

BIO-482 | Neuroscience: Cellular and circuit mechanisms

Teachers: Sylvain Crochet and Carl Petersen

Teaching assistants (TAs): Meriam Malekzadeh, Nishant Jana, Lana Smith and Jinyun Wu

Wednesday sessions will take place in room CM 1105

Friday sessions will take place in room CE1106

Exam room to be announced

Week 1 – Electrical properties of cell membranes

MOOC videos:

- 1.1 Introduction
- 1.2 The cell membrane
- 1.3 Ion channels
- 1.4 Membrane potential
- 1.5 Cable properties

11 September, 13:15-14:00 – Course introduction (Sylvain Crochet)

13 September, 13:15-14:00 – Exercises (TAs)

13 September, 14:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 2 – Excitability

MOOC videos:

- 2.1 Voltage-gated channels
- 2.2 Voltage-gating kinetics
- 2.3 The action potential
- 2.4 Action potential propagation
- 2.5 Whole-cell recordings

20 September, 13:15-14:00 – Exercises (TAs)

20 September, 14:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 3 – Synaptic transmission

MOOC videos:

- 3.1 Synaptic transmission
- 3.2 Neurotransmitter release
- 3.3 Presynaptic dynamics
- 3.4 Presynaptic modulation
- 3.5 Electron microscopy

27 September, 13:15-14:00 – Exercises (TAs)

27 September, 14:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 4 – Glutamatergic excitation

MOOC videos:

- 4.1 Glutamate receptors
- 4.2 Postsynaptic potentials
- 4.3 Glutamatergic circuits
- 4.4 Synaptic plasticity
- 4.5 Dendritic spines

4 October, 13:15-14:00 – Exercises (TAs)

4 October, 14:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 5 – GABAergic inhibition

MOOC videos: 5.1 GABAergic inhibition
5.2 Inhibitory synaptic conductances
5.3 Benzodiazepines
5.4 GABAergic projections
5.5 Neocortical inhibition

11 October, 13:15-14:00 – Exercises (TAs)

11 October, 13:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 6 – Measuring and controlling brain function

MOOC videos: 6.1 Brain function and behavior
6.2 Man and mouse
6.3 Imaging the brain in action
6.4 *In vivo* electrophysiology
6.5 Controlling brain function

18 October, 13:15-14:00 – Exercises (TAs)

18 October, 14:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 7 – Mechanisms of brain (dys)-function

MOOC videos: 7.1 Sensorimotor interactions
7.2 Sensory perception
7.3 Learning
7.4 Brain dysfunction
7.5 Concluding remarks

1 November, 13:15-14:00 – Exercises (TAs)

1 November, 14:15-15:00 – Discussion and Answers to exercise questions (Sylvain Crochet)

Week 8 – Mock exam

6 November, 13:15-16:00 – Mock exam (TAs)

8 November, 13:15-15:00 – Answers to Mock exam (TAs)

Week 9 – Exam and Mini-project introduction

13 November, 13:15-16:00 – Written exam (Sylvain Crochet and TAs) – Room XX

The written exam will count towards two-thirds of your final grade.

15 November, 13:15-15:00 – Mini-project introduction (Sylvain Crochet)

Weeks 10-14 – Mini-project: Neurophysiological data analysis

In the mini-project, you will use Matlab/Python to analyse a database of *in vivo* recordings of membrane potential during mouse behavior. The data are published:

Kiritani T, Pala A, Gasselin C, Crochet S, Petersen CCH (2023) Membrane potential dynamics of excitatory and inhibitory neurons in mouse barrel cortex during active whisker sensing. PLOS ONE 18: e0287174. <https://doi.org/10.1371/journal.pone.0287174>

Kiritani T, Pala A, Gasselin C, Crochet S, Petersen CCH (2023) Data set for “Membrane potential dynamics of excitatory and inhibitory neurons in mouse barrel cortex during active whisker sensing.” [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.7833080>

Week 10

20 November, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

22 November, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

Week 11

27 November, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

29 November, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

Week 12

4 December, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

6 December, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

Week 13

11 December, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

13 December, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

Week 14

18 December, 13:15-15:00 – Mini-project (Sylvain Crochet + TAs)

20 December, 13:15-15:00 – Mini-project (Sylvain Crochet + Tas)

Submit your mini-project report to sylvain.crochet@epfl.ch before Friday 20 December midnight

The mini-project report will count towards one-third of your final grade.
