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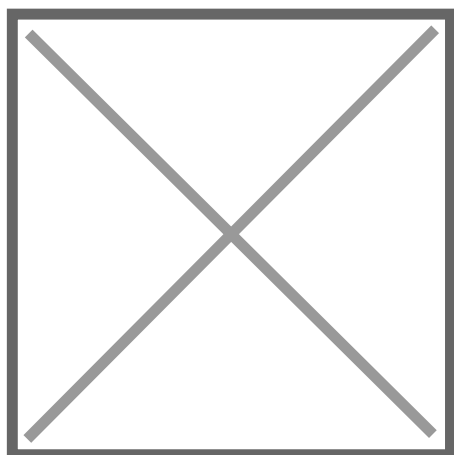
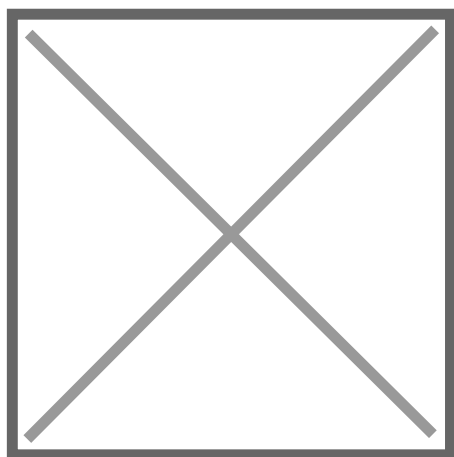
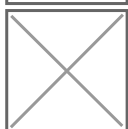
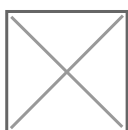
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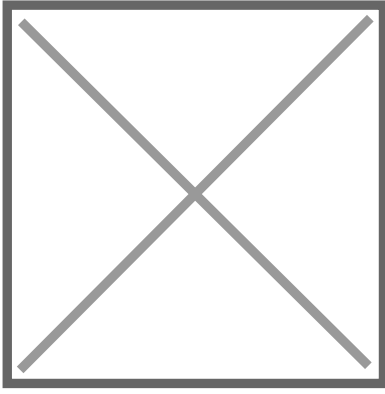
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Add to Compare

