MICAS Master's Degree

Course: "Microbiota, Gut, Brain and Healthy Eating"

Graduate Programme MICAS

Master's 1 and 2 Syllabus

SUMMARY

INTRODUCTION

The Microbiota, Gut, Brain and Healthy Food (MICAS) programme is held by the University of Nantes. It is an integrated course that offers excellent opportunities for those wishing to pursue a career in academic research, but also in corporate research and development. MICAS is supported by the French National Research Agency (ANR), which certifies that the programme draws on the expertise of two internationally recognised laboratories, PhAN and TENS, in neurobiology, microbiota, gastroenterology, metabolism, allergology, nutrition, biomedicine, bioinformatics and systems biology.

MICAS is a Master's programme focused on understanding the mechanisms of chronic diseases (neurological, inflammatory and metabolic) and their modulation by targeting the gut microbiota and diet. It explores the functioning and dysregulation of the gut-brain axis and associated organs in relation to the microbiota and nutrition. The programme emphasises preventive nutrition and the developmental origins of health and disease in order to preserve the proper functioning of organs. Based in Nantes, it draws on recognised expertise.

The synergy of skills within the MICAS team offers you the opportunity to **develop** unique expertise in the field of physiology and its modulation by food and microbiota. Teaching is based on a balance between lectures, practical work, tutorials and immersion in research laboratories. Workshops and projects involving close interaction with academic and agri-food stakeholders offer you the opportunity to tailor your course to your career goals.

The workshops and practical work are supported by state-of-the-art equipment available within the platforms and partner laboratories of the university research school to which this programme is affiliated. The complementary areas of expertise of these contributors enable you to address the entire molecular architecture development chain: design, modelling, synthesis and application. In addition, students are in contact with professionals from the socioeconomic world, enabling them to be well informed about the business world and the opportunities available to them.

The Master's program is taught in both English and French in the first year, then entirely in English in the second year.

MASTER'S PROGRAMME COORDINATORS

Khadija OUGUERRAM

Botum Kalyane BACH

TEACHING LOCATION

At Nantes University in, Faculty of Science and Technology, Faculty of Medicine and Medical Technology, Faculty of Pharmaceutical and Biological Sciences, and at Oniris VetAgroBio Veterinary Campus.

SKILLS DEVELOPED

- **Conducting** research and analysis of bibliographic and technological resources
- **Design** a project in Biology-Health in your area of specialisation
- **Develop** an experiment in Biology-Health
- **Analyse** data collected in a fundamental, clinical or pharmacological research study
- **Promote** one's results and scientific output

Upon completion of the MICAS (Microbiota, Intestine, Brain and Healthy Food) Master's programme, graduates can pursue positions in research and development in industry in the field of healthy food, or continue their career in academic research via a PhD. they are also aware of the challenges of microbiota and nutrition in medical care, which allows them to enter the public or semi-public sector depending on their profile.

It is possible to prepare a doctoral thesis in France or abroad with possible access to thesis funding (e.g. CIFRE-type grants in conjunction with a company, funding via calls for projects from EUR Biology Health and its network).

PROGRAMME STRUCTURE

1. General overview of the programme

MICAS is a Master's programme focused on understanding the mechanisms of chronic diseases (neurological, inflammatory and metabolic) and their modulation by the gut microbiota and diet. It explores the functioning and dysregulation of the gut, associated organs and the brain in relation to the microbiota and nutrition. The programme emphasises preventive nutrition and the DoHAD (developmental origins of health and disease) concept to preserve proper organ function. Based in Nantes, it draws on recognised expertise in neurobiology, microbiota, gastroenterology, metabolism, allergology, nutrition, biomedicine, bioinformatics and systems biology.

Year 1: From health and disease to the laboratory bench, mobilising various resources covering the latest scientific and methodological advances in the field.

Year 2: From the laboratory to health and disease - Physiopathology, prevention and therapy, scientific and clinical evidence of the effects of diet and microbiota on health and in the prevention or treatment of diseases. During this year, priority will be given to immersion in the student's professional field of interest (work-study programme in industry or academic or industrial research laboratory).

Depending on their career plans, the Master's programme will enable (1) M2 graduates to enter fields of activity related to nutrition and health, (2) students to pursue a PhD, and/or (3) students from medical and paramedical backgrounds to become more aware of issues related to nutrition and microbiota in medical care and practices.

JOIN THE MICAS MASTER'S PROGRAMME

Scholarship

A welcome grant of €1,500 is awarded to international students who enrol in our programme. They may also apply for the G. Eiffel Excellence Grant and any grants offered by their embassy.
Students from MICAS programme who wish to do an internship abroad may also be eligible for mobility assistance in the form of a monthly allowance of €500 to €700 (subject to eligibility).

How to apply?

The prerequisites and various admission procedures are detailed on the course information sheet on the Nantes University website:

Master's Programme 1

Specific MICAS Master 1

Nerve Circuits and Behaviour-Cognition

TOTAL: 24 hours
Year/semester: Master 1/Semester 1 Language of instruction: Mixed French-English
Prerequisites Validated Bachelor's degree, Human and animal physiology studied

Objectives *Upon completion of the course, students will be able to*:

- **Understand** how the central and peripheral nervous systems function during development and ageing
- **Integrate** nervous circuits into immune and endocrine functions
- **Associate** fundamental cellular and molecular concepts with behavioural and cognitive functions, in relation to the gut microbiota and diet

Content covered:

Lectures: 16 hours

• **Neurophysiology and cognitive functions:**
In this part of the course, the major stages of development of the central nervous system (CNS) and enteric nervous system (ENS) (cell proliferation and migration, neuronal and glial maturation, synaptogenesis) and the mechanisms of ageing will be covered and linked to neuropsychiatric and neurodegenerative diseases. The mechanisms of cognitive, linguistic, psychomotor and psychoaffective development in healthy individuals will also be discussed.

• **The nervous system and its integrated networks in the body:**
In this part of the course, examples of interactions between the nervous system and the immune/endocrine systems will be presented in relation to stress and neuroimmune pathologies.

• **Nerve circuits related to food and nutrition:**
In this part of the course, eating behaviour and the impact of diet on neurodevelopment will be discussed. A basic introduction to the concept of developmental origins of health and disease in adults (DOHaD concept) will be provided.

Tutorials: 8 hours
Educational workshops with case studies, article analyses and mini-projects will be offered to deepen knowledge of the interactions between the nervous system, food and microbiota. Students will be required to write reports and/or give oral presentations on their summary work, depending on the tutorial sessions.

