MIT-Portugal PhD Program in Bio-Engineering

Neuroscience Course 2014

March 17-28, 2014

CNC - Center for Neuroscience and Cell Biology, University of Coimbra

Coordinator:
Ana Luísa Carvalho (alc@cnc.uc.pt)

Lecturers, University of Coimbra:

Ana I Oliveira, CNC
Ana Luísa Carvalho, CNC and Dep Life Sciences, UC
Carlos B. Duarte, CNC and Dep Life Sciences, UC
Emília Duarte, CNC and Dep Life Sciences, UC
João Laranjinha, CNC and Faculty of Pharmacy, UC
Rui Barbosa, CNC and Faculty of Pharmacy, UC
Cácia Lourenço Marques, CNC
João Peça, CNC
Jorge Valero, CNC
Miguel Castelo-Branco, IBILI and Faculty of Medicine, UC
Paulo Pinheiro, CNC
Ramiro D. Almeida, CNC
Ricardo Rodrigues, CNC
Rodrigo Cunha, CNC and Faculty of Medicine, UC

Invited lecturer:

Carmen Varela, Picower Institute for Learning and Memory, MIT, Cambridge, MA, USA

The first week of the course (March 17-21) will lay the foundations for a basic understanding of brain function. The goal for this week is to set a common baseline for students with different backgrounds, and to expose the students to how neuroscience is approached at different levels (from molecules and neurons to circuits and behaviour).

In the second week of the course (March 24-28) recent methodological advances with an application in neuroscience will be discussed, in the context of emergent questions in this field.

Student Assignments:

The students will present an original paper (in groups of 2-3), as well write a grant proposal based on the results presented in the paper (to be finished on March 28th). The grant proposal is 3 pages long and should include the following sections: a) State of the art; b) Objectives of proposal; 3) Proposed tasks and methodology.
COURSE SYLLABUS

Week 1: From synapse formation to function and dysfunction

March 17

9.00h-9.15h: Structure of the course; Introduction of students and lecturers
9.15h-10.15h: Neurogenesis
Jorge Valero
10.45h-11.45h: Neuronal Migration
Ricardo Rodrigues
13.30h-14.45h: Introduction to Synapses: Structure-Function and Molecular Composition
Ana Luisa Carvalho
15.00h-16.30h: Molecular Triggers of Synapse Formation and Maturation
Ramiro D. Almeida

March 18

9.00h-10.15h: Electrophysiology: a primer (I)
João Peça
10.45h-11.45h: Electrophysiology: a primer (II)
Paulo Pinheiro
13.30h-14.45h: Presynaptic function
Paulo Pinheiro
15.00h-16.30h: Postsynaptic Receptor Function
Ana Luisa Carvalho

March 19

9.00h-10.15h: Glia cells and synaptic function
Emília Duarte
10.30h-11.45h: Synaptic plasticity & molecular mechanisms
Ana Luisa Carvalho
13.30h-14.45h: Synaptic plasticity and memory
Ana Luisa Carvalho
Afternoon: Time to work on presentations & grants
**March 20**

9.00h-10.15h: Synaptic modulation (neurotrophins)
*Carlos B. Duarte*

10.45h-12.00h: Synaptic modulation (adenosine)
*Rodrigo Cunha*

13.30-14.45: Synaptic dysfunction in Alzheimer's Disease
*Rodrigo Cunha*

15.00h: Paper presentations (1&2)

**March 21**

9.00-11h: Time to work on presentations & grants

11.30h-12.30h: Synaptic dysfunction in Autism (I)
*João Peça*

15.00h-16.00h: Synaptic dysfunction in Autism (II)
*João Peça*

**Week 2: Advanced methods to study brain function**

**March 24**

Human brain imaging
*Miguel Castelo-Branco*

Afternoon: Time to work on presentations & grants

**March 25**

9.00h-10.00h: Genetic Deconstruction of Neuronal Circuits
*João Peça*

10.30h-11.30h: Optogenetics: Toolbox and approaches
*João Peça*

Afternoon: Time to work on presentations & grants
March 26
9.00h-10.15h: *In vivo* electrophysiology recordings in awake animals / Behavior analysis (I)
Carmen Varela

10.30-11.45: *In vivo* electrophysiology recordings in awake animals / Behavior analysis (II)
Carmen Varela

Afternoon:
Disruption of hippocampal function using pharmacogenetics
Seminar by Carmen Varela

March 27
9.00h-10.15h: Multi-photon microscopy: principles and in vitro applications
Ana Oliveira

10.30h-11.45h: Imaging neuronal circuits in vivo
Ana Oliveira

Afternoon: Paper presentations (3 & 4)

March 28
9.00h – 10.00h: Sensors and biosensors for real-time measurements in the brain.
Rui Barbosa

10.30h-11.30h: Arrays for real-time sensing of function in the brain: neurovascular coupling
Cátia Lourenço Marques and João Laranjinha

Afternoon: Paper presentations (5 & 6)

Background Reading:

*Neurogenesis & Neural Patterning:*

*Neuronal Migration:*

*Neural Signaling, Channels and Transporters*
Neuroscience, D. Purves et al.
Presynaptic Mechanisms:

Synaptic Plasticity:

Optogenetics:

In vivo electrophysiology:

Two-Photon Microscopy

Sensory Cortex

Papers for presentations & Grant proposals:


