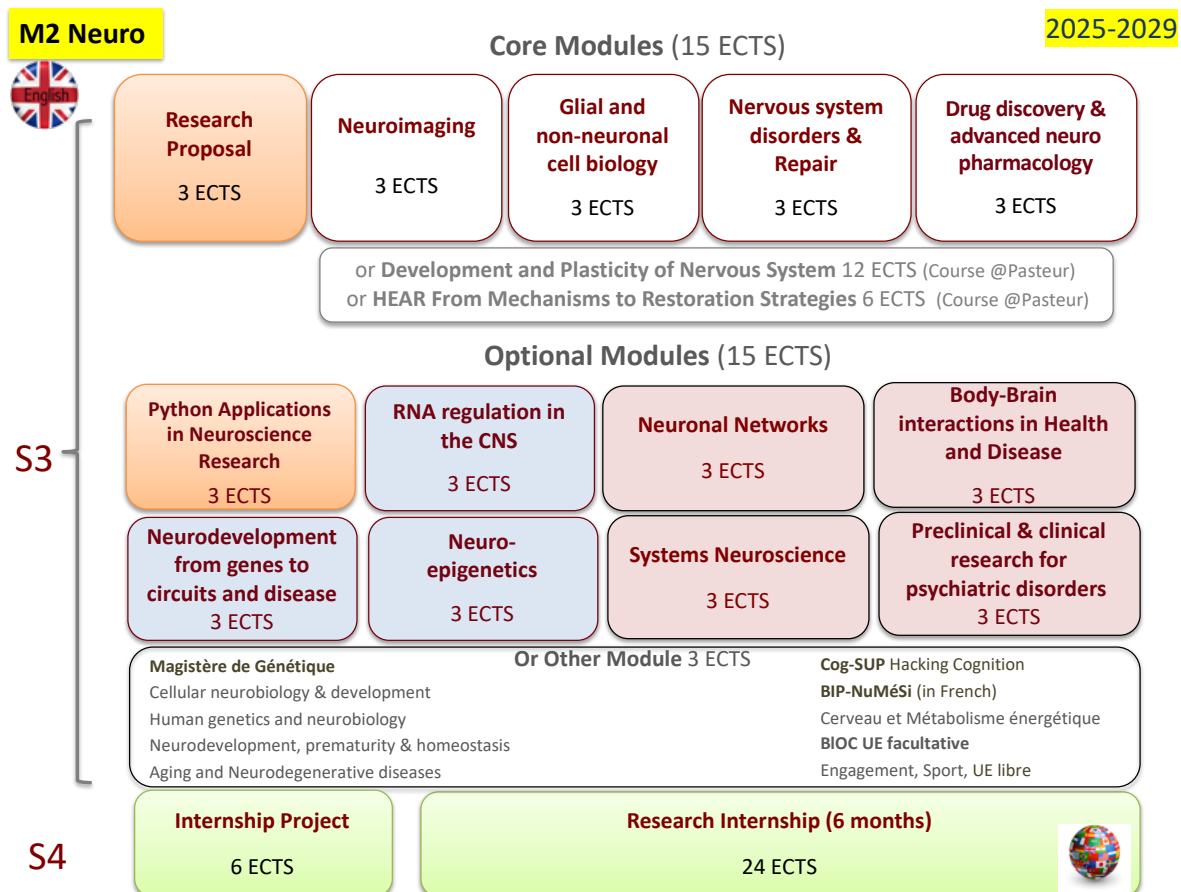# MASTER'S PROGRAM IN NEUROSCIENCE

Second year M2

List of modules at a glance

Courses are taught in **English**. During semester 3, in addition to core modules (15 ECTS), each student has to validate 15 ECTS optional modules taken in **cellular, molecular and integrative neuroscience**. Other optional modules are also offered (see in details below).

Specific optional modules (3 ECTS) from other Master's programs are also offered. Keep in mind that the timetable compatibility between different Master's programs and the number of places available per module are subject to change each academic year.

