

PASTEUR COURSE

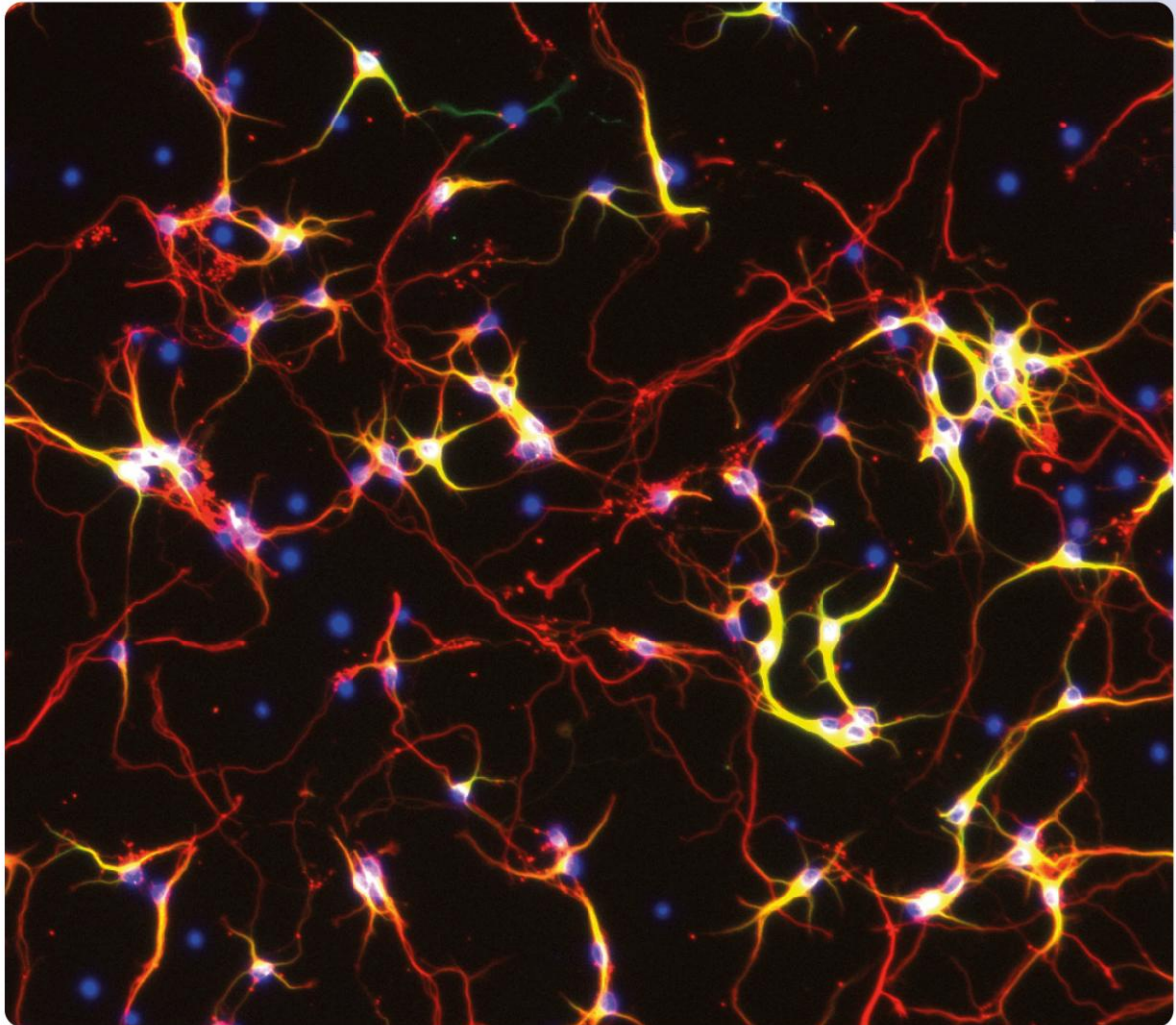
Development and Plasticity of the Nervous System



Education Center
Institut Pasteur, Paris



September 14 - October 15, 2026



PASTEUR COURSE
«DEVELOPMENT & PLASTICITY OF THE NERVOUS SYSTEM»

