

PASTEUR COURSE «DEVELOPMENT & PLASTICITY OF THE NERVOUS SYSTEM»

2016-2017

1st PART: EVOLUTION AND DEVELOPMENT OF THE NERVOUS SYSTEM

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



P R O G R A M



Institut Pasteur

centre d'enseignement

PASTEUR COURSE «DEVELOPMENT & PLASTICITY OF THE NERVOUS SYSTEM »2016-2017

FROM SEPTEMBER 19th TO OCTOBER 19th 2016

LOCATION : *TEACHING CENTER AT THE INSTITUT PASTEUR*

**Pavillon Louis Martin
Bâtiment N°9
28 rue du Docteur Roux
75724 PARIS CEDEX 15**

LECTURES: Room N° 2

PRACTICAL COURSES: 2nd Floor

INTRODUCTION

The course *Development and plasticity of the nervous system* (DPSN) 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, neuritogenesis of primary cortical neurons, drug stereotaxic injection, neuroanatomy and gene expression analyses using histochemical techniques, which are further described below.

Stem cell biology is approached by preparing neural stem cells and testing their multipotentiality and the influence of exogenous factors on their neural fate. 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, in addition to analyzing the influence of exogenous factors on their 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 images of the fine morphology of the tissues under study. The simplest way to obtain the picture of cellular structure and complexity is to develop classical staining procedures. We have selected two kinds of staining that will reveal the distribution of neural cell bodies: cresyl violet and luxol fast blue. During the staining procedure (composed of multiples steps) of rodent brain sections (paraffin sections) the students will be trained to brain anatomy and nuclear ontology to introduce them to the processes of 3D reconstruction and develop mental representations of anatomical structures and topological references.

Stereotaxic injection and functional consequences: We will study the anatomical and behavioral effects of dopaminergic depletion caused by the injection of a toxin into the striatum. This experimental session is divided into three parts, during which the student will be introduced to and will acquire experience in behavioral and statistical analyses and immunohistochemistry techniques. Students will perform stereotaxic injections of a toxin into the striatum of adult mice. Assessing mice abilities during several sensory-motor tasks will test the success of this procedure. Finally, the students will perfuse the mice, slice the brains in serial sections and perform immunohistochemistry to confirm the loss of dopaminergic cells due to the toxin injection, and to assess

Behavioral analysis: Effect of cholinergic modulation on short-term memory.

This part is devoted to the 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, after which students will assess behavioral performances of mice on a short-term memory task, namely the novel object recognition task. During this part of the course, students will further strengthen their background in behavior testing and statistical analysis.

Tools to investigate early neural development in *Xenopus laevis*:

Xenopus are very appropriate tools to study vertebrate embryology and development and to model human diseases in which the embryonic development is dysregulated.

Research using *Xenopus* embryos takes advantage of large and abundant production of eggs, and easily manipulated embryos, in addition to conserved cellular, developmental and genomic organization with mammals.

For the practical course, experiments will particularly focus on the analysis of the development of the neural plate in such models.

Neurite outgrowth using primary rat cortical neurons

Regional and subregional variations in the size and morphology of neurons occur in the mammalian nervous system. Neuritogenesis corresponds to the sprouting of neurites from neuronal cells and is the first step in the development of the mature neuronal morphologies. Neurite growth and the establishment of the dendrite-axon polarity are major elements to be studied. They involve cytoskeleton and actin polymerization as well as diverse signaling mechanisms allowing the selection of axonal formation among dendrites. Growth factors and calcium play key roles on the speed of neurite outgrowth, neuron morphologies and neurite length and branching. The course will offer the students to analyze such mechanisms and compare different methods of neurite outgrowth quantification.

***Drosophila* olfaction**

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. A morpho-functional and behavioral characterization of *drosophila* olfaction will be performed. The study will include an introduction of the nervous system of insects and some genetic concepts. The *drosophila melanogaster* model will be presented as a very interesting model for studying olfaction.