Teaching methods: Face-to-face; lectures and tutorials

Healthy and Pathological Digestive System

Number of hours: 24
Year/semester: Master's 1/Semester 1 Language of instruction: French/English

Prerequisites: Validated Bachelor's degree, Human and animal physiology studied

Objectives:

Upon completion of this course, students should be able to:

- **Understand** digestive physiology, including the associated organs and the various endogenous (nervous, endocrine, microbiota) and exogenous (diet, endocrine disruptors) factors that regulate it
- **Understand** the mechanisms involved in different pathological situations

Content covered: Fundamental physiological and pathophysiological principles of the digestive tract (8 hours of lectures; 4 hours of tutorials) Fundamental physiological and pathophysiological principles of the liver and pancreas (8 hours of lectures; 4 hours of tutorials)

Teaching methods: Face-to-face; lectures and tutorials

Nutritional and digestive examination methods

Number of hours: 24 **hours**
Year/semester: M1/S1 Language of instruction: mixed French/English

Prerequisites: Validated Bachelor's degree, Human and animal physiology studied

Objectives:

Upon completion of this course, students should be able to:

- **Be familiar with** the tools and methods used to conduct relevant bibliographic research and develop a project
- **Understand** the very general or more specialised tools and methods used in research in the field of neuro-digestive and metabolic science
- **Be familiar with** the very general or more specialised tools and methods used in research in the field of nutrition and food
- **Be familiar with** the very general or more specialised tools and methods used in research in the field of microbiota.

Contents covered:

TDI 24h

This course covers different approaches to comprehensive assessment of bodily functions through applied experimental methods, ranging from cells to organs to animal models. It is organised into two sub-modules, covering research environment methods and investigation methods.

The first aims to train students to develop and justify the construction of their research or business project using a mind map.

The second, organised in the form of workshops, introduces students to the various research techniques used by the Nantes laboratories supporting the MICAS programme: **Workshop** 1 - Technology applied to food and techniques for assessing food safety and nutritional status **Workshop** 2 - Techniques for assessing the abundance and diversity of microbiota, as well as methods used to obtain animal models with different microbiota **Workshop 3 -** Cell models used in the study of the nervous system (primary cultures, glia, neurons), digestive system (Caco2, etc.) or organs, enabling the function of these systems to be addressed **Workshop 4 -** Techniques used in the functional exploration of the nervous and digestive systems (permeability, absorption, motility, electrophysiology, etc.)

Workshop 5 - Innovative imaging and optogenesis techniques to further our understanding of the neuro-digestive sphere

Teaching methods: Face-to-face

Microbiota and health

Number of hours: 24 **hours**
Year/semester: M1/S2 Language of instruction: mixed French/English
Prerequisites Validated Bachelor's degree, Human and animal physiology studied

Objectives

Upon completion of this course, students should be able to:

- **Acquire** fundamental knowledge of the microbiota associated with humans and food (methods of study, composition, metabolic functions, inter-microorganism communication capabilities, modulation levers)
- **To deepen their understanding** of the interactions between microbiota and host pathophysiology.
- **Lay** the foundations for the experimental approach used in research (training in critical thinking, analysis of results, presentation of research projects with supporting arguments, and scientific writing)

Topics covered:
Teaching methods: Document analysis, workshops, lectures, independent study
Bibliography: The specific bibliography will be provided during the course.

Preventive nutrition and diet

Number of hours: 24
Year/semester: M1/S2 Language of instruction: mixed French/English
Prerequisites Validated Bachelor's degree, Human and animal physiology studied

Objectives

Upon completion of this course, students should be able to:

- **Identify** key foods and their nutritional content
- **Understand** the pathophysiology of nutrition, related epidemiological studies, the organs involved and the mechanisms at play
- Understand the role and mechanisms of action of phytonutrients and bioactive molecules on human health
- **Understand** the different dietary models and the strengths and weaknesses of each
- **Integrate** this knowledge to develop a preventive diet

Topics covered:

Lectures: 16 hours

- **Nutritional needs in healthy individuals and those in specific physiological situations:**

In this section, the various pathologies associated with nutritional disorders and those affecting nutritional functions, as well as the mechanisms involved, will be discussed in depth. Nutrition adapted to certain clinical situations will also be discussed. The teaching unit will then move on to preventive nutrition. To this end, the necessary methodological tools will be developed (role of the National Nutrition and Health Programme, nutritional epidemiological surveys, dietary models).

- **Knowledge of food composition, the nature of nutrients and health**

This section will provide a comprehensive overview of the nutrients that are appropriate for each physiological situation and/or known for their preventive effects on nutritional disorders. Finally, each nutritional disorder will be reviewed in the context of applied preventive nutrition, emphasising the role of each nutrient in this prevention.

Tutorials: 8 hours

The tutorials will be conducted according to the principle of the flipped classroom: scientific documents on the definition of the level of need, its calculation in particular by biodynamic methods, and the effects of bioactive substances will be provided to students, specifying the theme of each session. Students will work in groups of two or three to present the topic and answer questions from other students before the lecturer provides a summary. Each group of students will also produce a summary of the topic covered and distribute it to the whole class. These sessions will be marked on the basis of oral and written work.

Teaching methods: Face-to-face

Cross-disciplinary Master's 1 modules

Big data 1-1: Introduction to bioanalysis

Number of hours: 24 hours **Lectures:** 16h
Year/semester: M1/S1 Language of instruction: French/English

Prerequisites

Validated Bachelor's degree Human and animal physiology studied

Objectives

Upon completion of this course, students will:
• Be able to identify the stages involved in modelling a biological system
• Will be able to use different data structures and algorithms to propose an analysis of biological data
- Will be introduced to the digital environment

Content covered:

Lectures:
· Introduction/history of modelling living systems
· Presentation of scripting languages
· Algorithmic and data structures in scripting languages
· Manipulation of standard files in biology (e.g. fasta and csv)
· Manipulation of sequences (nucleic acids and amino acids)
· Randomness management

Practical work:
- Extraction of biological knowledge from a fasta file for the representation of a similarity graph via automated sequence alignment

Teaching methods: Lectures and face-to-face tutorials/practical sessions enable students to acquire theoretical knowledge, put it into practice and implement it on a machine.

Bibliography:

Guttag, J. V. (2013). Introduction to Computation and Programming Using Python. The MIT Press. ISBN: 0262525003

Ekmekci B, McAnany CE, Mura C (2016) An Introduction to Programming for Bioscientists: A Python-Based Primer. PLOS Computational Biology 12(6): e1004867. https://doi.org/10.1371/journal.pcbi.100486

Big data 1-2: Introduction to bioanalysis

Number of hours: 24h
Year/semester: M1/S1 Language of instruction: mixed French/English

Prerequisites

Validated Bachelor's degree

Objectives

Upon completion of this course, students will:
- **Practise** algorithmics and programming
- **Analyse** genomic sequences,
- **Implement** computer tools for representing and analysing biological data

Topics covered:

Use of computer science and mathematical concepts for the analysis and visualisation of biological data (sequence analysis and descriptive and inferential statistics) in conjunction with learning how to use a computer environment.