M1 Biologie Agrosiences Sciences du végétal- Plant Sciences





Master's degree

Specialisation Biologie-AgroSciences

Enrolment type

Full-time academic programmes Life-long learning

Language(s) of instruction

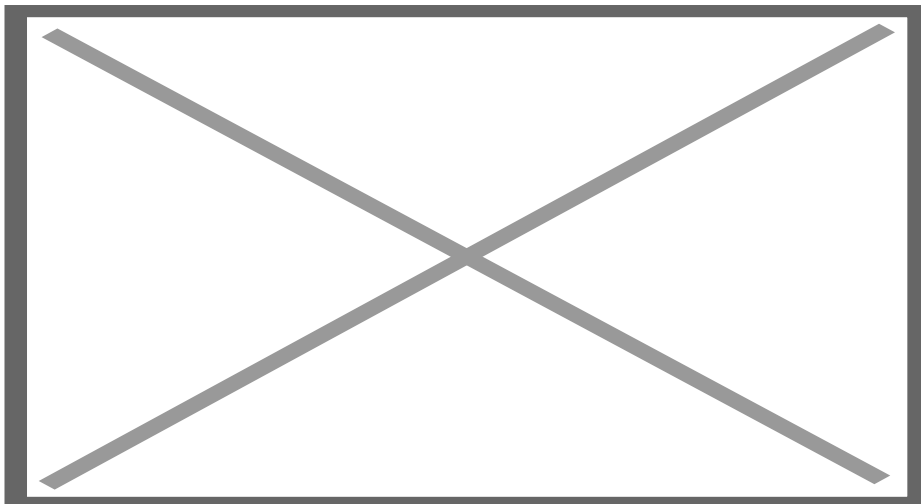
English French

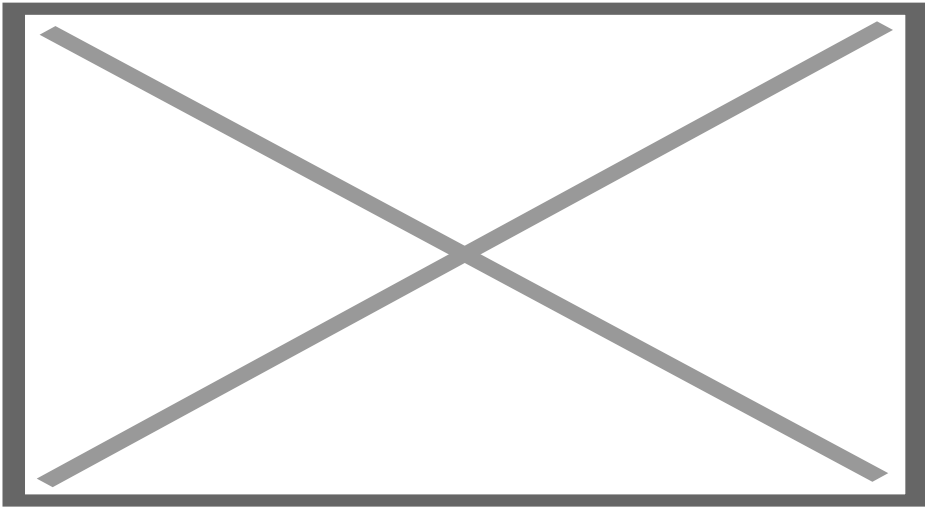
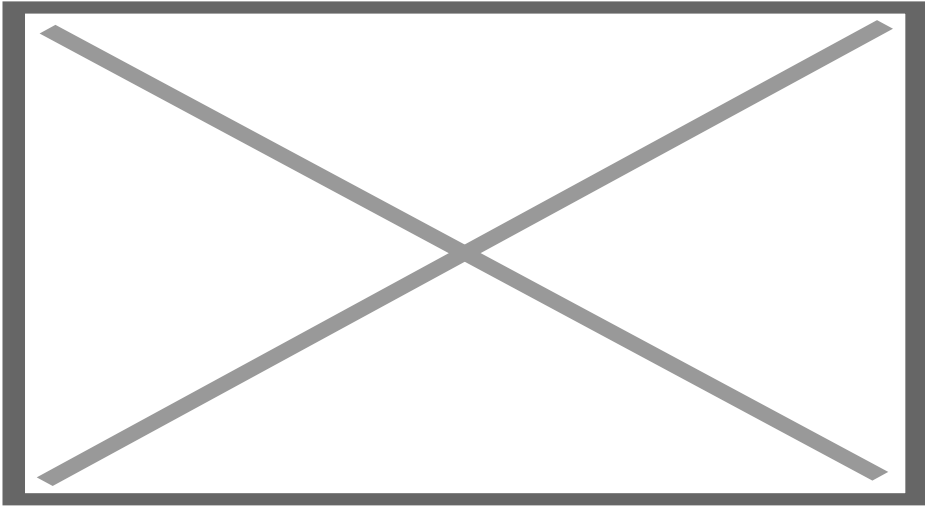
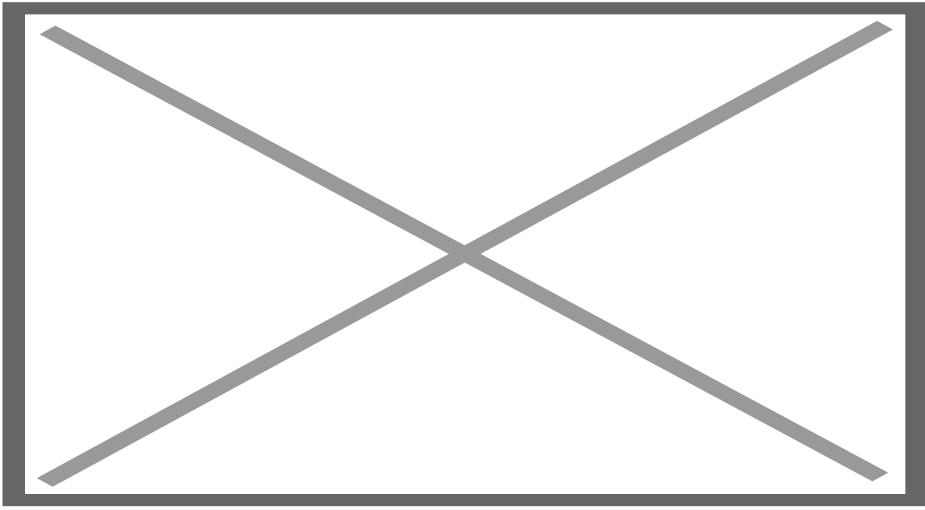
- **Be among the pioneers** shaping sustainable and resilient plant systems.
- **Join an elite, international program** fully **taught** in **English** from the first to the second year.
- **Access an outstanding research environment** through the [Saclay Plant Sciences](#) Excellence Network — over **800 leading plant scientists** in one of Europe's largest plant research hubs

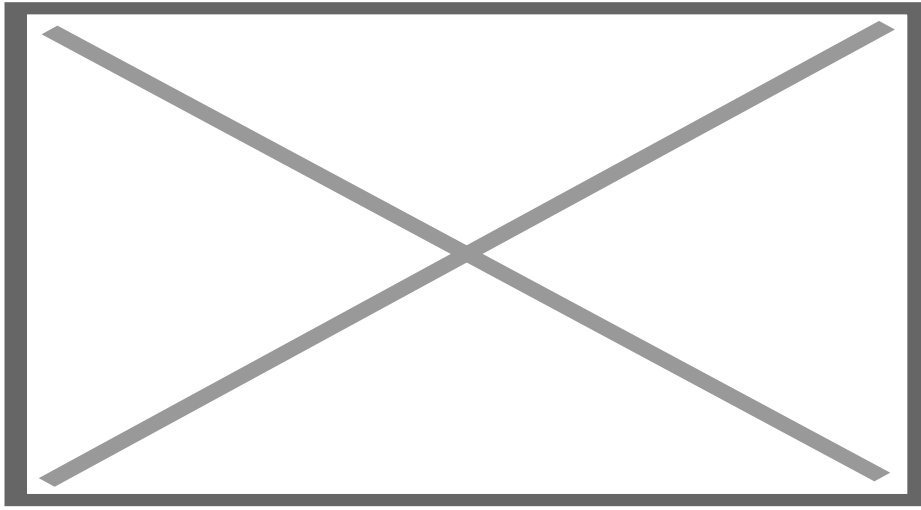
The programme is divided into two semesters and comprises four non-compensable blocks: the core curriculum block BCC1- Integrative foundations and methods for animal and plant sciences (17 ECTS); the two Plant Sciences blocks BCC2 and BCC3- Plant sciences : Specialised knowledge and innovative methods for sustainability (16 and 19 ECTS) with compulsory or optional teaching units (six optional sequences); the block dedicated to the compulsory 8-week teaching unit internship BCC4- Implementing a plant science research and innovation project in a professional context (8 ECTS). The Plant Sciences programme offers the option of a full M1 programme in English.