1st PART: EVOLUTION AND DEVELOPMENT OF THE NERVOUS SYSTEM: Week 1

DOCTORAL SCHOOL MODULE 1: FROM SEPTEMBER 19TH TO SEPTEMBER 29TH, 2016

MONDAY, SEPTEMBER 19

8:30 - 9:00 AM	Reception of the students	Pierre-Marie LLEDO, Alain TREMBLEAU Isabelle CLOEZ-TAYARANI (Institut Pasteur - Paris) & (Université Pierre et Marie Curie - Paris) Murielle ALMOUSSA & Christine VAUTHIER (Centre d'Enseignement, Institut Pasteur - Paris)
9:00 - 11:15 AM	General principles of the development and evolution of the central nervous system in Chordates	Philippe VERNIER (CNRS - Gif sur Yvette)
1:30 - 2:00 PM	INTRODUCTION TO PRACTICAL COURSES : Security rules	Isabelle CLOEZ-TAYARANI (Institut Pasteur - Paris) & Murielle ALMOUSSA (Institut Pasteur - Paris)
2:00 - 2:30 PM	INTRODUCTIONS TO MODULE I & II	Richard BELVINDRAH & Sandrine VITRY (Institut du fer à Moulin) (Institut Pasteur - Paris)
2:30 - 7:00 PM	PRACTICAL EXPERIMENTS : Modules I & II : Brain dissection, culture of neurospheres and neurons	Richard BELVINDRAH & Sandrine VITRY (Institut du fer à Moulin) (Institut Pasteur - Paris)

TUESDAY, SEPTEMBER 20

9:00 - 11:15 AM	Brain under construction: Molecular managers and cellular boulders.	Salvador MARTINEZ (Instituto Neurociencias Alicante- Spain)
2:00 - 6:00 PM	PRACTICAL EXPERIMENTS : MODULE III Paraffin brain sections and staining	Salvador MARTINEZ (Instituto Neurociencias Alicante- Spain)
12: noon - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV –A Stereotaxic injection of 6-OHDA	Mariana ALONSO (Institut Pasteur - Paris)

WEDNESDAY, SEPTEMBER 21

9:00 - 11:15 AM	The developing cortex and associated malformations	Fiona FRANCIS (INSERM - Paris)
2:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE III Signal analysis	Salvador MARTINEZ (Instituto Neurociencias Alicante- Spain)
12: noon - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV –A Stereotaxic injection of 6-OHDA	Mariana ALONSO (Institut Pasteur - Paris)

THURSDAY, SEPTEMBER 22

9:00 - 11:30 AM	Stem cells, asymmetric division and fate diversity in the fly nervous system	François SCHWEISGUTH (Institut Pasteur - Paris)
1:00 - 2:00 PM	INTRODUCTION TO FLUORESCENT MICROSCOPY AND IMAGE ANALYSIS (Room2)	Sandrine VITRY (Institut Pasteur - Paris)
2:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV-A Stereotaxic injection of 6-OHDA	Mariana ALONSO (Institut Pasteur - Paris)

FRIDAY, SEPTEMBER 23

9:00 - 11:15 AM	Axonal and dendritic local translation and its role in the development and plasticity of neural network	Alain TREMBLEAU (Université Pierre & Marie Curie - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE I&II Adhesion of neurospheres and neuron fixation	R. BELVINDRAH & S. VITRY (Institut du fer à Moulin - Paris) (Institut Pasteur - Paris)

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

Module II : How to quantify neurite outgrowth in vitro ?

Module III : Understanding the brain anatomy in 3D

Module IV: Elimination of dopaminergic afferents in mice striatum: Anatomical and functional consequences Lesions caused by stereotaxic injections of a toxin, behavioral and immunohistochemical analyze (Experiments A, B, C, respectively)

1st PART: EVOLUTION AND DEVELOPMENT OF THE NERVOUS SYSTEM: Week 2

DOCTORAL SCHOOL MODULE 1: FROM SEPTEMBER 19th TO SEPTEMBRE 29th, 2016

MONDAY, SEPTEMBER 26

9:00 - 11:15 AM	Compared embryonic and adult neurogenesis : new insights from the zebrafish model	Laure BALLY-CUIF (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : Module I&II <i>Immunostaining of NSCs and mouse cortical neurons</i>	R. BELVINDRAH & S. VITRY (Institut du fer à Moulin) (Institut Pasteur - Paris)