FROM SEPTEMBER 14TH TO OCTOBER 15TH 2026

PROGRAM 2026-2027

1ST PART: EVOLUTION AND DEVELOPMENT OF THE NERVOUS SYSTEM

2ND PART: DEVELOPMENT, PLASTICITY AND PATHOLOGIES OF THE NERVOUS SYSTEM

DIRECTORS OF THE COURSE

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HEAD OF STUDIES

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LOCATION: EDUCATION CENTER - INSTITUT PASTEUR

**28 rue du Docteur Roux
75724 PARIS CEDEX 15**

LECTURES: Room N°6 Building n°5 - Underground floor (entrance via building n° 10)

PRACTICAL COURSES: 2nd Floor Building N°9

INTRODUCTION

The course *Development and plasticity of the nervous system (DPNS)* covers the main cutting-edge topics of neuroscience research, at both theoretical and experimental levels. Students following the course will acquire a broad understanding of various topics ranging from molecules to behavior. Various animal models (mouse, frog and drosophila) commonly used in neuroscience research are used, giving students the opportunity to understand the difference between each model, and to further expand their repertoire of practical skills in carrying out experiments. International scientists, expert in their own field of research, provide theoretical and/or experimental courses. During the practical course, students will approach and test stem cell biology, behavioral analyses in mice, drug stereotaxic injection, neuroanatomy and gene expression analyses using histochemical techniques, which are further described below. Students will also follow a tutorial on computational techniques for behavioral analysis in neuroscience.

Preparing neural stem cells and testing their multipotentiality and the influence of exogenous factors on their neural fate approach stem cell biology: Neural stem cells are the most immature progenitor cells in the central nervous system and are defined by their ability to give rise to more stem cells via symmetric division, and to progenitors of all neural lineages by asymmetric division. In this session, students will isolate neural stem cells from various structures of the fetal mouse brain and will subsequently prepare neurospheres. The differentiation pattern of neural stem cells will be studied using the neurospheres they have prepared during the practical course. In addition, students will analyze the influence of exogenous factors on neurosphere differentiation.

Complexity of the brain aims to introduce the students to the basic histological methods that are currently used as the first step of sample analysis in neurobiology. It is necessary to obtain resolute images from morphology of the tissues under study. The simplest way to obtain the picture of cellular structures and complexity is to develop classical staining procedures. Two staining procedures, namely cresyl violet and luxol fast blue, will represent appropriate tools to analyze the distribution of neural cell bodies. During the staining procedure (composed of multiples steps) of rodent brain sections (paraffin embedded), students will be trained to brain anatomy and nuclear ontology. This training will introduce them to the processes of 3D reconstruction and to develop mental representations of anatomical structures and topological references.

Stereotaxic injection and functional consequences: The anatomical and behavioral effects induced by dopaminergic depletion, resulting from a toxin injection into the striatum, will be studied. This experimental session is divided into three parts, during which students will be introduced to and will acquire experience in behavioral and statistical analyses and labeling of brain slices. Students will perform stereotaxic injections of a toxin into the striatum of adult mice. Evaluating the mice's performance across several sensory-motor tasks will determine the success of this procedure. Finally, the students will perfuse the mice, slice the brains in serial sections and perform immunohistofluorescence techniques to confirm the loss of dopaminergic cells due to the toxin injection.

Behavioral analysis: Effect of cholinergic modulation on short-term memory: This part is devoted to behavioral analysis after transient inhibition of the cholinergic system in adult mice. Such inhibition will be achieved via intraperitoneal injection of a muscarinic receptor antagonist. Students will then assess the behavioral performances of mice on a short-term memory task, namely the novel object recognition. During this part of the course, students will strengthen their understanding of behavior testing as well as statistical analysis.

Tools to investigate early neural development in *Xenopus laevis*: *Xenopus laevis* are the appropriate tools to study vertebrate embryology and development, and to model human diseases in which the embryonic developments are dysregulated. Research using *Xenopus* embryos takes advantage of a large and abundant production of eggs, and embryos which can be manipulated easily, as well as a conserved cellular, developmental and genomic organization with mammals. For the practical course, experiments will particularly focus on analyzing the development of the neural plate in such models.