[Télécharger la fiche détaillée](#)

[Apply Now](#)







Information

- [Overview](#)
- [Application requirements](#)
- [Schedule](#)

Présentation

Skills

- Understand the major societal and economic issues relating to the use and improvement of cultivated plants.
- To be able to explain current knowledge of how plants function and develop in interaction with their environment.
- Competent in defining and describing the main concepts, methods and technological tools used in integrative biology, in particular omics approaches.
- Capable in analyzing complex data from these technologies and use the associated statistical and bioinformatic tools
- Implement basic techniques in molecular and cellular biology, biochemistry, genetics and plant physiology
- Synthesize information on a scientific topic in the field of plant sciences; communicate it orally and in writing, in French and English, alone or in a group
- Describe, analyze and critique the results of an experiment; design a scientific approach appropriate to a given problem

Objectives

The M1 Biologie Agrosiences Sciences du végétal/Plant Sciences aims to provide students with in-depth knowledge of how plants function and how they adapt to their environment in order to meet current needs for innovation in plant production. To train the scientists who will meet the new challenges of developing

sustainable agriculture, the M1 Biologie Agrosiences Sciences du végétal/Plant Sciences is based on integrated, interdisciplinary and multi-scale training in plant biology. It benefits from the expertise of a network of 'Saclay Plant Sciences' research laboratories, providing training through research that is unique in the Île-de-France region.

Débouchés

Career prospects

After a Master's degree: Data scientist

After a Master's degree: Research analyst

After Master and PhD : reseacher or assistant professor or professor

After a Master's + PhD: researcher or lecturer

After a Master's or Master's + PhD: researcher or lecturer

After a Master's or Master's + PhD: engineer (R&D, control, production, etc.)

Research officer

Data scientist

Data Scientist

Design engineer industry / public research

Academic staff

Design Engineer

R&D Engineer

R&D Project Manager

Further Study Opportunities

Master of Biology-Agrosciences

Biology-Agrosciences

R&D researcher or data modelling and analysis expert in leading-edge companies or laboratories.

Data Scientist, Data Analyst, Ingénieur·e en Machine Learning dans des secteurs innovants (tech, finance, santé, énergie, etc.) ;

PhD

PhD bio

Engineering in agriculture and the natural environment

PhD

PhD thesis

Fees and scholarships

The amounts may vary depending on the programme and your personal circumstances.

- [More information on tuition fees](#)
- [More information on scholarships](#)

Admission

Admission Route

Life Sciences

Life and Earth Sciences

Health sciences

Capacity

Available Places

16

Target Audience and Entry Requirements

Bachelor's degree (Biology, Life Sciences, Health Sciences, Life and Earth Sciences, equivalent) with knowledge acquired in the fields of: plant physiology and development, genetics (formal/molecular), genomics, cellular and molecular biology, biostatistics. A professional project in line with the objectives of the course is required. A minimum level of English (European B1) is required, enabling students to understand scientific articles and communicate in research.

Période(s) de candidature

Inception Platform

From 15/01/2026 to 16/03/2026

From 19/06/2026 to 25/06/2026

Supporting documents

Compulsory supporting documents

Copy diplomas.

Copy of identity document.

Motivation letter.

TOEIC.

All transcripts of the years / semesters validated since the high school diploma at the date of application.

Certificate of English level (compulsory for non-English speakers).

English language level certificate B1 (IELTS : score 4/5 ; TOEIC : score 550/760 ; TOEFL IBT : score 42/71). In the absence of official proof, level B1 certificate issued by the English teacher or transcript specifying level B1.

Curriculum Vitae.

Detailed description and hourly volume of courses taken since the beginning of the university program.

Additional supporting documents

Referring contact information (compulsory for non-international applicants).

Certificate of French (compulsory for non-French speakers).

Level B2 : Non native french speakers, a knowledge certificate issued by the French Embassy or a French language center. Students holding a French diploma or a diploma instructed in French are exempt from that obligation.

VAP file (obligatory for all persons requesting a valuation of the assets to enter the diploma).

Supporting documents :

- Residence permit stating the country of residence of the first country
- Or receipt of request stating the country of first asylum
- Or document from the UNHCR granting refugee status
- Or receipt of refugee status request delivered in France
- Or residence permit stating the refugee status delivered in France
- Or document stating subsidiary protection in France or abroad
- Or document stating temporary protection in France or abroad.

Programme

BCC1- Integrative foundations and methods for animal and plant sciences

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	c
Biodiversity and Genome Evolution	3	Semestre 1	9.5	15					

Biodiversity and Genome Evolution

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 9.5

Directed study: 15

Tutored project 2

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

- Génétique des populations (15h) : principales notions de génétique des populations ; influence des régimes de reproduction sur la diversité génétique ; effet de la sélection et de la dérive sur l'évolution des populations ; balance entre mutation et sélection et cryptopolymorphisme ; origine de la biodiversité spécifique, processus de spéciation.

- Structure et évolution du génome eucaryote (4h30) : composants majeurs du génome, éléments transposables et diversité structurale et fonctionnelle, duplication de génome et innovation pour l'adaptation des espèces.

- Epigénétique (5h) : organisation chromatinienne (euchromatine, hétérochromatine) ; expression des gènes (modification des histones, méthylation de l'ADN) ; épissage alternatif.

- Population genetics (15 hrs): main concepts of population genetics; influence of reproductive regimes on genetic diversity; effect of selection and drift on population evolution; balance between mutation and selection and cryptopolymorphism; origin of specific biodiversity, speciation processes.

- Structure and evolution of the eukaryotic genome (4.5 hrs): major components of the genome, transposable elements and structural and functional diversity, genome duplication and innovation for species adaptation.

- Epigenetics (5h): chromatin organization ; gene expression ;

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	c
Anglais / projet Soliya	2.5	Semestre 1		21					

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	other
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Anglais / projet Soliya

ECTS : 2.5

Semester: Semestre 1

Detail

Directed study: 21

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

Techniques de la présentation orale en sciences, rédaction d'abstracts, décrire des graphiques, des expériences, simulation d'une conférence scientifique avec interaction, introduction à la certification en anglais

Un groupe (15-20 étudiants de bon niveau peuvent participer à un programme de communication interculturel. Il s'agit de 8 semaines de visioconférences avec des étudiants étrangers (voir www.soliya.net), suivi par un rapport écrit et une présentation orale.

