The Hebrew University of Jerusalem

Syllabus

The Neurobiology of Learning and Memory - 94933

Last update 19-03-2025

HU Credits: 2.5

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Bio-Medical Sciences

Academic year: 0

Semester: 2nd Semester

Teaching Languages: Hebrew

Campus: Ein Karem

Course/Module Coordinator: Prof. Yonatan Kupchik

Coordinator Email: yonatan.kupchik@mail.huji.ac.il

Coordinator Office Hours: By appointment by email

Teaching Staff:

Prof. Yonatan Kupchik,
Dr. Ithai Rabinowitch,
Dr. Shai Sabbah

Course/Module description:

The course will deal with the neural mechanisms underlying learning and memory, from the molecular to the behavioral level

Course/Module aims:

The aims of this course are:
1) To educate the students in the neurobiology of learning and memory
2) To assimilate in students the language of neurobiological research
3) To develop in students the ability to integrate neurobiological research at different levels

Learning outcomes - On successful completion of this module, students should be able to:

1) To describe the molecular mechanisms that take place during learning
2) To understand the importance of the various types of synaptic plasticity for learning and memory
3) To link between neural systems and their associated types of learning
4) To implement neural mechanisms of learning in theories of learning and pathologies related to learning and memory

Attendance requirements(%):

100%

Teaching arrangement and method of instruction: 1) Frontal lectures
2) Active learning of various kinds
3) Active discussions in class about various subjects

Course/Module Content:

The course deals with learning and memory at 3 levels – the molecular/cellular level, the system level and the behavioral/pathological level. In each of these levels we will touch on central concepts in the field – encoding, consolidation and retrieval of memories, habituation, sensitization and more – and understand how each concept is applied in each level.

The molecular/cognitive level
1) Intracellular processes that underlie the encoding and consolidation of memories

2) Synaptic plasticity – mechanisms that underlie synaptic plasticity, the importance of AMPA and NMDA receptors in synaptic plasticity, the different types of synaptic plasticity (long-term vs. short-term)
3) Stabilizing memories at the cellular level – mechanisms of homeostatic plasticity

The system level
1) The importance of the hippocampus in learning and memory – the structure of the hippocampus and its neural circuits, the importance of the hippocampus for encoding and consolidating declarative memories, patient H.M.
2) Fear conditioning – emotional learning processes in the amygdala
3) The cerebellum and motor learning
4) The basal ganglia and reward-based learning

The behavioral/pathological level
1) Alzheimer's disease – The importance of acetylcholine for learning and the effect of its loss on memory
2) Post Traumatic Stress Disorder (PTSD) – Possible mechanisms and treatments based on learning processes and memory trace update
3) Drug addiction – cellular aberrant learning mechanisms and treatments based on memory manipulation

Required Reading:
1) The Neurobiology of Learning and Memory / J. Rudy (2nd or 3rd Edition)
2) Learning and Memory – From Brain to Behavior / Gluck, Mercado and Myers (4th edition) (Chapter 1 only)

Additional Reading Material:

Grading Scheme:
Computerized Exam - At the cluster % 75
Active Participation / Team Assignment 10 %
Mid-terms exams 15 %

Additional information: