

## GS14 1223 - “Neurocircuits and Behavior” – Course Syllabus

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**Class Time:** Tue and Thu, 9:00 - 10:30 A.M. Room MSE R649

### Course description

This is an advanced course aimed at students interested in systems neuroscience. The course will be divided into three modules: 1) new technologies in neuroscience; 2) functional neural circuits; and 3) manuscript peer review process. During the **new technologies** module, the students will be exposed to a basic introductory lecture about new techniques that are being actively used in current neuroscience research. In the following class, all students will read a scientific article about one of the techniques, and one of the students will lead the scientific discussion. During the **functional neural circuits** module, students will be exposed to an introductory lecture about functional neuroanatomy with a special emphasis on behavioral control. In the following class, the students will discuss a representative recent article that applies the previously learned techniques to identify neural circuits and/or cellular mechanisms underlying different types of behavior. These articles will serve as example cases to introduce new development in neuroscience. Given the vast literature on neural circuits and function, students will pre-select three articles directly related with the previous class, and the entire group will decide which article is most relevant for the group discussion. All the article presentations will be in the form of journal club discussion. The final module will be focused on the **manuscript peer review** process. During this module, students will select relevant unpublished manuscripts that are publicly accessible (e.g., BioRxiv), and will independently read, analyze, and evaluate the manuscripts by identifying strengths and weaknesses related to study design, technical approaches, data analysis and interpretation.

### SCHEDULE

#### Module 1. New Technologies in Neuroscience

*General course introduction and group/material distribution* (Dr. Fabricio Do Monte & Dr. Qingchun Tong) **(February 4<sup>th</sup>)**

1. Genetic manipulations I (Dr. Qingchun Tong)

*Lecture:* Introduction to the generation of knockout and transgenic rodents. **(February 6<sup>th</sup>)**  
*Article discussion* **(February 11<sup>th</sup>)**

2. Genetic manipulations II (Dr. Sheng Zhang)

*Lecture:* Ground rules of CRISPR/RNA interference. **(February 13<sup>th</sup>)**  
*Article discussion* **(February 18<sup>th</sup>)**

3. Brain activity manipulations I (Dr. Fabricio Do Monte)

*Lecture:* Advances on pharmacology, neurotransmitters, neuropeptides and their receptors. **(February 20<sup>th</sup>)**  
*Article discussion* **(February 25<sup>th</sup>)**

4. Brain activity manipulations II (Dr. Fabricio Do Monte)  
*Lecture:* Introduction to optogenetics, chemogenetics, deep brain stimulation (DBS) and transcranial magnetic stimulation (TMS). **(February 27<sup>th</sup>)**  
Article discussion **(March 3<sup>rd</sup>)**
5. Neuroanatomical tools (Dr. Qingchun Tong)  
*Lecture:* Introduction to neural tracing and immunohistochemical methods. **(March 5<sup>th</sup>)**  
Article Discussion **(March 10<sup>th</sup>)**
6. Brain activity monitoring in laboratory animals (Dr. Fabricio Do Monte)  
*Lecture:* Fundamentals of single-unit recordings, fiber photometry, 2-photon Ca<sup>2+</sup> imaging, and microendoscopy. **(March 12<sup>th</sup>)**  
Article discussion **(March 17<sup>th</sup>)**
7. Brain activity monitoring in humans (Dr. Francesco Versace)  
*Lecture:* Principles of functional magnetic resonance (fMRI), diffusion tensor imaging (DTI), electroencephalography (EEG). **(March 19<sup>th</sup>)**  
Article discussion **(March 24<sup>th</sup>)**

## **Module 2. Functional Neural Circuits**

8. Hypothalamus function in feeding (Dr. Qingchun Tong)  
*Lecture:* Introduction to hypothalamic functions with special focus on feeding behavior. **(April 2<sup>nd</sup>)**  
Article Discussion **(April 7<sup>th</sup>)**
9. Amygdala and emotion (Dr. Fabricio Do Monte)  
*Lecture:* Introduction to amygdalar functions with special focus on fear/anxiety. **(April 9<sup>th</sup>)**  
Article Discussion **(April 14<sup>th</sup>)**
10. Mesocorticolimbic circuits modulating reward behavior (Dr. Scott Lane)  
*Lecture:* The mesocorticolimbic dopaminergic system in the control of reward seeking. **(April 16<sup>nd</sup>)**  
Article Discussion **(April 21<sup>st</sup>)**
11. Cortical circuits in cognition and decision-making (Dr. Fabricio Do Monte)  
*Lecture:* Cortico-hippocampal pathways modulating learning and memory: from place cells and engram to choice behavior. **(April 23<sup>rd</sup>)**  
Article Discussion **(April 28<sup>th</sup>)**
12. The Brain Stem function (Dr. Michael Zhu)  
*Lecture:* The role of midbrain, pons and medulla in basic functions and brain-body communication. **(April 30<sup>th</sup>)**  
Article Discussion **(May 5<sup>th</sup>)**
13. Gut-Brain interactions (Dr. Qingchun Tong)  
*Lecture:* The crosstalk between central and peripheral nervous system: the microbiota as a major player. **(May 7<sup>th</sup>)**  
Article Discussion **(May 12<sup>th</sup>)**

### **Module 3. Manuscript Peer Review process**

1. Review of publicly accessible manuscripts (Dr. Fabricio Do Monte & Dr. Qingchun Tong)  
**(May 19<sup>th</sup>, May 21<sup>st</sup>, May 26<sup>th</sup>, May 28<sup>th</sup>)**

*Manuscript Review 1, 2, 3 and 4:* The students will take turns to present their peer reviews on one pre-selected manuscript each lecture. A total of 4 manuscripts will be reviewed. According to the number of participants, the students may be divided into groups to present.