Drosophila olfactory learning: *Drosophila* flies present an olfactory sensory system allowing the recognition and discrimination of hundreds of discrete odorants. The perception of odorants is crucial for the animal to locate and choose mates, food sources, hosts and oviposition sites that are essential for their survival. Morpho-functional analyses and characterization of *drosophila* olfactory learning will be performed. The study will include an introduction to the nervous system of insects and key genetic concepts. The *drosophila melanogaster* model will be presented as an interesting model for studying olfaction and the role of dopamine in learning behaviors.

THURSDAY, SEPTEMBER 10

12:00 - 12:45 PRE-STARTING MEETING

IT TOOLS TO BE CHECKED TOGETHER



Camille CARPENTIER, Samia CHERIET

Maria PEREZ, Virginie PONTICELLI

(Education Center, Institut Pasteur - Paris)

1ST PART: EVOLUTION AND DEVELOPMENT OF THE NERVOUS SYSTEM: WEEK 1

DOCTORAL SCHOOL MODULE 1: FROM SEPTEMBER 14TH TO SEPTEMBER 18TH, 2026

MONDAY, SEPTEMBER 14

9:00 - 9:15 RECEPTION OF THE STUDENTS

Pierre-Marie LLEDO, Alain TREMBLEAU

Isabelle CLOEZ-TAYARANI

(Sorbonne Université & Institut Pasteur - Paris)

Camille CARPENTIER, Samia CHERIET

Maria PEREZ, Virginie PONTICELLI

(Education Center, Institut Pasteur - Paris)

9:15 - 11:15 ON THE USE AND PROTECTION OF ANIMALS IN RESEARCH
AND EDUCATION

Caroline MANET

(Institut Pasteur - Paris)

11:15 - 11:30 INTRODUCTION TO PRACTICAL COURSES

Isabelle CLOEZ-TAYARANI

(Institut Pasteur - Paris)

12:30 - 13:00 SECURITY RULES

Camille CARPENTIER

(Institut Pasteur - Paris)

13:00 - 18:00 PRACTICAL EXPERIMENTS:
MODULE I: BRAIN DISSECTION AND CULTURE OF NEUROSPHERES

Richard BELVINDRAH

Ana BLAS MEDINA

Inès BOUTEAU

Venera KHACHATRYAN

(Sorbonne Université & Institut Pasteur - Paris)

TUESDAY, SEPTEMBER 15

9:00 - 11:15 AXONAL AND DENDRITIC LOCAL TRANSLATION AND ITS ROLE IN
THE DEVELOPMENT AND PLASTICITY OF NEURAL NETWORK

Alain TREMBLEAU

(Sorbonne Université - Paris)

11:15 - 12:00 INTRODUCTION TO MODULE II

Béatrice DURAND

(Sorbonne Université - Paris)

13:00 - 18:00 PRACTICAL EXPERIMENTS: MODULE II (5 pairs)
EGG PREPARATION FOR MRNA INJECTION AND PREPARATION OF ANIMAL CAPS

Béatrice DURAND

(Sorbonne Université)

12:30 - 18:00 PRACTICAL EXPERIMENTS: MODULE III-A (5 pairs)
STEREOTAXIC INJECTION OF 6-OHDA

Mariana ALONSO

Chloé BOUARAB, Stéphanie PONS

Claire-Hélène DE BADTS, Viviana BISCEGLIA

(Institut Pasteur - Paris)

WEDNESDAY, SEPTEMBER 16

9:00 - 11:15 FUNCTIONAL ARCHITECTURE OF NICOTINIC RECEPTORS AND THEIR
HOMOLOGS - CONSEQUENCES FOR NEURONAL SIGNALING

Pierre-Jean CORRINGER
(Institut Pasteur - Paris)

12:00 - 18:00 PRACTICAL EXPERIMENTS: MODULE II
EGG PREPARATION FOR MRNA INJECTION
AND PREPARATION OF ANIMAL CAPS

Béatrice DURAND
(Sorbonne Université)

PRACTICAL EXPERIMENTS: MODULE III-A
STEREOTAXIC INJECTION OF 6-OHDA

Mariana ALONSO
Chloé BOUARAB, Stéphanie PONS
Claire-Hélène DE BADTS, Viviana BISCEGLIA
(Institut Pasteur - Paris)