Lectures:
- Presentation of the computer environment
- Presentation of univariate statistical tests
- Presentation of different types of information visualisation

Practical work:
- Analysis of genomic sequences
- Development of scripts for analysing biological data
- Representation and visualisation of biological data

Teaching methods: Lectures and practical work in class enable students to acquire theoretical knowledge, put it into practice and implement it on computers.

Bibliography:

Steven Haddock and Casey Dunn. (2010) Practical Computing for Biologists. Oxford University Press ISBN: 0878933913

Tiago Antao. (2022) Bioinformatics with Python Cookbook: Use modern Python libraries and applications to solve real-world computational biology problems. Packt Publishing. ISBN: 1803236426

Scientific writing workshops

Number of hours: 24

Year/semester: M1/S1

Language of instruction: mixed French/English

Objectives:

Upon completion of the course, students will be able to:

- **Analyse** raw biological results.
- **Propose** a graphical representation and statistical analysis of the results.
- **Organise** several results in the form of a figure.
- **Be familiar with** the formal codes of scientific publication.
- **Write** a scientific article with the help of the teacher at different stages.

Contents covered:

The aim of this course is to guide students through the process of scientific publication, from data processing to the actual writing of a complete publication.
The starting material is a set of raw data with a specific theme for each GP. As a result, a lecturer from each GP will be part of the teaching team and will assist students with thematic aspects.
The data set can be used to answer a scientific question within the theme of one of the GPs, which could lead to the writing of a medium-sized publication, i.e. 4 complex figures. The data set uses at least 4 or 5 different techniques. The data is provided randomly with a minimum of information.
CM1: Scientific publication: principles, structures and general rules 1 hour 20 minutes TP: Identification and processing of raw data 5 x 1 hour 20 minutes
In groups of 3, students identify the tools and operations necessary for using raw data and proceed. Students ask appropriate questions about the methods.
Tutorials 1 and 2: Statistical analysis and graphical representation 2 x 1 hour 20 minutes
After processing the raw data, students generate the appropriate graphical representation and perform the appropriate statistical analysis.
TD 3: Final organisation of figures 1 hour 20 minutes
Students organise all the figures without instruction. They decide what goes together and write the title and caption for the figure. At the end of the session, the teacher validates the figures.
TD 4 to 6: Results session 3 x 1 hour 20 minutes
TD 4 and 5 Oral presentation of a selection of data slides with a short introduction to the context: 2 x 1 hour 20 minutes
TD 6 General advice on how to write a results section: 1 hour 20 minutes From now on, the writing assignment becomes personal.
Students begin writing during the session and finish at home. TD 7: Introduction 1 hour 20 minutes
General advice on writing an introduction section. Students begin writing during the session and finish at home. TD 8: Discussion 1 hour 20 minutes
General advice on how to write a discussion section. Students begin writing during the session and finish at home. TD 9: Summary + graphic summary 1 hour 20 minutes
General advice on how to write a results section. Students begin writing during the session and finish at home.
Student's personal work: finalisation of the article. The methodology section is written without specific guidance but using examples available online.
The teacher corrects the article.
TD 10, 11, 12: Feedback 3X1 hour 20 minutes
End of the workshop: individual meeting (15 minutes) with the student to discuss their work in more detail.

Teaching methods: Competency-based learning

Bibliography: Used during the course

Genome manipulation tools_Workshops

Number of hours: 24 **hours**
Year/semester: M1/S1 Language of instruction: French/English

Prerequisites
Validated Bachelor's degree

Objectives
This module presents genetic engineering tools for manipulating and modifying genomes and gene expression.
Upon completion of these workshops, students will be able to:

- **Choose** the appropriate vectors to express a gene (gene coding for a protein, gene coding for a small RNA) in mammalian cells depending on the purpose of the manipulation (expression of a protein, expression of a labelled protein, expression of a shRNA or miRNA for knock-down, expression of a guide RNA for KO or KI, inducible expression, etc.).
- **Designing** a viral vectorisation strategy
- **Design** a KD/KO/KI strategy,
- **Develop** oligonucleotide design strategies for: cloning DNA into an expression vector, modifying DNA by site-directed mutagenesis or adding tags.

Topics covered: Cloning a sequence encoding a protein or small RNA: Choosing a cloning vector (plasmids/viral vectors, constitutive/inducible expression, stable/transient expression, etc.), choosing a cloning strategy (restriction enzymes and modification/PCR/Gibson/Golden Gate/Gateway cloning, etc.) with the aim of expressing/overexpressing a native, labelled or fused protein, causing the under-expression of a gene (Knockdown siRNA/shRNA), modifying a gene or its expression with CRISPR cas9

Teaching methods:
After setting up a toolbox at the beginning of the course unit, students will be placed in a learning and assessment situation.
Face-to-face work in groups of four with the support of a teacher. Use of web interfaces to implement the strategy for cloning, KD, KO, KI, and production of modified proteins according to specifications. Use of commercial websites to obtain the protocols to be implemented.
Each task lasts 6 hours and is assessed on an ongoing basis based on the submission of a report.

Bibliography: Principles of Genetic Engineering, Sandy PRIMROSE, Richard TWYMAN, Bob OLD, Éditions DE Principles of Genetic Engineering – Primrose.Twiman.Old – De BOECK UNIVERSITÉ

Genome Manipulation Tools_Course

Number of hours: 24 **hours**
Year/semester: M1/S1 Language of instruction: French/English

Objectives :
This module presents genetic engineering tools for manipulating and modifying genomes and gene expression.
Upon completion of this course, students will be able to:

- **Select** the appropriate vectors for expressing a gene (protein-coding gene, small RNA-coding gene) in mammalian cells depending on the purpose of the manipulation (expression of a protein, expression of a labelled protein, expression of a shRNA or miRNA for knock-down, expression of a guide RNA for KO or KI, inducible expression, etc.).
- **Designing** a viral vectorisation strategy
- **Design** a KD/KO/KI strategy,
- **Describe** recombinant protein production systems (prokaryotes and eukaryotes).

