BIO-482 | Neuroscience: Cellular and circuit mechanisms

Teachers: **Sylvain Crochet and Carl Petersen**

Teaching assistants (TAs): **Myriam Hamon, Nishant Jana, Lana Smith and Morgane Storey**

Wednesday sessions will take place in room CM 1105 (except, likely, the written).

Friday sessions will take place in CE 1106

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

10 September, 13:15-14:00 – Course introduction (Carl Petersen)

12 September, 13:15-14:00 – Exercises (TAs)
12 September, 14:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

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

19 September, 13:15-14:00 – Exercises (TAs)
19 September, 14:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

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

26 September, 13:15-14:00 – Exercises (TAs)
26 September, 14:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

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

3 October, 13:15-14:00 – Exercises (TAs)
3 October, 14:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

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

10 October, 13:15-14:00 – Exercises (TAs)
10 October, 13:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

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

17 October, 13:15-14:00 – Exercises (TAs)
17 October, 14:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

Holiday week

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

31 October, 13:15-14:00 – Exercises (TAs)
31 October, 14:15-15:00 – Discussion and Answers to exercise questions (Carl Petersen)

Week 8 – Mock exam

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

7 November, 13:15-15:00 – Answers to Mock exam (Carl Petersen)

Week 9 – Exam and Mini-project introduction

12 November, 13:15-16:00 – Written exam (Carl Petersen and TAs) – Rooms TBD
The written exam will count towards two-thirds of your final grade.

14 November, 13:15-15:00 – Mini-project introduction (Carl Petersen & 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

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

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

Week 11

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

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

Week 12

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

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

Week 13

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

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

Week 14

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

19 December – Submit your mini-project data analyses to sylvain.crochet@epfl.ch
The mini-project will count towards one-third of your final grade.
