Exchange programme Vrije Universiteit Amsterdam

Vrije Universiteit Amsterdam - Exchange programme Vrije Universiteit Amsterdam - 2024-2025

Exchange

Vrije Universiteit Amsterdam offers many English-taught courses in a variety of subjects, ranging from arts & culture and social sciences, neurosciences and computer science, to economics and business administration.

The International Office is responsible for course approval and course registration for exchange students. For details about course registration, requirements, credits, semesters and so on, please visit the exchange programmes webpages.

Metabolomics

Course Code	AB_1291
Credits	6
Period	P2
Course Level	300
Language Of Tuition	English
Faculty	Faculty of Science
Course Coordinator	prof. dr. P.E.G. Leonards
Examiner	prof. dr. P.E.G. Leonards
Teaching Staff	prof. dr. P.E.G. Leonards, dr. L.A. Baumann
Teaching method(s)	Written partial exam, Practical, Seminar, Study Group, Lecture

Course Objective

Molecular biology studies the functioning of cells and organisms at the molecular level, and is applied in many fields. Metabolomics is a rapidly emerging field in molecular biology, and is one of the so-called omics technologies (genomics, proteomics, metabolomics). Metabolomics measures small molecules – the metabolites – in the cell or organism with the aim of determining the health status. But it can also determine the influence of the environment on health, for example through diet or exposure to toxic substances. Examples of metabolites are amino acids, ATP, sugars, neurotransmitters, lipids, etc.

Metabolomics aims to measure the complete set of metabolites (the metabolome) in organisms and is widely used in the medical, toxicological, and biological field. Metabolites function in a network and are transported to the desired destination via the streets as in a city. Metabolites have a major influence on the phenotype, behavior but also on the development of organisms.

This course aims to provide insight into the principles of metabolism in organisms, how metabolomics can be used in practice, how metabolites can be determined in organisms, and how the large amount of data can be handled, processed, visualized and statistically analysed (Big data analysis). The course has a practical approach and consists of lectures followed by a metabolomics experiment (practical). The practical is an important part of the course in which the student will conduct an experiment with zebrafish eggs and determine metabolites in the zebrafish embryos. Another important part is the processing of the large amount of data generated by using data visualization and statistical tools (introduction to processing of Big Data).

The following topics are covered:

- What is metabolomics
- What are metabolic networks
- Basic principles and workflows for determining and processing metabolite data
- Methods for the analysis of metabolites
- Applications of metabolomics
- Setting up a metabolomics experiment
- Processing and analysis of large data (visualization, metabolite networks, statistical analysis)

The practical is an important part of the course to give the student a better insight into the various aspects of metabolomics. The student carries out a metabolomics experiment with zebrafish eggs, whereby the development from egg to embryo is monitored. The metabolites (lipids and neurotransmitters) are determined, and the data is processed, among other things by visualizing the data, creating metabolic networks and statistically processing the data.

The learning objectives at the end of the course are:

- The student has knowledge and insight into the topics covered from metabolomics in cells and organisms. The interactions between metabolites, proteins and genes.
- The student has insight into the methods of measuring metabolites and the challenges of studying the metabolome.
- The student gains experience with chemical analysis methods and the analysis of large data sets.
- The student has practical experience in setting up and conducting a metabolomics experiment.
- The student can process and analyse collected experimental data and can do the interpretation.

Course Content

The course provides an introduction to metabolomics and will discuss and use the tools and techniques (practical) needed to conduct a metabolomics study. Various applications of metabolomics in biology, medical and toxicological fields will be discussed. A focus point in the course is the performance of a metabolomics experiment in which you will work with eggs of zebrafish. You follow the development from egg to embryo, determine lipids and neurotransmitters in the embryos, and process and analyse the large amount of data.

In this course a large number of fundamental and practical topics from metabolism and metabolomics are covered such as:

- Metabolic Networks
- Metabolomics (principles, workflows in metabolomics, applications)
- Introduction to chemical analysis methods (chromatography, mass spectrometry)
- Introduction to data processing (including visualization and Big data analysis)

In the practical, the students will apply the material from the lectures via a metabolomics experiment with zebrafish to understand the principles of metabolic networks, the use of analytical equipment to determine metabolites, and the processing and analysis of large data sets.

Additional Information Teaching Methods

Lectures (18 hours)
Metabolomics practical (28 hours)
Data processing (20 hours)
Presentation (16 hours)
Practicum report (8 hours)
Self-study (78 hours)

Method of Assessment

Examination (50% of the final grade, average grade at least 5.5).
Presentation (25% of the final grade, average grade at least 5.5).
Practicum report (25% of the final grade, average grade at least 5.5).

Attending practicals and working groups must be sufficient.

Literature

- Background literature, not needed.
- Metabolome analysis : an introduction. Silas G. Villas-Bôas, et al. 2007. ISBN-13: 978-0-471-74344-6. Chapters 1-5.

Additional Information Target Audience

Part of the minor Biomolecular Sciences.