Topics covered:
Enzymes and cloning vectors. Gibson/Golden Gate/Gateway cloning, etc. Construction and screening of cDNA libraries. Other sources of cDNA: synthetic genes, ESTs, etc. Expression of a recombinant protein in prokaryotic or eukaryotic systems: E. coli; S. cerevisiae; P. pastoris; baculovirus; vaccinia virus; CHO DHFR cells, etc. Use of viral vectors for gene transfer and gene therapy (retrovirus, lentivirus, adenovirus, AAV).
Knockdown siRNA/shRNA. Modification of genes or their expression with CRISPR cas9.

Teaching methods: Lecture-based, participatory, self-directed and cognitive teaching methods

Bibliography: Principles of Genetic Engineering, Sandy PRIMROSE, Richard TWYMAN, Bob OLD, DE BOECK UNIVERSITÉ Publishing

Tools for bibliographic research

Number of hours: 0 **learning:** 0
Year/semester: M1/S1 Language of instruction: French

Objectives:

Upon completion of the course, students will be able to:

- - **Search** for publications and works in databases using keywords
- - **Search** for bibliographic resources
- **- Present** the results of a summary bibliographic search

Topics covered:

Presentation of bibliographic search and management tools (PubMed, Zotero, etc.).
Assistance with formatting and organising bibliographic data for a project

Teaching methods:

Training materials + exercises on Madoc
Library workshops for students who feel the need

Fundamentals of organisations and management I

Number of hours: 24 hours
Year/semester: M1/S1 Language of instruction: French

Prerequisites

• Validated Bachelor's degree

Objectives

- **Describe** an organisation
- **Identify** an organisational problem
- **Take** a reflective and critical look at the world of organisations
- **Describe** a project
- **Organise** a project
- **Define** and implement management practices

Contents covered:

As part of this course unit, students will have two introductions, one focused on organisations and the other on project management:
EC 1 (16 hours)
• Introduction to the managerial and economic challenges facing organisations, enabling students to understand and define what constitutes an organisational problem. Students will develop the theoretical and practical foundations needed to understand the variety of organisations that exist, as well as the key principles that underpin them. We will also address the major challenges facing contemporary organisations in relation to several organisational dimensions: culture, power, decision-making methods, the place and role of incentives and management tools, and strategy. Examples, readings (press, research, specialised magazines) and case studies (papers, films, series) will be used to address these different themes.
EC2 (8 hours)
Introduction to project management. Students will explore the main definitions of project management and learn about the specific characteristics of project activity within organisations. We will discuss the three fundamental principles of project management (defining objectives, planning tasks, communicating internally and externally), which will enable students to acquire the basic tools and reflexes of project management.

Teaching methods: Face-to-face

Bibliography:

• ***Théorie des Organisations*** *(A. Desreumaux),* Editions EMS: 2015 (3rd ed)
• **Organisation Theory: Challenges and Perspectives**. Mc Aulay et al. (2007) Pearson
• ***Mintzberg on Management: Inside Our Strange World of Organisations*** *(H. Mintzberg)**,***
[Management: Journey to the Centre of Organisations, Free Press [Eyrolles Ed. d'Organisation] 1989 [1998]
• ***Project Management,*** Garel, G. (2011).. La découverte collection *Repères*,
• **Anti-manual for project management: dealing with uncertainty,** Thomas Reverdy, 2021, Dunod
Project management practices; 46 tools and techniques for making the right decision, Vincent Drecq, 2020, Dunod

Fundamentals of Organisations II

Number of hours: 24
Year/semester: M1/S2 Language of instruction: French

Prerequisites
• Validated Bachelor's degree

Objectives:
- **Work** in a highly interdisciplinary group
- **Understand** and utilise team leadership and collective intelligence tools
- **Master** the theoretical challenges of in situ design

Topics covered:
As part of this course unit, students will:
• Acquire project management and entrepreneurship skills through a two-day (intensive) interdisciplinary project. Each year, GS Santé + students will tackle a different theme related to a major transition (or technological challenge), for which they will be required to provide a response in a format to be defined by the teaching team (e.g. business project, initiative project, prospective scenarios, creation of a work of art, etc.).
• In addition to the project activity, students will take various course modules over the two days to acquire new knowledge:
- - Introduction to the use and challenges of "canva"-type tools (business model, circular model, impact models, etc.).
Innovative design courses to develop reflexes and the ability to produce prototypes and/or artefactual solutions to a given problem.

Teaching methods: Face-to-face

Bibliography:
• ***Lean Startup***, Ries, 2012, Pearson
• ***Value Proposition Design***, Pigneur et al, 2015, Pearson
58 tools for systemic design: for planet-centred design, Daumal, 2023 Eyrolles

English and Scientific Communication

Number of hours: 24 hours **Distance learning:** 0 hours
Year/semester: M1/S2 Language of instruction: English

Prerequisites
1- Validated Bachelor's degree, English language studied

Objectives
2- **Give** a presentation in English on a topic of your choice.
3- **Read** an article in English, extract the key points and present them in English.
4- **Listen** to audio or video recordings on biology and health issues and summarise them in writing or orally.
Acquire and use technical vocabulary related to biology and health.

Topics covered:
1- Give a presentation in English on a topic of your choice.
2- Read an article in English, extract the key points and present them in English.
3- Listen to audio or video recordings on biology and health issues and summarise them in writing or orally.
Acquire and use technical vocabulary related to biology and health.

Teaching methods: Face-to-face and distance learning

Bibliography: Glendinning Eric H et al. *Professional English in Use: Medicine*. Repr ed. Cambridge University Press 2015.

Study and research work Defence

Number of hours: 0
Year/semester: M1/S1 Language of instruction: mixed French/English

Prerequisites

Validated Bachelor's degree

Objectives

Students are responsible for finding their own internships, which requires them to put communication techniques into practice (CV, cover letter, interview). However, a number of internships in laboratories (mainly academic laboratories in Nantes) and hospital departments (mainly Nantes University Hospital) will be offered to students. The aim of the internship is to strengthen the student's professional profile by placing them in a professional environment.
At the end of this course, students will:

- **conduct** research and produce a bibliographic summary on a given topic (analysis of articles from scientific journals in English)
- **carry** out experimental protocols, having understood all the steps involved
- will have mastered the techniques learned during their internship independently
- **keep** a laboratory notebook in accordance with Good Laboratory Practice rules
- **be able to critically** analyse their experimental results
- **present** their work clearly, precisely and rigorously in the form of an oral presentation
- **answer** questions from the jury.