TUESDAY, SEPTEMBER 27

9:00 - 11:15 AM	Adult neurogenesis in the olfactory system: A recapitulation of embryogenesis?	Pierre-Marie LLEDO (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE I <i>Microscope acquisitions and quantification</i>	Richard BELVINDRAH (Institut du fer à Moulin)

WEDNESDAY, SEPTEMBER 28

9:00 - 11:15 AM	Functional architecture of nicotinic receptors and their homologs - consequences in neuronal signaling	Pierre-Jean CORRINGER (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE II <i>Microscope analysis of labeled neurons and quantification</i>	Sandrine VITRY (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : Module V <i>Egg preparation for mRNA injection and preparation of animal caps</i>	Béatrice DURAND (Institut Curie - Orsay)

THURSDAY, SEPTEMBER 29

9:00 - 11:15 AM	Genes, synapses, and autism	Thomas BOURGERON (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE II <i>Microscope analysis of labeled neurons and quantification</i>	Sandrine VITRY (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : Module V <i>Egg preparation for mRNA injection and preparation of animal caps</i>	Béatrice DURAND (Institut Curie - Orsay)

FRIDAY, SEPTEMBER 30

9:00 - 11:15	Molecular-genetic dissection of nicotine addiction	Uwe MASKOS (Institut Pasteur - Paris)
1:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE V <i>Observations and analysis</i>	Béatrice DURAND (Institut Curie - Orsay)

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

Module II : How to quantify neurite outgrowth *in vitro* ?

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

2nd PART : DEVELOPMENT, PLASTICITY AND PATHOLOGIES OF THE NERVOUS SYSTEM: Week 3

DOCTORAL SCHOOL MODULE 2 : FROM OCTOBER 3RD TO OCTOBER 14TH, 2016

MONDAY, OCTOBER 3

9:00 - 11:15AM **How to built brain maps**

Patricia GASPAR
(Institut du Fer à Moulin - Paris)

1:30- 7:00 PM **PRACTICAL EXPERIMENTS : MODULE I**

Richard BELVINDRAH
Microscope acquisitions and quantification

(Institut du fer à Moulin)

TUESDAY, OCTOBER 4

9:00 - 11:15AM **The neurons of addiction**

Jean-Antoine GIRAULT
(INSERM - Paris)

1:00 - 7:00 PM **PRACTICAL EXPERIMENTS : MODULE IV-B**
Behavioral analysis of 60HDA injected mice

Mariana ALONSO
(Institut Pasteur - Paris)

1:00 - 7:00 PM **PRACTICAL EXPERIMENTS : MODULE VI**

Stéphanie DAUMAS

Behavioral analysis of mice (+scopolamine treatment)

(UPMC- Paris)

WEDNESDAY, OCTOBER 5

9:00 - 11:15AM **Hearing – or how the cochlea does a hard job
using soft parts**

Jonathan ASHMORE
(University College - London)

11:15 - 1:15PM **ROUND TABLE**

**Laure BALLY CUIF, Shahragim TAJBAKHSH
Béatrice DURAND, Sigolène MEILHAC
And DPNS Course organizers**
(Université Pierre et Marie Curie - Paris) (Institut Pasteur - Paris)

1:15 - 7:00 PM **PRACTICAL EXPERIMENTS : Module IV - B**
Behavioral analysis of 60HDA injected mice

Mariana ALONSO
(Institut Pasteur - Paris)

1:15 - 7:00 PM **PRACTICAL EXPERIMENTS : MODULE VI**
Behavioral analysis of mice (+scopolamine treatment)

Stéphanie DAUMAS
(UPMC- Paris)

THURSDAY, OCTOBER 6

9:00 - 11:15 AM **The cerebellum: What are the majority
of brain neurons good for ?**

Clément LENA
(Ecole Normale Supérieure - Paris)

1:00 - 7:00 PM **PRACTICAL EXPERIMENTS : MODULE IV-B**
Data computerizing

Mariana ALONSO
(Institut Pasteur - Paris)

1:00 - 7:00 PM **PRACTICAL EXPERIMENTS : MODULE VI**
Data computerizing

Stéphanie DAUMAS
(UPMC- Paris)

FRIDAY, OCTOBER 7

9:00 - 11:15 AM **Ionotropic glutamate receptors : mechanisms
and pharmacology**

Pierre PAOLETTI
(Ecole Normale Supérieure - Paris)