THURSDAY, SEPTEMBER 17

9:00 - 11:15 IONOTROPIC GLUTAMATE RECEPTORS: MOLECULAR MECHANISMS
AND THERAPEUTIC POTENTIAL

Pierre PAOLETTI
(ENS - Paris)

13:00 - 18:00 PRACTICAL EXPERIMENTS: MODULE II
OBSERVATIONS AND ANALYSIS

Béatrice DURAND
(Sorbonne Université)

12:00 - 17:00 PRACTICAL EXPERIMENTS: MODULE III-A
STEREOTAXIC INJECTION OF 6-OHDA

Mariana ALONSO
Chloé BOUARAB, Stéphanie PONS
Claire-Hélène DE BADTS, Viviana BISCEGLIA
(Institut Pasteur - Paris)

FRIDAY, SEPTEMBER 18

9:00 - 11:15 THE CEREBELLUM: WHAT ARE THE MAJORITY
OF BRAIN NEURONS GOOD FOR?

Clément LENA
(ENS - Paris)

13:30 - 18:00 PRACTICAL EXPERIMENTS: MODULE I
ADHESION OF NEUROSPHERES

Richard BELVINDRAH
(Sorbonne Université - Paris)

Module I: Neural stem cell differentiation: Multipotentiality and influence of endogenous and exogenous factors on the fate of neural progenitors

Module II: Tools to investigate early neural development in *Xenopus* *Leavis*

Module III: Elimination of dopaminergic afferents in mice striatum: Anatomical and functional consequences (**Part A**)

1ST PART: EVOLUTION AND DEVELOPMENT OF THE NERVOUS SYSTEM: WEEK 2

**DOCTORAL SCHOOL MODULE 1:
FROM SEPTEMBER 21TH TO SEPTEMBER 25TH, 2026**

MONDAY, SEPTEMBER 21

9:00 - 11:15 **GENERAL PRINCIPLES OF THE DEVELOPMENT AND EVOLUTION
OF THE CENTRAL NERVOUS SYSTEM IN CHORDATES** **Philippe VERNIER**
(CEA – Gif-sur-Yvette)

11:30 - 12:00 **COURSE PHOTO**

13:00 - 18:00 **PRACTICAL EXPERIMENTS: MODULE I** **Richard BELVINDRAH**
IMMUNOSTAINING OF NSCs (Sorbonne Université - Paris)

TUESDAY, SEPTEMBER 22

9:00 - 11:15 **THE NEUROARCHEOLOGY OF AUTISM
AND BRAIN DISORDERS** **Yehezkel BEN-ARI**
(INMED / INSERM U29 - Marseille)

13:00 - 18:00 **PRACTICAL EXPERIMENTS: MODULE I** **Richard BELVINDRAH**
MICROSCOPE ACQUISITIONS AND QUANTIFICATION (1) **Inès BOUTEAU**
Ana BLAS MEDINA
Venera KHACHATRYAN
(Sorbonne Université & Institut Pasteur - Paris)

WEDNESDAY, SEPTEMBER 23

9:00 - 11:15 **BRAIN UNDER CONSTRUCTION: MOLECULAR MANAGERS
AND CELLULAR BOULDERS** **Salvador MARTINEZ PEREZ**
(Instituto Neurociencias - Alicante)

14:00 - 14:15 **INTRODUCTION TO COURSES IN ALICANTE** **Salvador MARTINEZ PEREZ**
PARAFFIN BRAIN SECTIONS STAINING AND ANALYSIS (Instituto Neurociencias - Alicante)

14:15 - 18:00 **PRACTICAL EXPERIMENTS: MODULE IV** **Salvador MARTINEZ PEREZ**
PARAFFIN BRAIN SECTIONS STAINING AND ANALYSIS (Instituto Neurociencias - Alicante)

THURSDAY, SEPTEMBER 24

9:00 - 11:15 **THE DEVELOPING CORTEX AND ASSOCIATED MALFORMATIONS** **Fiona FRANCIS**
(INSERM - Paris)

14:00 - 18:00 **PRACTICAL EXPERIMENTS: MODULE IV** **Salvador MARTINEZ PEREZ**
PARAFFIN BRAIN SECTIONS STAINING AND ANALYSIS (END) (Instituto Neurociencias - Alicante)