M2 Neuro

2025-2029

Core Modules (15 ECTS)

Research Proposal 3 ECTS	Neuroimaging 3 ECTS	Glial and non-neuronal cell biology 3 ECTS	Nervous system disorders & Repair 3 ECTS	Drug discovery & advanced neuro pharmacology 3 ECTS

or **Development and Plasticity of Nervous System** 12 ECTS (Course @Pasteur)
or **HEAR From Mechanisms to Restoration Strategies** 6 ECTS (Course @Pasteur)

Optional Modules (15 ECTS)

S3

Python Applications in Neuroscience Research 3 ECTS	RNA regulation in the CNS 3 ECTS	Neuronal Networks 3 ECTS	Body-Brain interactions in Health and Disease 3 ECTS
Neurodevelopment from genes to circuits and disease 3 ECTS	Neuro-epigenetics 3 ECTS	Systems Neuroscience 3 ECTS	Preclinical & clinical research for psychiatric disorders 3 ECTS

Or Other Module 3 ECTS

Magistère de Génétique
Cellular neurobiology & development
Human genetics and neurobiology
Neurodevelopment, prematurity & homeostasis
Aging and Neurodegenerative diseases

Cog-SUP Hacking Cognition
BIP-NuMéSi (in French)
Cerveau et Métabolisme énergétique
BIOC UE facultative
Engagement, Sport, UE libre

S4

Internship Project 6 ECTS	Research Internship (6 months) 24 ECTS

S3: Semester 3; **S4:** Semester 4; **ECTS:** European Credit Transfer and Accumulation System

MASTER NEURO M2

COURSE OUTLINE

Course Title: Research proposal

Course(s) supervisor(s):

Title: Prof. Université Paris Cité
First name: Mehrnaz
LAST NAME: JAFARIAN-TEHRANI

Title: PR Université Paris Cité
First name: Nicolas
LAST NAME: GUEROUT

Total number of hours: few practical sessions, mainly personal and team working

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: To be able to write and defend a research proposal over 3 years based on a scientific publication, and fictive collaborations through interactions with the scientific community, researchers and engineers in research labs or technical facilities. The student has to write a proposal according to the instructions given at the beginning of the semester and finally be able to defend the proposal in front of a Jury.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Mandatory course ☒

Prerequisites/skills needed: M1 Neuroscience (UE Methodologies in Neuroscience S1 and S2)

Key words: Research project; experimental design; scientific report; scientific collaboration

Teaching methods and activities: personal/team working (to be proactive and interactive with researchers/engineers)

Assessment: written report and defense

SCIENCES FONDAMENTALES
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Sciences
Université Paris Cité

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NEURO PARIS

MASTER NEURO M2

COURSE OUTLINE

English

Course Title: Neuroimaging

Course(s) supervisor(s):

Title: MCU Université Paris Cité
First name: Clément
LAST NAME: RICARD

Total number of hours: 22h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: Give an overview of the different neuroimaging techniques and approaches from the researcher, clinician and industrial point of view.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Mandatory course ☒

Prerequisites/skills needed: Knowledge in neuroanatomy (attending the M1 « Neuroanatomie fonctionnelle » course is not mandatory but recommended).

Key words: Neuroimaging, Optics, MRI, CT-Scan, Ultrasound, Nuclear imaging

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

COURSE OUTLINE

Course Title: Glial and non-neuronal cell biology

Course(s) supervisor(s):

Title: PR Université Paris Cité
First name: Charbel
LAST NAME: MASSAAD

Title: MCU Université Paris Cité
First name: Delphine
LAST NAME: MEFFRE

Total number of hours: 22h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: The aim of this teaching unit is to learn the recent advances in glial biology and glial and non-glial cell interactions. Besides the main courses, tutorials will guide the students to perform innovative academic project based on the topics developed during the main lectures.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Mandatory course ☒

Prerequisites/skills needed: cellular and molecular neurobiology, electrophysiology

Key words: Schwann cell, astrocyte, oligodendrocyte, microglia, endothelial cell, neurovascular unit, cell interaction, neuron-glia interaction

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

MASTER NEURO M2

COURSE OUTLINE

Course Title: Drug Discovery and Advanced Neuropharmacology

Course(s) supervisor(s):

Title: CR CNRS
First name: Nicolas
LAST NAME: MARIE

Total number of hours: 24h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: Neuropharmacology is the study and understanding of the actions of chemical agents on neurobiological processes in nervous system. Students will discover the recent advances in neuropharmacology and some aspects of the development of drugs for the nervous system.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Mandatory course ☒

Prerequisites/skills needed: Strong background in physiology and neuropharmacology