Contents covered:

This "Internship" module is designed as an introduction to the professional world, under the supervision of an internship supervisor, researcher or teacher-researcher in academia or industry, in France or abroad. It takes place at the end of the second semester, over an 8-week period integrated into the curriculum.
This professional training module takes several forms, depending on the student's career orientation:

- either an internship in a research laboratory or in a company whose field of activity is related to the biological sciences and the career profile chosen by the student (experimental research, bioanalysis)
- or an internship in a hospital department for students who have chosen the Clinical Research career profile.

or a bibliographic study on a research topic in biology.

Teaching methods:

Students are supervised by an internship supervisor within the host organisation.
Each student is monitored by a tutor who is a member of the teaching team and who ensures that the internship is running smoothly.

Bibliography: Scientific articles related to the theme of the internship research project.

Study and research work Dissertation

Number of hours: 0 Number of ECTS credits

Year/semester: M1/S2 Language of instruction: mixed French/English

Objectives:

Students are responsible for finding their own internships, which requires them to put communication techniques into practice (CV, cover letter, interview). However, a number of internships in laboratories (mainly academic laboratories in Nantes) and hospital departments (mainly Nantes University Hospital) will be offered to students. The aim of choosing an internship is to strengthen the student's professional profile by placing them in a professional environment.

At the end of this course, students will:

- **conduct** research and produce a bibliographic summary on a given topic (analysis of articles from scientific journals in English)
- **carry out** experimental protocols, having understood all the steps involved
- **will have mastered** the techniques learned during their internship independently
- **keep** a laboratory notebook in accordance with Good Laboratory Practice rules
- **be able to critically** analyse their experimental results
- **present** their work clearly, precisely and rigorously in the form of a written report.

Contents covered:

This "Internship" module is designed as an introduction to the professional world, under the supervision of an internship supervisor, researcher or teacher-researcher in academia or industry, in France or abroad. It takes place at the end of the second semester, over an 8-week period integrated into the curriculum.

This professional training module takes several forms, depending on the student's career orientation:

- either an internship in a research laboratory or in a company whose field of activity is related to the biological sciences and the career profile chosen by the student (experimental research, bioanalysis)
- or an internship in a hospital department for students who have chosen the Clinical Research career profile.

or a bibliographic study on a research topic in biology.

Teaching methods:

Students are supervised by an internship supervisor within the host organisation.

Each student is monitored by a tutor who is a member of the teaching team and who ensures that the internship is running smoothly.

To help students write their internship report, a thesis writing guide is available on the University's Moodle teaching platform.

Bibliography: The bibliography necessary for understanding and developing the internship topic.

Experimental Research Career Profile Master 1

Biological Data Management - Semantic Web

Number of hours: 24
Year/semester: M1/S2 Language of instruction: mixed French/English
Prerequisites Validated Bachelor's degree

Objectives

Upon completion of this course, students will:

- Will be able to access biomedical data available on the web
- Formalise queries to explore this data
- Model medical knowledge using formal languages that can be understood by machines
- Reason symbolically about medical data

Contents covered:

The lessons in this course focus on biomedical knowledge graphs available on the web:

· Modelling knowledge graphs
· Concepts of linked data
· Knowledge graph querying
· Concepts of ontology in biomedicine
- Deduction of new knowledge Applications of ontology in biomedicine

Teaching methods: Teaching will take the form of lectures based on scientific publications. Teaching will also involve knowledge sharing, know-how and practical scenarios during practical work.

Bibliography: A bibliography updated annually will be included in the course materials.

Exploration of metabolism in pathologies

Number of hours: 24
Year/semester: M1/S2 Language of instruction: French
Prerequisites Validated Bachelor's degree

Objectives

Upon completion of the course, students will:

- Have a general understanding of integrated and cellular metabolism
- Be able to distinguish between homeostatic and pathological metabolism
  Be familiar with current approaches to studying metabolism
- Be able to propose the use of an approach based on the question asked Be able to present this message in a short oral presentation

Topics covered:

Lecture: 17:20
General concept of energy metabolism (2 hours 40 minutes) Xavier Prieur
Basics of cellular metabolism
Energy substrate and cellular phenotype (examples of metabolic disease, oncology and immunity)
Energy supply and exchange and inter-organ dialogue; concept of metabolic flexibility
Assessing cellular metabolism (2 hours 40 minutes) (Claire Pecqueur)
Different techniques for exploring mitochondrial activity and oxygen consumption. Exploring fluxomic approaches to deciphering the active metabolic pathway.
Analysing a cell's substrate dependence and preferences in different situations (fasting or fed, normal or tumourigenic, activated or at rest, etc.).
An integrated view of metabolism in vivo (4 hours)
Kinetic studies of labelled molecules - In vivo fluxomics (Khadija Ouerram) 1 hour 20 minutes PET and metabolic imaging (18-F glucose monitoring) (see Françoise Kraeber Bodéré) 1 hour 20 minutes In vivo metabolic phenotyping (Xavier) 1 hour 20 minutes
Systemic biology of metabolic data (4 hours) (Mikael Croyal 1 hour 20 minutes, Yann Guitton 1 hour 20 minutes, Damien Eveillard 1 hour 20 minutes)

Metabolomic, lipidomic and high-throughput metabolite analysis: principles of analytical chemistry (mass spectrometry, NMR, etc.)
Analysis of metabolic networks using big data **Metabolic**
stress and cellular remodelling (4 hours) Cellular stress and metabolism (Xavier Prieur) 1 hour 20 minutes
Hypoxia resistance and metabolic switch Claire Pecqueur (1 hour 20 minutes) Overview of immunometabolism (1 hour 20 minutes) Aurélie Moreau) **Tutorial: 6 hours 40 minutes**
An integrated overview: An article from Cell Metabolism or Nature Metabolism studying a key phenomenon. There will be a choice of articles depending on the student's GP (cardiometabolic orientation, nutrition/health orientation, immunometabolism orientation, onco-metabolism orientation)
Tutorial 1: 1 hour 20 minutes after reading, summarise the scientific question in a graphical abstract 1 hour 20 minutes Tutorial 2: highlight a method
Presentation session: 4 hours, flash poster

Examination: a scientific question asked > proposal of an experimental plan to answer the question.