Oral presentation techniques in science, techniques to write scientific abstracts and to describe graphs and experiments, simulation of an interactive scientific conference, introduction to certification in English

A group of 15-20 high-level students can participate in an intercultural communication program. This consists of eight weeks of videoconferences with foreign students (see www.soliya.net), followed by a written report and an oral presentation.

Overall organisation

Début septembre : Test de niveau

Septembre-Octobre-novembre : plusieurs séances de TD

Janvier : certification.

Early September: test to check the level

September-October-November: several tutorial sessions

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	other
Epistémologie, Histoire des Sciences	2	Semestre 1	15						

Epistémologie, Histoire des Sciences

ECTS : 2

Semester: Semestre 1

Detail

Lecture: 15

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

Sont abordées les questions suivantes :

- Le concept de méthode scientifique à travers les âges.
- Créer de la vie : défi technique ou défi théorique ?
- Qu'y a-t-il derrière un concept : histoire de la notion de programme génétique.
- Histoire des réceptions critiques du darwinisme.
- Doute nécessaire, doute instrumentalisé : le scientifique face à l'inconnu.
- Qu'est-ce qu'une imposture scientifique ?
- Science et société : nouvelles formes d'expertise, panels citoyens, débats public.
- Regards de philosophes sur l'Animal.

The following questions are addressed:

- The concept of scientific method through the ages.
- Creating life: a technical challenge or a theoretical challenge?
- What lies behind a concept: history of the notion of genetic programs.
- History of critical reactions to Darwinism.
- Necessary doubt, instrumentalized doubt: scientists faced with the unknown.
- What is scientific fraud?
- Science and society: new forms of expertise, citizen panels, public debates.
- Philosophers' thoughts on animals.

Learning objectives

Objectifs: L'histoire et la philosophie des sciences

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	c
Project Adopt a gene (Elective courses A - option 1)	3	Semestre 1	0	0	15				

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	other
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Project Adopt a gene (Elective courses A - option 1)

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 0

Practical study : 15

Directed study: 0

Tutored project 0

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Bases de biologie moléculaire

Fundamentals in molecular biology

Programme/contents

Etude d'une accession (recherche dans les bases de données bibliographique et biologiques, analyses bioinformatiques)

TP sur ordinateur et techniques de base en biologie moléculaire

Study of an accession (searching bibliographic and biological databases, bioinformatic analyses)

Practical work on computers and basic techniques in molecular biology

Learning objectives

Illustrer les principales méthodes permettant l'étude d'un gène ou une protéine (méthodes expérimental et outils in silico). Définir une question biologique pertinente à partir des données existantes sur un sujet scientifique. Proposer un plan d'expérience. Etre en capacité de construire une requête sur des outils IA pour produire un résumé et d'être en capacité d'identifier les erreurs et les corriger. Être capable de produire une figure scientifique légendée et expliquée et de la présenter à l'oral.

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	class
Metabolism and Physiology	2.5	Semestre 1	9	6					

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	other
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■

Metabolism and Physiology

ECTS : 2.5

Semester: Semestre 1

Detail

Lecture: 9

Directed study: 6

Tutored project 0

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Fundamentals of physiology and metabolism at the bachelor's degree level

Programme/contents

This unit begins with an introduction to metabolic diversity across prokaryotes and eukaryotes, establishing a foundation for understanding both universal features and key divergences. The central theme of the module is the study of metabolic responses and adaptations to environmental stress, providing a framework for a comparative approach across different biological kingdoms. The programme continues with an exploration of core metabolism, including carbon fixation, respiration, and energy production. These fundamental processes are examined within the context of their role in maintaining homeostasis and physiological performance under changing conditions. A dedicated strand focuses on specialised metabolic pathways, with particular emphasis on responses to oxidative, water, and nutrient stress. Illustrative case studies of metabolic adaptations in extremophilic bacteria, plants, and animals are used to highlight the diversity of evolutionary strategies and to explore the principle of inter-kingdom complementarity. Finally, the module concludes with an overview of modern approaches in metabolomics and integrative biology, which enable the analysis of metabolic and physiological responses to stress across multiple scales, from the cell to the whole organism.

Learning objectives

The intended learning outcomes of this module are to achieve a comprehensive understanding of the

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	other
Cycle de conférences Biosphera	1	Semestre 1	6						

Cycle de conférences Biosphera

ECTS : 1

Semester: Semestre 1

Detail

Lecture: 6

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

Les conférenciers sont des professionnels du monde académique ou privé bénéficiant d'une reconnaissance dans leur discipline. Les conférences se rapporteront aux thématiques suivantes : Biodiversité, Alimentation et agriculture, Société, Environnement

The speakers are professionals from both academic and private sectors with a recognized expertise in their respective fields. The lectures will cover the following topics: Biodiversity, Food and agriculture, Society, Environment

Learning objectives

Cette UE vise à améliorer la culture générale scientifique des étudiants dans le domaine des sciences du vivant et de ses interactions avec la biosphère et les sociétés. Elle permet aux étudiants de s'initier à des problématiques sociétales en lien avec les thématiques de la graduate school BIOSPHERA: Biodiversité, Alimentation et agriculture, Société, Environnement.

This course aims to improve students' general scientific knowledge in the field of life sciences and its interactions with the biosphere and societies. It introduces students to societal issues related to the themes of the BIOSPHERA graduate school (Biodiversity, Food and Agriculture, Society, Environment).

Overall organisation

Conférences en présentiel ou en visioconférence

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
Statistiques	3	Semestre 1	10		11			
■								

Statistiques

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 10

Practical study : 11

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

L'accent est mis sur les tests statistiques paramétriques.