FRIDAY, SEPTEMBER 25

9:00 - 11:15	RECENT ADVANCES IN COMPUTATIONAL ANALYSIS OF ANIMAL BEHAVIOR	Alex BARBIER-CHEBBAH (Institut Pasteur - Paris)
12:15 - 14:15	ROUND TABLE “SYSTEMS BIOLOGY AND MULTI-OMICS” SALLE 6	Frédéric CAUSERET Sébastien MELLA & DPNS Course organizers (Institut Pasteur - Paris)
14:30 - 18:30	PRACTICAL EXPERIMENTS: MODULE V COMPUTATIONAL ANALYSIS OF MOUSE BEHAVIOR	Alex BARBIER-CHEBBAH Astrid NILSSON (Institut Pasteur - Paris)

Module I: Neural stem cell differentiation Multipotentiality and influence of endogenous and exogenous factors on the fate of neural progenitors

Module IV: Paraffin brain sections staining and analysis

2ND PART: DEVELOPMENT, PLASTICITY AND PATHOLOGIES OF THE NERVOUS SYSTEM: WEEK 3

DOCTORAL SCHOOL MODULE 2: FROM SEPTEMBER 28TH TO OCTOBER 2TH, 2026

MONDAY, SEPTEMBER 28

- 9:00 - 11:15 **THE NEURO-IMMUNE AXIS**
FROM NEW INSIGHTS TO PROSPECTS FOR NOVEL TREATMENTS
Gabriel LEPOUSEZ
(Institut Pasteur - Paris)
- 13:00 - 18:00 **PRACTICAL EXPERIMENTS: MODULE I**
MICROSCOPE ACQUISITIONS AND QUANTIFICATION (2)
Richard BELVINDRAH
Inès BOUTEAU
Ana BLAS MEDINA
(Sorbonne Université & Institut Pasteur - Paris)
Venera KHACHATRYAN

TUESDAY, SEPTEMBER 29

- 9:00 - 11:15 **ENGINEERING A BRAIN USING THE GENOMIC NETWORK**
Bassem HASSAN
(ICM - Paris)
- 12:00 - 18:00 **PRACTICAL EXPERIMENTS: MODULE III-B** (5 pairs) Introduction *Room 6*
BEHAVIORAL ANALYSIS OF 60HDA INJECTED MICE (*ANIMAL FACILITIES*)
Mariana ALONSO
(Institut Pasteur - Paris)
- PRACTICAL EXPERIMENTS: MODULE VI** (5 pairs) Introduction *Room 6*
EFFECT OF CHOLINERGIC MODULATION
ON SHORT TERM MEMORY IN MICE (+SCOPOLAMINE TREATMENT)
Stéphanie DAUMAS
(Sorbonne Université - Paris)

WEDNESDAY, SEPTEMBER 30

- 9:00 - 11:15 **COMPARED EMBRYONIC AND ADULT NEUROGENESIS:**
TWO MODES IN ZEBRAFISH
Laure BALLY-CUIF
(Institut Pasteur - Paris)
- 13:00 - 17:00 **PRACTICAL EXPERIMENTS: MODULE III-B** (5 pairs)
BEHAVIORAL ANALYSIS OF 60HDA INJECTED MICE
Mariana ALONSO
(Institut Pasteur - Paris)
- PRACTICAL EXPERIMENTS: MODULE VI** (5 pairs)
EFFECT OF CHOLINERGIC MODULATION
ON SHORT TERM MEMORY IN MICE (+SCOPOLAMINE TREATMENT)
Stéphanie DAUMAS
(Sorbonne Université - Paris)

THURSDAY, OCTOBER 1

- 9:00 - 11:15 **MOLECULAR GENETIC DISSECTION OF NICOTINE ADDICTION**
Uwe MASKOS
(Institut Pasteur - Paris)
- 13:00 - 18:00 **PRACTICAL EXPERIMENTS: MODULE III-B & MODULE VI**
STATISTICAL ANALYSIS (ROOM 6)
Mariana ALONSO
Stéphanie DAUMAS
Camille CARPENTIER
(Sorbonne Université & Institut Pasteur - Paris)