Teaching methods: Lectures – Tutorials: article analysis and flash poster presentations

Bibliography: That used during the course

Genome manipulation tools_Practical work

Number of hours: 10 h

Year/semester: M1/S2

Language of instruction: French/English

Prerequisites

Validated Bachelor's degree

Objectives

This module aims to illustrate and enable the implementation of tools for manipulating and modifying genomes**.** At the end of these practical sessions, students will be able to:

- Design a KO strategy
- Implement a CRISPR/Cas9 strategy (Nobel Prize, 2020) to achieve genetic knockout.
- Analyse and present their experimental results
- Integrate their experimental results into a broader panel

Topics covered:

Gene editing using the CRISPR/Cas9 technique has changed research practices in many laboratories. Its use currently allows genes to be deactivated or manipulated. This technology is implemented in these practical exercises to extinguish a gene in E. *coli*.
The steps involved are:
- Analysis of the GFP sequence
- Definition of crRNA sequences enabling GFP extinction.
- Construction of an expression plasmid allowing the expression in bacteria of an sgRNA targeting GFP and Cas9.
- Co-transformation of E. *coli* bacteria with plasmids encoding GFP, an sgRNA targeting GFP and Cas9.
- Induction of GFP +/- sgRNA and Cas9 expression in bacteria
- Observation and analysis of differences in GFP expression.

Performing a T7 endonuclease assay analysis of the extinction of the eukaryotic p53 gene

Teaching methods: Practical work in pairs in a fully equipped room allowing manipulations to be carried out in professional conditions

Bibliography: Principles of Genetic Engineering, Sandy PRIMROSE, Richard TWYMAN, Bob OLD, DE BOECK UNIVERSITÉ Publishing

Stem Cells and Organoids

Number of hours: 24
Year/semester: M1/S1 Language of instruction: mixed French/English

Prerequisites
Validated bachelor's degree

Objectives
Upon completion of the course, students will be able to:
- - Identify the hypothesis and experimental approach in an article
- - Search for bibliographic resources
- - Analyse and interpret scientific results

Contents covered:
Lecture section
• Human stem cells (General concepts: developmental biology and cell fate – Pluripotency – foetal and adult stem cells)
• Multicellular systems derived from stem cells (introduction to organoids, impact of environmental changes on organoids, complex organoids derived from pluripotent stem cells, 3D culture models
Tutorial section: Application of stem cell culture processes
• Identifying the hypothesis and experimental approach in a selected article
Analysis of the results of a scientific study, selection of articles after a literature review

Teaching methods: Blended, with the possibility of hybridisation

Bibliography: The dedicated bibliography will be provided during the course

Innovative Strategies in Therapy

Number of hours: 24 h
Year/semester: M1/S2 Language of instruction: French

Prerequisites
Validated Bachelor's degree

Objectives
Upon completion of this course, students will be able to:
- identify the key stages of proof-of-concept studies with the clinical development of a biotherapy
- have a reasoned opinion on a range of therapies, including gene therapies, cell therapies, drug therapies and immunotherapies
- assess the need for multidisciplinary knowledge to develop a health therapy
- will summarise a research topic and discuss it with students and teacher-researchers as part of a graphic summary presentation based on the analysis of two scientific articles

Contents covered:
Lecture section – 14.67 hours
After an introductory lecture, two examples of therapeutic strategies currently in use will be presented in each of the themes associated with *the Graduate Programmes*: Cell therapies after allogeneic haematopoietic stem cell transplantation Gene therapy for SCID-X
Generation of monoclonal antibodies for therapeutic use Transfer of genetically modified lymphocytes
From skeletal pathophysiology to reconstruction Duchenne muscular dystrophy
Faecal transplantation Phage therapy
Cardiovascular stem cells Cardiovascular pharmacotherapy **Tutorial section – 9.33 hours**
Two articles related to a given topic will be distributed to a group of 2 to 3 students, who will be required to present them in the form of graphic summaries.

Teaching methods:
All teaching will be face-to-face.
Live or online surveys will be conducted at the beginning of the semester to assess prerequisites in immunology and/or physiology, then regularly during classes to ensure that students understand important concepts. Video and photo materials (Toolbox) will be made available on Madoc to illustrate the courses and techniques.

Self-assessment tests and sample exam questions will be provided, and an online forum will be opened for a question-and-answer exchange between teaching staff and students. Students will work independently and prepare summaries of two articles in the form of written and graphic summaries.

Bibliography:

Principles of Genetic Engineering, Sandy Primrose et al. (DeBoeck Publishing)
"Immunology - The Course by Janis Kuby" Judy Owen et al. (Dunod Publishing)
"Fundamentals of Basic and Clinical Immunology" Abul K. Abbas et al. (Elsevier)

Master's 2 programme

Conditions for obtaining the year:

The validation of the programme complies with the M3C (Modalities for the Assessment of Knowledge and Skills, formerly MCCA), which are organised into three levels:
• Level I: the General Regulations for the Assessment of Knowledge and Skills (RG3C) of Nantes University, voted on by the CAC on 31 March 2023.
• Level II: the specific rules for knowledge and skills assessment of the Faculty of Science and Technology, voted on by the CG on 29 June 2023,
• Level III: the provisions specific to each specialisation/course/EU/EC.
The documents associated with Levels I and II can be consulted on the Madoc Master UFR des Sciences et des Techniques -Section M3C. The provisions of Level III are specified in this document.

Conditions for validating the year specific to the course:

• Compensation rule:

Indicate in this section the compensation rules at the level: semesters are not compensable
UE from the same semester can be compensated between themselves
Candidates are admitted when they have obtained an average mark in the theoretical examinations (first semester) and an average mark in the internship assessment: dissertation plus defence plus report (second semester).
There is no compensation between the first and second semesters.

• Threshold marks:

There are no defined threshold marks.

MICAS Experimental Research for Scientists Master 2 course units

Big data 2 - Multivariate Analysis

Number of hours: 4h
Year/semester: Master 2/S1 Language of instruction: mixed French/English
Prerequisites
- Master 1 level validated

Objectives (learning outcomes)

Upon completion of this course, students will:
- Will be able to access biomedical data available on the web
- Formalise queries to explore this data
- Model medical knowledge using formal languages that can be understood by machines
- Reason symbolically about medical data

Content

The lessons in this course focus on biomedical knowledge graphs available on the web:
- Modelling knowledge graphs
- Concepts of linked data
- Knowledge graph querying
- Concepts of ontology in biomedicine

Deduction of new knowledge Applications of ontology in biomedicine

Teaching methods: Teaching will take the form of lectures based on scientific publications. Teaching will also involve knowledge sharing, know-how and practical scenarios during practical work.

Bibliography: A bibliography updated annually will be included in the course materials.