Contenu : Cours + exercices sur Excel et R (Rcmdr).

Learning objectives

L'objectif est d'apporter aux étudiants quelques notions de statistiques non développées en licence, tout en restant dans les limites de ce qui peut être raisonnablement acquis dans le temps d'un module court. L'accent est mis sur les tests statistiques paramétriques.

Overall organisation

Tout l'enseignement, cours et travaux pratiques (en salles informatique) est obligatoire et présentiel.

Skills

Manipulation de jeux de données, définition de questions statistiques et identification de la méthode statistique à mettre en œuvre pour y répondre, autonomie en analyse de données courante (description de données, comparaison de distributions, de moyennes, corrélation et régression) grâce à un logiciel simple (Excel, R via l'interface Rcmdr).

Type of assessment

Evaluation Continue non Intégrale

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
Project Adopt a dataset (Elective courses A - option 2)	3	Semestre 1	3		12			
■								

Project Adopt a dataset (Elective courses A - option 2)

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 3

Practical study : 12

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

During this course, students will be given a data set to analyse in depth. The teaching is based on active pedagogy, accompanied by a scientific tutor who will have his or her own dataset to be analysed.

Learning objectives

During this course, students will learn to :

- Exhaustively search and synthesise the information available in public databases (bibliographic, genomic, transcriptomic, proteomic data, etc.)
- The use of certain software to analyse these data
- Identify a relevant biological question from their synthesis
- Design and present a mini research project to answer this biological question and to deepen the knowledge about it.

Type of assessment

Evaluation Terminale

BCC2- Plant sciences: from specialised knowledge to innovative methods for sustainability

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
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Proteins and
biotechnologies
(Elective
courses D -
option 2)

4

Semestre
1

14

16



Proteins and biotechnologies (Elective courses D - option 2)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 14

Directed study: 16

Tutored project 6

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Aucun

Programme/contents

The programme first introduces the major families of alternative proteins (plant-based, insect-derived, microbial), their functional properties, and their prospects for use in food systems. It then addresses the biotechnological approaches involved, ranging from conventional techniques such as mutagenesis, transgenesis and cisgenesis, to new genome-editing technologies, as well as the contributions of protein engineering, synthetic biology, and systems biology. Cross-cutting themes, including protein separation, industrial transformation processes, and metabolic pathway engineering, are also explored. Ethical, societal, and regulatory aspects of applying biotechnology to food production are considered throughout. The course is complemented by a research and development centre visit, allowing students to directly link theoretical knowledge with industrial applications.

Overall organisation

The unit is structured around 14h of lectures, 16h of tutorials, and 6h dedicated to a supervised project, in addition to the R&D centre visit. Lectures provide the conceptual foundations and highlight recent advances in the field, while tutorials encourage active learning through case studies, critical discussions, and problem-solving exercises. The supervised project allows students to work independently on an applied problem, thereby integrating theoretical knowledge with creativity and analytical skills. Assessment in the first session consists of coursework (written dossier, 30%) and an oral examination (70%), while the second session consists of a final written examination

<u>Workshop on plant responses to biotic and abiotic stresses (Elective courses C - option 1)</u>	4	Semestre 1	6	36
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Workshop on plant responses to biotic and abiotic stresses

(Elective courses C - option 1)

ECTS : 4

Semester: Semestre 1

Detail

Practical study : 36

Directed study: 6

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Niveau d'une Licence générale en Sciences du vivant en bio-statistiques, physiologie, biologie moléculaire, biochimie. Connaissances des principes des approches haut débit de type « omiques ».

Programme/contents

This course consists mainly in a practical approach as well as intensive scientific reasoning based on a theme close to a research question. In recent years, the theme chosen has been the following: What is the impact of a beneficial bacterium of the plant responses to biotic and abiotic stresses? Other research questions may potentially replace the current theme, but the idea is to maintain a set of integrative questions in the field of plant response to biotic and/or abiotic stresses. In parallel, the students are implementing a complete approach to a Koch postulate (diagnosis of the pathogen responsible for symptoms observed on plants).

Techniques and methodologies used: DNA extraction, PCR and quantitative PCR, different methods of inoculation of pathogens on plants and qualitative and quantitative analysis of symptoms, Koch's postulate, manipulation of different bioinformatics tools (blastn, AgriGO, G.Profiler, MEME, STRING, KEGG,...).

Interactive tutorials, generally in the form of round tables, will allow students to step back from the experimental work carried out and to broaden the scope of their experimental strategies in response to a biological question. They allow the students to refresh the basic principles of numerous techniques by integrating them into a research approach (analysis of mutants, transformation techniques for higher plants and limitations, regulation of gene

[Integrative
plant
physiology
\(Elective
courses D -
option 1\)](#)

4	Semestre 1	20	16
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Integrative plant physiology (Elective courses D - option 1)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 20

Directed study: 16

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Good knowledge of the basics of plant physiology and metabolism.

Programme/contents

The module involves interactive discussions, exercises (including some that involve the preparation of written reports), and work undertaken by students in small groups towards the preparation of oral presentations on a given topic.

Learning objectives

Students will acquire theoretical and practical knowledge aimed at furthering their understanding of the flexibility of plant function in a changing and potentially stressful environment. Group-centered bibliographic research projects are focused on key players in metabolic responses to external factors, and involve the preparation of a report in the form of a structured and logical oral presentation. Supervised exercises aim at the acquisition of a more in-depth knowledge of plant biochemistry and molecular biology.