1:00 - 7:00 PM **PRACTICAL EXPERIMENTS : Module IV - B**
Statistical analysis

Mariana ALONSO
(Institut Pasteur - Paris)

1:00 - 7:00 PM **PRACTICAL EXPERIMENTS : MODULE VI**
Statistical analysis

Stéphanie DAUMAS
(UPMC- Paris)

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

Module IV: Elimination of dopaminergic afferents in mice striatum: Anatomical and functional consequences *Lesions caused by stereotaxic injections of a toxin*, behavioral and immunohistochemical analyze (Experiments A, B, C, respectively)

Module VI : Effect of cholinergic modulation of short-term memory

**2nd PART : DEVELOPMENT, PLASTICITY AND PATHOLOGIES OF
THE NERVOUS SYSTEM : Week 4**

**DOCTORAL SCHOOL MODULE 2 :
FROM OCTOBER 3rd TO OCTOBER 14th, 2016**

MONDAY, OCTOBER 10

9:00 - 11:15 AM	Evolution and function of Sensory System - I	Stuart FIRESTEIN (Columbia University - New-York)
12: noon -7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV-C <i>Mice perfusion - Vibratome sections</i>	Marc DAVENNE (UMPC, Paris)

TUESDAY, OCTOBER 11

9:00 - 11:15 AM	Evolution and Function of Sensory Systems – II	Stuart FIRESTEIN (Columbia University - New-York)
12:30 - 1:00 PM	PRACTICAL EXPERIMENTS : MODULE VII <i>Introduction</i>	CAROLINE DUBACQ & THOMAS CHERTEMPS (UMPC, Paris)
1:15 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV-C <i>Vibratome sections</i>	Marc DAVENNE (UMPC, Paris)
2:00 -7:00 PM	PRACTICAL EXPERIMENTS : MODULE VII <i>Dissection, microscopic analysis and exposure to odorants</i>	Caroline DUBACQ & Thomas CHERTEMPS (UMPC, Paris)

WEDNESDAY, OCTOBER 12

9:00 - 11:15 AM	Genes and Environment in cerebral development	Yehezkel BEN-ARI (INMED / INSERM U29 Marseille)
2:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV-C <i>Immunohisto-chemistry</i>	Marc DAVENNE (UMPC, Paris)
2:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE VII <i>Olfactory behavior in larvae</i>	Caroline DUBACQ & Thomas CHERTEMPS (UMPC, Paris)

THURSDAY, OCTOBER 13

9:00 - 11:15 AM	Neuroglial interactions in brain physiology	Christian GIAUME (College de France - Paris)
2:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE IV-C <i>Microscope observations</i>	Marc DAVENNE (UMPC, Paris)
2:00 - 7:00 PM	PRACTICAL EXPERIMENTS : MODULE VII <i>Morpho-fonctionnal analysis - Conclusion</i>	Caroline DUBACQ & Thomas CHERTEMPS (UMPC, Paris)

FRIDAY, OCTOBER 14

9:00 - 11:15 AM	Initial Events in the Development of Olfactory Circuits	Charles GREER (Yale University - New Haven)
1:15 - 2:00 AM	FAREWELL PARTY	
2:00 - 5:00 PM	PRACTICAL EXPERIMENTS : MODULE IV-C <i>Conclusion</i>	Marc DAVENNE (UMPC, Paris)

Module IV: Elimination of dopaminergic afferents in mice striatum: Anatomical and functional consequences *Lesions caused by stereotaxic injections of a toxin*, behavioral and immunohistochemical analyze (Experiments A, B, C, respectively)

Module VII: Fly Olfaction : Morpho-functional and behavioral characterization of drosophila olfaction

Week 5

FROM OCTOBER 17 TO OCTOBER 19, 2016

MONDAY, OCTOBER 17

1:15 - 5:00 PM

ORAL EXAMINATION (ARTICLE PRESENTATION)

TUESDAY, OCTOBER 18

1:15 - 5:00 PM

ORAL EXAMINATION (PRACTICAL COURSES)

WEDNESDAY, OCTOBER 19

9:00 - 13:00 PM

WRITTEN EXAMINATION