FRIDAY, OCTOBER 2

9:00 - 11:15	ADULT NEUROGENESIS IN THE OLFACTORY SYSTEM: A RECAPITULATION OF EMBRYOGENESIS	Pierre-Marie LLEDO (Institut Pasteur - Paris)
11:20 - 11:30	INTRODUCTION TO MODULE III-C	Marc DAVENNE (Sorbonne Université - Paris)
11:35 - 12:15	INTRODUCTION TO MODULE VII	Thomas CHERTEMPS Caroline DUBACQ (Sorbonne Université - Paris)
13:15 - 18:00	PRACTICAL EXPERIMENTS: MODULE III-B & MODULE VI DATA PRESENTATION (ROOM 6)	Mariana ALONSO Stéphanie DAUMAS (Sorbonne Université & Institut Pasteur - Paris)

Module I: Neural stem cell differentiation: Multipotentiality and influence of endogenous and exogenous factors on the fate of neural progenitors

Module III: Elimination of dopaminergic afferents in mice striatum: Anatomical and functional consequences Lesions (Part B)

Module VI: Effect of cholinergic modulation on short-term memory in mice

Module VII: Learning to fly: Morpho-functional and behavioral characterization of drosophila dopaminergic neurons in associative learning

2ND PART: DEVELOPMENT, PLASTICITY AND PATHOLOGIES OF THE NERVOUS SYSTEM: WEEK 4

DOCTORAL SCHOOL MODULE 2: FROM OCTOBER 5TH TO OCTOBER 9TH, 2026

MONDAY, OCTOBER 5

9:00 - 11:15	HEARING – OR HOW THE COCHLEA DOES A HARD JOB USING SOFT PARTS	Pascal MARTIN (Institut Curie - Paris)
11:15 -11:45	PRACTICAL EXPERIMENTS: MODULE III-C INTRODUCTION & VIDEO « PERFUSION PFA 4% »	Marc DAVENNE (Sorbonne Université - Paris)
12:45 -13:00	INTRODUCTION TO MODULE VII	Thomas CHERTEMPS CAROLINE DUBACQ (Sorbonne Université - Paris)
13:00 -18:00	PRACTICAL EXPERIMENTS: MODULE III-C MICE PERFUSION - VIBRATOME SECTIONS	Marc DAVENNE Inès BOUTEAU Laetitia TRAVIER (Sorbonne Université & Institut Pasteur - Paris)
	PRACTICAL EXPERIMENTS: MODULE VII DROSOPHILA BRAIN DISSECTION	Thomas CHERTEMPS Caroline DUBACQ (Sorbonne Université - Paris)

TUESDAY, OCTOBER 6

9:00 - 11:15	BRAIN, REWARD, AND ADDICTION	Jean-Antoine GIRAULT (Inserm - Paris)
12:30 -18:00	PRACTICAL EXPERIMENTS: MODULE III-C Vibratome sections (end) & start of IHC (last pairs)	Marc DAVENNE Inès BOUTEAU Ana BLAS MEDINA (Sorbonne Université & Institut Pasteur - Paris)
13:00 - 18:00	PRACTICAL EXPERIMENTS: MODULE VII DISSECTION OF DROSOPHILA AND MICROSCOPIC ANALYSIS	Thomas CHERTEMPS CAROLINE DUBACQ (Sorbonne Université - Paris)

WEDNESDAY, OCTOBER 7

9:00 - 11:15	GENES, SYNAPSES AND AUTISM	Thomas BOURGERON (Institut Pasteur - Paris)
11:15 - 11:35	PRACTICAL EXPERIMENTS: MODULE III-C IMMUNOHISTOCHEMISTRY (ANTIBODY INCUBATION)	Marc DAVENNE (Sorbonne Université - Paris)
13:00 -18:00	PRACTICAL EXPERIMENTS: MODULE VII ANALYSIS OF LEARNING BEHAVIOR	Thomas CHERTEMPS CAROLINE DUBACQ (Sorbonne Université - Paris)
13:35 -18:00	PRACTICAL EXPERIMENTS: MODULE III-C IMMUNOHISTOCHEMISTRY & SLIDE MOUNTING FOR IHC	Marc DAVENNE (Sorbonne Université - Paris)