Overall organisation

Tutorials, exercises, supervised projects

Type of assessment

Evaluation Continue non Intégrale

Plant-microbe
interactions
(Elective
courses E -
option 1)

4

Semestre
1

25.5

1.5

9



Plant-microbe interactions (Elective courses E - option 1)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 25.5

Practical study : 9

Directed study: 1.5

Tutored project 0

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Basic knowledge of the biology of microorganisms (fungi, bacteria, viruses) and plants, as well as molecular biology and genetics, at Bachelor's level in life sciences.

Programme/contents

Plants interact with microorganisms in their environment and must continuously adapt to them. These microorganisms can exert either negative (pathogenic) or beneficial (symbiotic) effects on plants, both in natural ecosystems and agroecosystems. This issue is particularly relevant today, as agricultural practices must ensure productivity while preserving the environment. The teaching unit includes 9 hours of lectures on plant–pathogen interactions (fungi, bacteria, viruses), 3 h on plant–symbiotic microorganism interactions, and 1.5 h on the plant microbiota and its interactions within the rhizosphere. Students are introduced to epidemiology (3 h of lectures), plant immunity (6 h), and methods for plant protection (3 h).

The course is complemented by a 1.5-h seminar involving the analysis of scientific articles on symbiosis, and 9 h of practical work during which students apply techniques and concepts from plant pathology to assess the susceptibility/resistance of two plant genotypes (wild type and mutant) to various pathogens, and discuss the role of the altered function in plant immunity. Throughout the course unit, students work in teams on a plant pathology topic, culminating in an oral presentation based on a scientific poster.

Learning objectives

Acquire the knowledge and methodologies

Plant genomics
and
bioinformatics
(Elective
courses B -
option 1)

4

Semestre
1

17

2

12.5



Plant genomics and bioinformatics (Elective courses B - option 1)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 17

Practical study : 12.5

Directed study: 2

Tutored project 4

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

The application of genomics and bioinformatics tools to the study of the genome of cultivated plants will be presented. The specific features of genome structure, such as duplications, transposable elements and multi-genomes, as well as the genome diversity of cultivated plants, including heterozygosity, will be discussed in relation to the evolution of crops and specific agronomic traits. The specificities of organelle genomes will also be presented and discussed. The available genetic and genomic resources will be presented in light of their potential applications. The section on teaching bioinformatics through practical exercises will expand on the concepts of comparative genomics, protein motif research, and structure-function relationships. It will also introduce gene regulatory networks and protein-protein interaction networks, demonstrating how to construct and analyse them for functional annotation.

This course provides an overview of the principles of long-read sequencing and its advantages for generating high-quality de novo assemblies, including those of entire genomes from telomere to telomere (T2T). Students will explore methods for evaluating the quality of genome assemblies and discuss their key applications in genomics research. The course will introduce pangenomes and pangenomics, emphasising their role in representing genetic diversity beyond single reference genomes.

Learning objectives

Understand the basic elements and specificities of genomics as applied to cultivated plants. Use the different bioinformatics databases and their characteristics to perform an appropriate search by selecting specific parameters. Understand the

<u>Fonctionnement de l'entreprise innovante (FR)</u> <u>(Elective courses C - option 2)</u>	4	Semestre 1	36
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Fonctionnement de l'entreprise innovante (FR) (Elective courses C - option 2)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 36

Language(s) of instruction

Français

Remote teaching

non

Programme/contents

- Economie de marché et libéralisme
- Circuit économique et intervention publique
- Economie de l'innovation et croissance économique
- Recherche, Innovation et Concurrence interfirmes

Learning objectives

- Maîtriser les concept clés de l'analyse économique (croissance économique, concurrence, libéralisme, intervention publique)
- Comprendre le lien entre innovation, croissance et profit.
- Appréhender la recherche, l'information et la connaissance comme des éléments essentiels de la compétitivité de l'entreprise.

Overall organisation

Cours magistraux, lecture et analyse d'articles scientifiques et de la presse économique, documentaires audiovisuels, travail en petits groupes

Skills

- Etre capable d'appréhender et de décrire l'environnement économique de l'entreprise
- Comprendre les contraintes et le fonctionnement de l'entreprise pour mieux s'y insérer
- Maîtriser les enjeux de l'innovation dans la compétitivité de l'entreprise

Type of assessment

Evaluation Continue non Intégrale

Physiologie des
systèmes –
animal et
végétal (FR)
(Elective
courses E -
option 2)

4

Semestre
1

18

14



Physiologie des systèmes – animal et végétal (FR) (Elective courses E - option 2)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 18

Directed study: 14

Tutored project 4

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

La biologie des systèmes vise à comprendre comment les fonctions biologiques émergent des interactions entre les multiples composantes des systèmes vivants, en modélisant la dynamique de ces interactions et processus. Trois thèmes principaux seront abordés : le rythme circadien, le microbiote et le stress abiotique.

Systems biology aims to understand how biological functions emerge from interactions between the multiple components of living systems by modelling the (dynamics of) interactions and processes. Three main topics will be discuss: circadian rhythm, microbiote and abiotic stress.

Learning objectives

Un système biologique est un ensemble d'éléments interagissant qui forment une unité biologique fonctionnelle. Un système peut être appréhendé à différents niveaux : écosystème, organisme, organe, tissu, cellule, organite, voie métabolique, processus physiologique, réseau de gènes ou de protéines, etc. L'objectif de cet enseignement est de comprendre l'organisation et le fonctionnement des organismes complexes, de structurer et d'intégrer des informations multi-échelles et multidisciplinaires (biologie intégrative), de révéler des propriétés émergentes qui resteraient insoupçonnées par l'étude séparée des différents éléments, et de permettre de prédire le comportement d'un organisme dans des conditions inédites.