Key words: Optopharmacology, drug development, biased ligands, drug delivery, drug design

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

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NEURO
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Université Paris Cité

MASTER NEURO M2

COURSE OUTLINE

English

Course Title: Nervous system disorders and repair

Course(s) supervisor(s):

Title: PR Université Paris Cité
First name: Mehrnaz
LAST NAME: JAFARIAN-TEHRANI

Title: PR Université Paris Cité
First name: Nicolas
LAST NAME: GUEROUT

Total number of hours: 21h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: Recent advances in the pathophysiology of nervous system disorders including neurodegenerative diseases, cerebrovascular diseases, movement disorders, pathologies of myelin, spinal cord and head injuries, child neurology, and an introduction to psychiatric disorders. Some aspects of nervous system repair are taught related to neuroprotection, physical exercise and brain stimulation.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Mandatory course ☒

Prerequisites/skills needed: Neurobiology, neuroanatomy

Key words: CNS disorders, Prion diseases, cerebrovascular diseases, stroke, spinal cord and brain injury, multiple sclerosis, movement disorders ALS, SMA, Psychiatric disorders

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

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Sciences
Université Paris Cité

NEURO
PARIS

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MASTER NEURO M2

COURSE OUTLINE

English

Course Title: Neurodevelopment, from genes to circuits and disease

Course(s) supervisor(s):

Title: PR Université de Genève – Université Paris Cité
First name: Denis
LAST NAME: JABAUDON

Title: CR INSERM
First name: Frédéric
LAST NAME: CAUSERET

Total number of hours: 20h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: This course will provide students with key concepts, methodological approaches and experimental data related to the developmental programs underpinning CNS function. The aim is to understand how neural tissue emerges and undergoes spatial and temporal patterning to generate distinct neurons types that wire together and form functional circuits. We will also provide examples of species-specific developmental features and discuss how alterations in neurodevelopmental processes can result in human diseases. The course is designed to be interactive and involves direct contact with researchers who will share their lab experience.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒

Prerequisites/skills needed: Basic knowledge in development and cellular/molecular neurobiology

Key words: Tissue patterning, Neurogenesis, Fate specification, Neuronal differentiation, Neuronal diversity, Axon guidance, Activity-dependent circuit refinement

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

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MASTER NEURO M2

COURSE OUTLINE

Course Title: RNA regulation in the CNS

Course(s) supervisor(s):

Title: MCU Université Paris Cité
First name: Laure
LAST NAME: WEILL

Total number of hours: 22h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: The course provides an in-depth knowledge on RNA metabolism and RNA regulation and its role in neurobiology: brain development and cell differentiation, plasticity and how RNA dysregulation can lead to different neuropathology.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒

Prerequisites/skills needed: Molecular Biology

Key words: Ribonucleopathy (splicing disease), RNA localization, local translation, non coding RNA, mRNA bodies

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

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MASTER NEURO M2

COURSE OUTLINE

Course Title: Neuroepigenetics

Course(s) supervisor(s):

Title: PR Université Paris Cité
First name: Délara
LAST NAME: SABERAN-DJONEIDI

Title: MCU Université Paris Cité
First name: Véronique
LAST NAME: DUBREUIL

Total number of hours: 24h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: The course aims at providing in-depth research-based knowledge about the epigenetic processes that govern behaviors and brain functions. The student will appreciate how basic epigenetic mechanisms tightly regulate brain development, neural cell differentiation and brain integrity, and how the perturbation of normal epigenetic processes lead to a wide spectrum of neurodevelopmental and neuropsychiatric disorders. Moreover, special focus will be put on the impact of environmental insults on the neural epigenome and neural cell fate during development and in a lifetime manner, to the protective responses, which underlies the proper brain functions.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒ (maximum 16 students)

Prerequisites/skills needed: brain development, molecular and cellular biology

Key words: Epigenome, neurodevelopment, brain integrity, NGS, cohort analysis, neurodegeneration

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

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MASTER NEURO M2

COURSE OUTLINE

English

Course Title: Neuronal Networks

Course(s) supervisor(s):