THURSDAY, OCTOBER 8

9:00 - 11:15 INITIAL EVENTS IN THE DEVELOPMENT OF
OLFACTORY CIRCUITS

Charles GREER
(Yale University - New Haven)

13:00 - 18:00 PRACTICAL EXPERIMENTS: MODULE III-C
MICROSCOPE OBSERVATIONS

Marc DAVENNE
(Sorbonne Université - Paris)

13:00 - 18:00 PRACTICAL EXPERIMENTS: MODULE VII
MORPHO-FUNCTIONAL ANALYSIS - CONCLUSION

Thomas CHERTEMPS
Caroline DUBACQ
(Sorbonne Université - Paris)

FRIDAY, OCTOBER 9

9:00 - 11:15 EVOLUTION AND FUNCTION OF SENSORY SYSTEMS

Stuart FIRESTEIN
(Columbia University - New York)

12:45 - 13:30 "FAREWELL PARTY"

BUILDING 10 (PER) EMILE ROUX - GROUND FLOOR

13:30 - 16:00 PRACTICAL EXPERIMENTS: MODULE III-C
CONCLUSIONS - (ROOM 6)

Marc DAVENNE
(Sorbonne Université - Paris)

PRACTICAL EXPERIMENTS: MODULE VII
CONCLUSIONS - (ROOM 6)

Thomas CHERTEMPS
CAROLINE DUBACQ
(Sorbonne Université - Paris)

Module III: Elimination of dopaminergic afferents in mice striatum: Anatomical and functional consequences (Part C)

Module VII: Learning to fly: Morpho-functional and behavioral characterization of drosophila dopaminergic neurons in associative learning

Week 5

FROM OCTOBER 12TH TO OCTOBER 15TH

MONDAY, OCTOBER 12

13:15 - 17:00 ORAL EXAMINATION (ARTICLE PRESENTATION) - ROOM 6

TUESDAY, OCTOBER 13

13:15 - 17:00 PRACTICAL COURSE EXAMINATION (ORAL PRESENTATION) - ROOM 6

THURSDAY, OCTOBER 15

9:00 - 12:00 WRITTEN EXAMINATION - ROOM 6

DPNS Course Examinations

1) ***Practical courses*** – Daily evaluation of student participation during the practical courses (Head of Studies and all organizers of practical modules).

(20 points)

2) ***Monday, October 12, (13:15-17:00)*** - Oral presentation of a scientific article by pairs of students (Students will be provided with published articles at the end of the first week of the DPNS Course).

(20 points; 10-min presentation followed by 10-min discussion)

3) ***Tuesday, October 13, (13:15-17:00)*** - Oral presentation of a subject related to the practical courses, by groups of 2 pairs of students (Subjects will be given to students on Oct. 9).

(20 points; 20-min presentation followed by 15-min discussion)

4) ***Thursday, October 15, (9:00-12:00)*** - Written examination.

Some questions may be related to selected topics from the conferences and/or practical courses. It is therefore very important to attend all conferences and assimilate them, as well as the practical courses.

(140 points)

Total: 200 points

Modalités d'examen et barème

1) ***Durant toute la période des TP*** - Evaluation journalière individuelle de l'investissement dans les TP, de la qualité et du sérieux du travail (ces évaluations seront effectuées par les responsables des TP et par la Chef de Travaux).

(20 points)

2) ***Lundi 12 octobre (13h15-17h00)*** - Présentation orale d'un article, en binôme (l'article sera tiré au sort par les binômes à la fin de la première semaine du Cours).

(20 points; 10 minutes de présentation et 10 minutes de discussion)

3) ***Mardi 13 octobre (13h15-17h00)*** - Présentation orale d'une question relative aux TPs en groupe de 2 binômes (la question sera tirée au sort le dernier jour des TP, soit le 9 octobre).

(20 points ; 20 minutes de présentation et 15 minutes discussion)

4) ***Jeudi 15 octobre (9h00-12h00)*** - Examen écrit individuel, pouvant porter sur des questions de cours (d'où l'obligation de suivre tous les cours, avec le plus grand sérieux) et sur des analyses de résultats.

(140 points)

Total : 200 points