A biological system is a set of interacting elements

<u>Systems biology I and II (Elective courses B - option 2)</u>	4	Semestre 1	18	18
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Systems biology I and II

(Elective courses B - option 2)

ECTS : 4

Semester: Semestre 1

Detail

Lecture: 18

Practical study : 18

Project : 20

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

System biology I. Integrative approaches are key steps in the thorough exploitation of omics data and their translation into knowledge. In this module, students will have courses on the architecture and the machinery of the cell, and on the genome and epigenome organization. They will learn how to combine predictive and experimental approaches to decode the genomic information through the structural and functional annotation of genomes. The integration and the querying of heterogeneous data imply to perfectly know their origin in order to take into consideration their quality, relevance and confidence levels. The understanding of this approach is the basis of holistic analyses for systems biology.

System Biology II. Global analyses (omics) currently generate large datasets that do not capture the complexity of living systems. Systems Biology is an approach where omics data are integrated and exploited (compared) through mathematical models of biological systems or sub-systems. The complexity of biological systems and the diversity of issues to be considered require the use of different types of modelling.

Learning objectives

System Biology I. Students will see different methods to produce transcriptome, ORFeome, proteome and interactome resources and how to integrate them in modeling approaches to have new insights on cellular processes.

Systeme Biology II. Students will explore a number of mathematical approaches to tackle biological issues through the integration of "omics" data. The mathematical approaches include the methods known as constraint-based modeling, i.e. flux balance analysis, resource balance analysis, but

BCC3- Plant sciences: from molecular innovation to agroecological solutions

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
Plant breeding for agroecology	4	Semestre 2	18	6	12				

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	directed study/practical class
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Plant breeding for agroecology

ECTS : 4

Semester: Semestre 2

Detail

Lecture: 18

Practical study : 12

Directed study: 6

Tutored project 0

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Basic concepts of formal genetics and molecular biology

Programme/contents

Main topics : population genetics (linkage disequilibrium, population evolution, population structure); mechanisms of genome evolution; introduction to quantitative genetics and methods to study complex traits (including QTL mapping and GWAS); genetic basis of crop domestication; genetic resources and their importance in plant breeding

Learning objectives

Skills: DNA extraction and genotyping using SSR markers; perform a QTL detection approach

Knowledge: Understanding the mechanisms of genome evolution; consolidating the fundamentals of population genetics and quantitative genetics; understanding the genetic determinism of quantitative traits and the methods used in plant breeding to improve these traits

Overall organisation

Lectures to introduce and define new concepts; practical work and tutorials to perform genotyping, to study the segregation of a population and to detect QTL; visit of a research lab (GQE-Le Moulon)

Skills

Master the key concepts and approaches presented

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
Physiologie de la nutrition et agronomie (Elective courses G - option 1)	4	Semestre 2	8	7	21				

Physiologie de la nutrition et agronomie (Elective courses G - option 1)

ECTS : 4

Semester: Semestre 2

Detail

Lecture: 8

Practical study : 21

Directed study: 7

Language(s) of instruction

Français

Remote teaching

non

Prerequisites

Bases de physiologie et de métabolisme chez les plantes niveau licence sciences de la vie

Programme/contents

Cette UE est structurée en trois parties :

1. Introduction à la nutrition azotée et carbonée

Présentation des bases de la nutrition minérale des plantes et des enjeux actuels en agronomie, notamment la réduction des pollutions des sols, l'optimisation de la fertilisation et l'adaptation de la nutrition des espèces cultivées aux changements climatiques.

2. Travaux pratiques en laboratoire

Mise en œuvre des principales techniques de physiologie végétale permettant de quantifier la nutrition azotée et carbonée. Ces séances visent à familiariser les étudiants avec les méthodes d'analyse utilisées en recherche et en agronomie expérimentale.

3. Travaux pratiques au champ

Mesure des teneurs en azote dans des plantes cultivées en conditions réelles. L'objectif est de montrer comment ces données permettent d'améliorer la gestion des engrais et la durabilité des systèmes de production.

Learning objectives

Caractériser la physiologie de la nutrition minérale et carbonée à l'échelle de la plante entière et de la parcelle.

Overall organisation

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
Genome engineering and RNA interference (Elective courses F - option 1)	4	Semestre 2	8	7	21				

Genome engineering and RNA interference (Elective courses F - option 1)

ECTS : 4

Semester: Semestre 2

Detail

Lecture: 8

Practical study : 21

Directed study: 7

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Bon niveau en biologie moléculaire et biologie cellulaire d'une Licence générale en Sciences du vivant

Programme/contents

1st week: courses, tutorials and seminars on genome editing, RNA interference (and other RNA-based technologies) and synthetic biology. Several seminars will be given by researchers, platform engineers and professionals from private companies, specialized in one of these fields. During this practical course, students will first analyse different Arabidopsis lines, that are silenced -or not- for a reporter transgene. For that, they will carry on several experiments, that are commonly used to estimate the efficiency of a RNAi approach and/or to analyse small RNAs (RT-qPCR, DNA methylation analysis, dedicated northern for small RNAs, tissue and subcellular localisation of proteins using fluorescence microscopy, ...).

Learning objectives

The objective of this teaching will be to explore the methodologies of genome engineering, RNA interference and synthetic biology and to understand their underlying fundamental biological mechanisms. Challenges in medicine and agronomy and ethical/legal issues will be discussed.