Title: MCU Université Paris Cité
First name: Aude
LAST NAME: MARZO

Total number of hours: 22h

Number of ECTS: 3

Semester: Semester 3 (M2) ⊠

Description: The course aims to enhance your understanding of neural networks. You will explore various examples of synaptic plasticity, which result from the differential integration of synaptic inputs and signal modulation. The study will focus on neural networks both within and between structures to understand their associated functions, as well as the underlying mechanisms of learning and memory.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ⊠

Prerequisites/skills needed: Master 1 in Neuroscience; good understanding of cellular electrophysiology

Key words: synaptic plasticity; dendritic integration; computational neurosciences; learning and memory

Teaching methods and activities: lectures (CM) ⊠ Practical sessions (TD) ⊠

 Assessment: continuous assessment and exam

COURSE OUTLINE

Course Title: Systems Neuroscience

Course(s) supervisor(s):

Title: DR CNRS
First name: Mathieu
LAST NAME: BERANECK

Total number of hours: 24h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: the goal of the *Systems and Integrative Neuroscience* course is to provide the student the basic knowledge regarding the methodologies and approaches used to study functional neural systems. The course brings together teachers and researchers who are studying different functions on various species. They all work to understand how functions emerge by studying their respective systems at different levels with a so-called integrative approach. For each system we will consider the role of the electrophysiological properties of the neurons, of the properties that emerge from neural networks and microcircuits, and relate these properties to quantified behaviors through modeling.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒

Prerequisites/skills needed: Master 1 in Neuroscience; basic knowledge regarding sensory and motor systems; basic knowledge about cellular electrophysiology

Key words: multisensory integration; sensory systems; motor systems; sensorimotor; balance; orientation & navigation; basal ganglia-thalamus-cortical loop; cerebellum; oculomotor systems; electrophysiological intrinsic properties and synaptic properties; microcircuits; models of action selection; models of learning; statistical models; principle of maximum likelihood; baysian models; initial theories; memory &learning; Hebb theory and experimental demonstrations

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

 Assessment: continuous assessment and exam

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MASTER NEURO M2

COURSE OUTLINE

English

Course Title: Preclinical and clinical research for psychiatric disorders

Course(s) supervisor(s):

Title: MCU Université Paris Cité
First name: Aude
LAST NAME: MARZO

Title: CR INSERM
First name: Nicolas
LAST NAME: RAMOZ

Total number of hours: 22h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: This course aims to explain the interface between basic research in neuroscience, through different strategies, especially molecular biology of genetics, epigenetics and pharmacogenetics, and clinical research to understand behavior and psychiatric disorders. It also aims to present clinical research in order to show its contribution to the understanding of psychiatric diseases and the interest of developing translational research. In the end, this course aims to show by practical examples the interest of neuropsychiatric domains in the understanding of normal and pathological behaviors.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒

Prerequisites/skills needed: M1 in science with a good understanding in fundamental neuroscience, genetics or molecular biology or M1 in health with the medical practice in neuroscience, psychiatry or pharmacology.

Key words: addiction, brain molecular biology, Epigenetics, Genetics, human behavior, psychopharmacogenetics, translational psychiatry

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

MASTER NEURO M2

COURSE OUTLINE

Course Title: Body-Brain Interactions in Health and Disease

Course(s) supervisor(s):

Title: PR Université Paris Cité
First name: Giuseppe
LAST NAME: GANGAROSSA

Title: DR INSERM
First name: Thierry
LAST NAME: GALLI

Total number of hours: 20h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: Over the past decade, groundbreaking advances in modern technologies and transformative concepts have revolutionized neuroscience, shifting the focus to a more dynamic interplay between the brain and the body. This paradigm shift underscores how systemic physiology, metabolism and interoceptive signals profoundly shape brain functions and dysfunctions - and vice versa - highlighting the importance of *holistic*, interdisciplinary approaches in neuroscience. Emerging evidence links disruptions in these interactions to a wide range of neurological and psychiatric disorders, redefining our understanding of health and disease.

This course bridges diverse disciplines and cutting-edge technologies, offering a comprehensive, research-driven education. Students will explore the intricate and bidirectional connections between the brain and body, delving into how physiological and pathological interoceptive processes influence body-brain homeostasis. Designed to inspire innovation, this program equips participants to tackle complex scientific challenges and pioneer solutions in both basic and clinical neuroscience.