MICAS Experimental Research for Scientists Master 2

Big Data 2 - Multivariate Analysis

Number of hours: 24h
Year/semester: M2/S3 Language of instruction: mixed French/English
Prerequisites
- Master's 1 level validated

Objectives
- Learn multivariate analysis techniques
- Learn data discrimination techniques
- Learn data regression techniques
- Learn data classification techniques
- Implement data analysis techniques in Python

Use implementation results to identify relevant biological results
- Introduction to multivariate data analysis
- Introduction to Python programming libraries for implementing multivariate analyses

Topics covered:

Teaching methods:

Innovative strategies for therapy II

Language of instruction: mixed French/English

Prerequisites
- Master's 1 level completed

Objectives

Upon completion of this course, students will be able to:
- identify the key stages of proof-of-concept studies with the clinical development of a biotherapy
- have a reasoned opinion on a range of therapies, including gene therapies, cell therapies, drug therapies and immunotherapies
- will appreciate the need for multidisciplinary knowledge to develop a health therapy

Topics covered:

Lectures: Presentation of new strategies currently being developed to treat a disease in topics related to the various Graduate Programmes. Speakers will be invited to begin with a history of the development of treatments and tools:
GP-I3 and OHNU: New bioactive microbial metabolites for therapy, new-generation CAR-T cells for cancer, potentiation of cancer therapies
GP M4R: Bioprinting, large-scale production of viral vectors GP MICAS:
Extracellular vesicles, medicinal bacteria
GP InnoCare: Extracellular vesicles in cardiology, High-throughput screening for new therapeutic target
Tutorials and practicals will allow students to work in groups of 2 to 3 to produce a poster illustrating an innovative strategy associated with a GP theme (possibly covered in lectures in M1) and 2 to 4 related articles dealing with development and progress (cell/gene therapy, animal models, etc.) up to the clinical stage for treating a disease. The theme and articles will be validated by the teacher at the end of the work presentation session.
Tutorial: introductory/presentation session
Practical work: preparation sessions during which students must read the articles, submit a detailed plan and then prepare their poster. Poster to be submitted at the end of the practical work.

Teaching methods:

All teaching will be face-to-face.
Video and photo materials (toolbox) will be made available on Madoc to illustrate the courses and techniques.
Self-assessment tests and sample exam questions will be provided, and an online forum will be set up for a question-and-answer exchange between teaching staff and students. Students will work independently and prepare a poster.

Industry and technology

Number of hours: 20
Year/semester: M2/S3

Language of instruction: mixed French/English

Objectives:

Upon completion of this course unit, students will be able to:
- Select the information necessary to develop an appropriate experimental approach based on their knowledge and the literature;
- Identify the most appropriate complementary research techniques for developing a research project;
- Apply these techniques to a research project;
- Determine their limitations in the implementation of a research project.

- Students will also acquire knowledge of:
- -industry
- -applicability of the skills acquired during the Master's programme to industry

Contents covered: The aim of this teaching unit is to present innovative technologies in biomedical research within the framework of research projects from various laboratories in Nantes. It will be structured around two main areas:

- a technological focus: new technological approaches in biomedical research, such as transgenesis using the CRISPR/Cas9 approach, high-throughput sequencing and its applications, multiparametric analysis using cellular imaging or flow cytometry, and IPs, through various research projects;
- an industry focus: various speakers will be invited (alumni of the Nantes master's programme, start-ups, biotech companies, etc.) to present their professions and career paths

The presentations will be renewed, in part, each year.

Teaching methods: lectures and round table discussions

Animal models and integrated physiology

Number of hours: 24

Year/semester: M2/S3 Language of instruction: mixed French/English

Objectives:

- To provide students with a solid foundation in integrative biology and with the essential know-how for an ethical and scientific approach to the use of animals in biomedical research (in the fields of anatomy, behaviour, ecology, environmental footprint, evolution, genetics, genomics and pathophysiology).
- To promote the integrative analysis of animals, particularly in the context of the post-genomic era, at the interface of organoids, in vitro and in silico approaches.
- To understand the fundamental and methodological advances and the most recent conceptual principles for the study of genes and their products, as well as their integrated regulations and pathophysiological implications and their use as therapeutic targets and innovative therapies.

Topics covered: Introduction

From genome to integrative biology/The rational use of animals/Legislation and ethics in experimental research on animals/From genome to integrative biology

Integrated genomics

- Transgenic rodents, Knock-Out and Knock-In and immunophenomic.
- Spontaneous genetic model for aetiological, physiopathological and therapeutic approaches to human genetic diseases
- High-throughput study of gene function (zebrafish, Xenopus)
- Genetic modelling and evolution (animal and human phylogeny, choice of animal model) Environment and post-transcriptional regulation models
- Epigenetic mechanisms of gene expression control and programming
- MicroRNAs, physiological and pathological roles
- Roles of extracellular vesicles in cell-to-cell communications.
- Nutritional footprint
- Nuclear medicine and phenotypic imaging

Cognitive models of pathophysiology and therapeutic approaches

- Autonomic nervous system and immune system interface
- Environmental factors
- Large animal models (translational and precision medicine, osteoarticular repair, transplantation …)

Vivo approaches in animal imaging

Teaching methods: Conferences/Lectures

Journal club

Number of hours: 24
Year/semester: Master 2/Semester 3 Language of instruction: French/English

Prerequisites: Master's 1 level validated

Objectives: Upon completion of this work, the student will:

- Conduct a bibliographic review in biomedical research;
- Design a research project in this field;
- Determine the most appropriate strategies for its implementation;
- Oral presentation of this project and a relevant scientific publication related to it;
- Defend and argue for the project presented and the scientific publication chosen.

Contents covered:

1. Students will give an oral presentation on the research project they will develop during their internship, including (1) its international context, supported by a relevant scientific publication (not from their host laboratory), and (2) the context of their host team.

Teaching methods: The expectations will be specified during an introductory lecture.

Interdisciplinary project - Management I

Number of hours: 21
Year/semester: Master 2/Semester 3 Language of instruction: mixed French/English

Prerequisites

- Master's degree level completed

Objectives

- Acquisition of specific tools for project management in uncertain situations
- Responding to a call for projects
- Knowing how to plan and organise over time
- Managing a team in a situation of uncertainty
- Knowledge and understanding of the technological, human and societal challenges associated with transitions
- Critical and analytical view of technologies
- Basic knowledge of local, national and international innovation systems

Topics covered:

As part of this course unit, students will:

Deepen their knowledge and tools in project management and address major contemporary issues in innovation and technology management as well as transitions. Two themes will be addressed:

Contemporary project management practices (tutorials/practical work): you will build on the initial knowledge developed in semesters 1 & 2: refined understanding of the organisation of research through calls for projects and the inherent difficulties, discovery and application of contemporary project management tools, discovery of agile methods for acting under conditions of uncertainty, etc.