Skills

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
Les semences : de la biologie à la filière (FR) (Elective courses F - option 2)	4	Semestre 2	12		14				

Les semences : de la biologie à la filière (FR) (Elective courses F - option 2)

ECTS : 4

Semester: Semestre 2

Detail

Lecture: 12

Directed study: 14

Tutored project 10

Language(s) of instruction

Français

Remote teaching

non

Programme/contents

Le programme est structuré autour de trois grands axes thématiques :

1. Biologie et technologie des semences :
bases physiologiques et biochimiques du développement des semences ; mécanismes de régulation de la dormance, de la germination et de la longévité ; pathologies des semences ; progrès des biotechnologies appliquées aux semences, notamment l'amélioration des semences, les traitements (enrobage, granulation, etc.), la lutte biologique, la biostimulation et les nouvelles biosolutions.
2. Qualité des semences et chaîne de valeur :
organisation des systèmes de production de semences ; procédés de préparation, de conditionnement et de conservation ; mise en œuvre des protocoles de contrôle qualité ; normes internationales pour les essais et la certification des semences ; et contributions des principaux acteurs institutionnels tels que le GEVES, le SEMAE, le FNAMS, l'INRAE ??et les entreprises privées.
3. Économie, réglementation et innovation dans le secteur semencier : marchés mondiaux et français des semences ; enregistrement des variétés et protection de la propriété intellectuelle ; stratégies de

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
Plant cell biology and development	4	Semestre 2	20	10	6				

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
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Plant cell biology and developement

ECTS : 4

Semester: Semestre 2

Detail

Lecture: 20

Practical study : 6

Directed study: 10

Independant learning: 0

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Basic concepts of of formal genetics and molecular biology and of plant structure

Programme/contents

The aim of this course is to understand and master key concepts in plant developmental biology at the molecular, cellular and whole-organism levels. The topics covered, whether in model or cultivated species, will concern the major stages of plant life and morphogenesis, responses to environmental change, natural diversity and variation, and certain aspects of Evo-Devo. This knowledge can be re-used to explore new themes in future courses, whether or not they specialize in the study of development.

Learning objectives

At the end of the course, students will be able to:

- To understand in a theoretical and practical way the development of plants and their adaptations as the main stages of angiosperms development and their molecular and cellular determinism
- To know the major regulators of developmental transitions and their signaling pathways, whether endogenous (hormones, peptide signals, etc...) or exogenous (light and photoperiod) and their possible interactions.
- To be able to formulate hypotheses and to set up an experimental approach to answer them
- To gain autonomy in learning recent methods of plant cellular and molecular analysis used in development biology (genetic forward, gene targeting and genome editing, protein-protein and

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
Design an experiment	2.5	Semestre 2	4	15	6				
■									

Design an experiment

ECTS : 2.5

Semester: Semestre 2

Detail

Lecture: 4

Practical study : 6

Directed study: 15

Project : 20

Language(s) of instruction

Anglais

Remote teaching

non

Learning objectives

Training in the experimental approach – designing and implementing a biological experiment independently

Overall organisation

Lecture: Experimental procedures, characteristics of a scientific experiment

Tutorial: Designing an experiment to validate results from an omics approach

Practical: Implementing the experiment

Skills

Working in a team,
designing and conducting a relevant experiment to answer a given biological question,
critically analyzing a methodology and data

Type of assessment

Evaluation Continue non Intégrale

[Metagenomics and microbial molecular ecology \(Elective courses G - option 2\)](#)

4	Semestre 2	18	18
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Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	d
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Metagenomics and microbial molecular ecology (Elective courses G - option 2)

ECTS : 4

Semester: Semestre 2

Detail

Lecture: 18

Practical study : 18

Project : 20

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Basic knowledge in microbial taxonomy, in biostatistics and in the use of R language

Programme/contents

Knowledge and implementation of molecular and bioinformatic tools for the analysis of microbial ecosystems using metagenetic approaches (e.g. 16S gene amplicon sequencing; or other markers depending on the microbial ecosystem studied). Knowledge of the principles of descriptive and functional microbial ecology. The course will aim to compare several samples taken either from a food microbial ecosystem, from environmental microbiota or plant, human or animal digestive microbiota, or from biotechnological digesters used to treat bio-waste. Descriptive and functional knowledge of these ecosystems will be presented in lectures, and the acquisition of the skills necessary for data processing will be addressed in tutorials and practicals. Emphasis will be placed on the critical study of the different stages of analysis using bioinformatics tools that are easy for microbiologists to use and implemented on a Galaxy interface or R biostatistics packages specific to molecular ecology studies (e.g. Phyloseq package).

Overall organisation

Face-to-face (lectures; tutorials; practicals). Skills will be acquired during tutorials using test data sets, then put into practice on unknown data sets (see Practical Course), the analysis of which will form part of the assessment. Opening an account

BCC4- Implementing a plant science research and innovation project in a professional context

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	distance learning courses
Stage	8	Semestre 2		104					



Stage

ECTS : 8

Semester: Semestre 2

Detail

Directed study: 104

Language(s) of instruction

Anglais

Remote teaching

non

Programme/contents

Stage en laboratoire ou en entreprise, en France ou à l'étranger.

Internship in a laboratory or in a private company, in France or abroad.

Learning objectives

Contribuer à un projet de recherche en s'intégrant dans une équipe tout en faisant preuve d'autonomie et d'initiative ; mettre en œuvre une démarche scientifique pour répondre à une problématique donnée ; recueillir, analyser et synthétiser les informations de la bibliographie ; analyser et présenter à l'oral et à l'écrit des résultats expérimentaux.

Contribute to a research project by working as part of a team while demonstrating autonomy and initiative; implement a scientific approach to address a given issue; collect, analyze, and synthesize information from the bibliography; analyze and present experimental results both in oral and written form.

Overall organisation

Stage en laboratoire ou en entreprise, en France ou à l'étranger.

1 tuteur par étudiant (suivi recherche de stage et pendant le stage).

Internship in a laboratory or in a private

Teaching Location(s)

ORSAY
GIF SUR YVETTE
PARIS 13
PALAISEAU
VERSAILLES

Contact

- **Karine ALIX**

Responsable du M2 Plant Sciences IQPV
- **Axel DE ZELICOURT**
- **Gianluca TEANO**

Links

Scholarship

<http://www.universite-paris-saclay.fr/formation/master/biologie-agrosciences/m1-biologie-agrosciences-sciences-du-vegetal-plant-sciences>