Exact location: Campus Saint-Germain-des-Prés, UFR Basic and Biomedical Sciences, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒

Prerequisites/skills needed: M1 in life sciences with a good understanding in fundamental neurosciences, physiology, genetics and/or molecular biology.

Key words: Interoception, Integrative neurosciences, Systems (neuro)physiology, Inter-organs communications, Periphery-to-Brain circuits, Integrative and cellular allostatic processes.

Teaching methods and activities: lectures (CM) ☒ Practical sessions (TD) ☒

Assessment: continuous assessment and exam

MASTER NEURO M2

COURSE OUTLINE

Course Title: Python Applications in Neuroscience Research

Course(s) supervisor(s):
Title: CR CNRS
First name: Michael
LAST NAME: GRAUPNER

Total number of hours: 20h

Number of ECTS: 3

Semester: Semester 3 (M2) ☒

Description: The field of neuroscience is becoming increasingly quantitative, with a continuously growing torrent of brain-derived data, supplemented by sophisticated brain simulations. This trend underscores the importance of equipping students with essential skills for processing, analyzing, and visualizing the large datasets commonly encountered in neuroscience research. Additionally, many neuroscience research projects increasingly rely on expertise in conducting advanced computational simulations, implementing cutting-edge analytical techniques and extensive database explorations. The purpose of a Python Applications in Neuroscience Research is to provide students with an intensive and collaborative environment to apply and expand their theoretical knowledge and technical skills towards solving real-world neuroscience challenges using the Python programming language within a condensed time frame. Python's accessibility, extensive libraries, and wide-spread usage in the Neuroscience domain make it an invaluable tool for implementing research projects. Prior to the course, projects will be sought from local (Saints-Pères and Parisian) scientists. Projects can revolve around reproducing published data or implementing novel approaches beneficial to the proposing scientist. Examples encompass tasks such as introducing novel psychophysical paradigms, devising or applying innovative analysis methods for existing data sets, or creating data visualization tools. These projects will be tailored to fit the timeframe and constraints of the one-week course, ensuring feasibility and alignment with course objectives. Soliciting projects for the course from local scientists adds a practical and relevant dimension to the Neuroscience Masters curriculum by addressing local research priorities. Additionally, involving local scientists provides students with opportunities for mentorship, networking, and potential future internships, enriching their learning experience and facilitating the translation of academic knowledge into the scope of the Master's program.

Exact location: Campus Saint-Germain-des-Prés, 45 rue des Saints-Pères, 75006 Paris

Optional course ☒

Prerequisites/skills needed: Master-level knowledge about neuroanatomy, physiology of the nervous systems are necessary. Prior knowledge of Python programming is essential for this course, as it does not include an introductory section on programming fundamentals. Students should be familiar with basic concepts, syntax and usage of Python, which are taught during the "Neural Data Science with Python" module (S1 M1). This course is designed to delve deeper into Python programming techniques, building upon existing knowledge and skills.

Key words: Python, neuroscience projects, programming

Teaching methods and activities: lectures (CM) ☐ Practical sessions (TD) ☒

Assessment: Presentation of the project work at the end of the week

MASTER NEURO M2

COURSE OUTLINE

Course Title: Internship project and Research Internship

Course(s) supervisor(s):

Title: PR Université Paris Cité
First name: Mehrnaz
LAST NAME: JAFARIAN-TEHRANI

Title: PR Université Paris Cité
First name: Nicolas
LAST NAME: GUEROUT

Total number of hours: 5 to 6-month internship

Number of ECTS: 6 ECTS (Internship project) + 24 ECTS (Research internship)

Semester: Semester 4 (M2) ☒

Description: An overall five to six-month internship is required to validate the M2 level. Before starting the internship, students have to present and defend their internship project (6 ECTS) at the beginning of semester 4. They have to contact their internship supervisor during semester 3 and spend time with the host research team in order to understand their research project.

Exact location: Research teams in France or abroad, but mainly research teams affiliated to the Paris University (see Master Neuro internship offers).

Mandatory course ☒

Prerequisites/skills needed: Master Neuro S3

Key words: Research teams, Europe, International, CNRS, INSERM, IPNP, Neurodiderot, Cochin, Necker, BFA, Institut Imagine, Campus Saint-Germain-des-Prés, Institut Pasteur

Teaching methods and activities: Experimental work ☒ attending the neuroscience seminars ☒

Assessment: written report and defense