Innovation management in transitions (lecture): you will explore key concepts through elements of general culture, but also develop a critical and relevant perspective on both theoretical and more topical subjects (the place of technology in transitions, understanding innovation processes, the challenges of disseminating and gaining acceptance for innovations and technologies in society, taking ecological constraints into account in innovation models, etc.). In particular, you will address three themes in this course: the question of the definition and possibility of managing innovation; the question of spatial anchoring in innovation ecosystems; and the question of paradigm shifts (growth, ecology, sobriety, etc.) around innovation.

Teaching methods: Face-to-face

Interdisciplinary project - Management II - professional integration

Number of hours: 24
Year/semester: M1/S1 Language of instruction: mixed French/English

Prerequisites
- Master's 1 level completed

Objectives Learning outcomes are achieved in two stages:
- interview with a professional in the field (recruitment agency) real-life scenario
- -preparation of a CV based on a job description
- -preparation for the interview
- -role play
- debriefing of stage 1 with the course coordinators via an individual appointment

Topics covered: professional integration support module - preparing for and conducting interviews with professionals

Teaching methods: role-playing and individual interviews

MICAS WORKSHOP -

Number of hours: 24
Year/semester: M2/S3 Language of instruction: mixed French/English
Lecturer:

Objectives:
- Integrate new knowledge from ongoing research
- Question/reinforce the research methodology based on current hypotheses
- Assess an experimental approach in a constrained context (joint research unit, funding, ethics, regulations, etc.)
- Synthesise and report key information
- Further your knowledge through bibliographic monitoring

Contents covered: This course unit will address fundamental and/or translational research questions pursued by the GP MICAS research units. Researchers, clinicians and industry professionals will speak on topics related to the effects of the environment (diet, chemical exposome, stress, infections, etc.) on the microbiota-gut-brain axis and health. Students will have access to recent epidemiological data and scientific advances on the pathophysiological mechanisms of chronic diseases, particularly neurodevelopmental/neurodegenerative, metabolic and inflammatory diseases.

Organised in the form of half-day thematic sessions, this course aims to immerse students in "environment-health" issues targeting diseases of the microbiota-gut-brain axis. Six workshops (3 hours of lectures/workshops) will be offered by the GP MICAS partner units. They will be developed/led by speakers who are involved in and/or conducting projects that address fundamental or translational questions or are supported by industry.
Students will be divided into pairs or groups of three, who will choose a thematic workshop, prepare for it in advance (personal work, preparation of questions for the speakers on the subject) and give an oral presentation afterwards. The preparation and presentation of the workshops will be carried out
in tutorials (6 hours) and supervised by a teacher.

Teaching methods: Face-to-face

Health food development and regulation - CMD - MICAS

Number of hours: 24
Year/semester: Master 2/Semester 3 Language of instruction: mixed French/English
Objectives: •
Topics covered:

CM: 14H

- **Regulations and claims:**

This section will cover clinical research regulations, the implementation of clinical studies for the purpose of making claims, and the selection of biomarkers in these studies. The teaching unit will also cover how to compile a claim application file. Concrete examples will be used to enable students to understand the application process in accordance with regulations.

CM: 10 hours

Case study and project development in food and health

This part will involve students working in teams of three. It will be organised into two sub-parts:

- Case study: This involves exhaustive bibliographic research on a health food or ingredient, which will be presented in two forms, written and oral.

Development of a health claim project for a food or ingredient, supported by bibliographic and legislative arguments.

Teaching methods:

Biomarkers: their value in the diagnosis and monitoring of metabolic diseases and the microbiota-gut-brain axis - CMD - MICAS

Number of hours: 24

Language of instruction: mixed French/English

Objectives: *Description to follow*
Topics covered: **Lectures: 14 hours**

- **Biomarkers: diagnosis and monitoring of chronic diseases**

In this section, the first chapter will focus on the different methodologies and techniques used to measure qualitative or quantitative biomarkers related to metabolic diseases, the gut-brain axis, the gut-liver axis, the liver-adipose tissue axis, and dysbiosis in a non-invasive manner in accessible body fluids or parts (urine, blood, saliva, hair, faeces, etc.).
Next, biomarkers that can help diagnose metabolic disorders (diabetes, obesity, dyslipidaemia, eating disorders, allergies, etc.) and disorders of the gut-brain axis (IBD, Crohn's disease, autism, etc.) will be discussed. Examples of pre-clinical/clinical studies highlighting the relevance or irrelevance of biomarkers in a pathological process will be discussed, as well as the use of these biomarkers to monitor patients during treatment.

Tutorials: 10 hours

Students are the main participants in tutorials and will work in groups (2-3 students). They will present, via flipped classrooms and critically, after the most extensive bibliographic studies possible, the current knowledge on the use of biomarkers to develop diagnoses for a given pathology in relation to the themes mentioned above.

Teaching methods: *Description to follow*

CMD M2 oral internship

Objectives : By the end of this course, students will:
- Conduct a relevant literature review;
- Apply their acquired theoretical knowledge to the development of a research project ;
- Design scientific protocols;
- Select the most relevant methodologies for implementing a research project;
- Critically analyse scientific results;
- Write and present an informative internship report;
- Argue hypotheses and results in a relevant manner during a discussion with a panel.

Contents covered: UE Internship assessment of oral defence

Teaching methods: Immersion

M2 internship report

Language of instruction: French/English

Objectives: By the end of this course, students will:
- Conduct a relevant literature review;
- Apply their acquired theoretical knowledge to the development of a research project ;
- Design scientific protocols ;
- Select the most relevant methodologies for implementing a research project;
- Critically analyse scientific results;
- Write and present an informative internship report;
- Argue hypotheses and results in a relevant manner during a discussion with a panel.

Content The student will complete a 6-month internship in an academic or private laboratory.

Mobility of students enrolled in the MICAS Master's programme during the internship:

This programme promotes international mobility among students by providing them with access to the international network of teacher-researchers at partner laboratories.

Students receive a mobility grant of €500 to €700 per month, depending on the destination country. They may also be eligible for a €1,000 installation grant offered by the Regional Council, subject to eligibility.

Hosting foreign students for internships in our partner laboratories:

Foreign students wishing to undertake an internship in one of our partner laboratories must send their application, accompanied by their CV and a summary of their areas of interest, to the programme coordinators. If the application is deemed eligible, an interview will be offered to discuss their objectives in more detail.

CMD internship evaluation form

TOTAL: 16 hours

Year/semester: Master 2 / Semester 4 Language of instruction: French/English

Objectives:
- Learners will receive an assessment from the professional who supervised them during their internship, providing them with detailed feedback on their work.

Content The objective of this internship assessment form will be presented to students and supervisors. This form, completed by the supervisor, will be used to assess the work carried out by the student

during their internship.
This assessment will be taken into account in the final internship mark.

Teaching methods Immersion