods and computational methods that are central to systems biology
Ability to use Mathematics: matrix operations, simple ordinary differential equations, basic of parameter estimation, statistical analysis methods for microarray analysis

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).

Understanding of Mathematics: basic linear algebra, basic matrix operations, ordinary differential equations, testing statistical hypothesis in context of large datasets

Bioinformatics: basic programming concepts applicable to writing scripts, accessing databases, steps involved in analyzing large biological datasets applied on microarray analysis

Description: 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 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.

Modalité d'enseignement: Lectures + Practicals

Langue: Anglais

Obligatoire: Non

Evaluation: graded homework

Remarque: Lecture slides, PDF-files of review articles, Book: Systems biology in practice (selected parts), Klipp et al Wiley-VCH

ISB811: Safety in the Laboratory

Module:	Module 1.5 (Semestre 1)
ECTS:	2
Objectif:	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
Description:	Safety regulations in bioscience Sterile working Ordering reagents Preparing solutions Designing and organizing experiments Analysis of data Presentation of research results
Modalité d'enseignement:	40 h instructions and demonstrations, 25 h independent study
Langue:	Anglais
Obligatoire:	Oui
Remarque:	Learning material Instruction hand-outs, PDF-files of method articles Teaching methods and assessment Obligatory attendance, summary protocol
Professeur:	SALSMANN Alexandre

ISB902: Research practical

Module:	Module 3.2 (Semestre 1)
ECTS:	18
Langue:	Anglais
Obligatoire:	Non
Professeur:	SCHWAMBORN Jens Christian

Academic writing workshop

Module:	Module 3.4 (Semestre 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

Description: 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.

Langue: Anglais

Obligatoire: 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

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

Professeur: SKIPP Jennifer