DEPARTMENT OF CELL AND MOLECULAR BIOLOGY

C5F3107, CNS Injuries and Repair, 2 credits (hec)

CNS-skador och reparation, 2 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by the The Committee for Doctoral Education on 2023-11-27, and was last revised on 2025-03-04. The revised course syllabus is valid from autumn semester 2025.

Responsible department

Department of Cell and Molecular Biology, Faculty of Medicine

Prerequisite courses, or equivalent

The course targets PhD students and postdocs interested in regenerative medicine applied to the central nervous system (CNS).

Purpose & Intended learning outcomes

Purpose

The goal of this course is to enable doctoral students and postdocs to accurately identify and understand the cellular and molecular mechanisms activated by lesions or degeneration in the central nervous system. It aims to deepen their knowledge of state-of-the-art methodologies for studying these mechanisms and the current landscape of regenerative biology and novel therapeutic strategy development. Participants will be trained to critically assess and integrate the latest research findings and methodologies into their scholarly work to contribute effectively to the advancement of regenerative neuroscience.

Intended learning outcomes

Upon successful completion of the course, the doctoral students can identify and explain molecular and cellular mechanisms of injury response and the limitations of endogenous regenerative responses in the adult mammalian central nervous system. The participants will demonstrate knowledge of novel approaches to study CNS development, injury response and regeneration, with a focus on neural stem cells, molecular regulation of cell identity and injury

response, single cell and spatial genomics and strategies to manipulate the regenerative response of resident cell populations. The participants can analyze and connect injury responses to their potential use in regenerative medicine. The participants will be able to discuss and critically evaluate different regenerative strategies to repair central nervous system lesions, from basic research to potential clinical applications.

Course content

The lectures will include the following topics. Molecular and cellular mechanisms of injury response and regeneration in the central nervous system. Scientific approaches and cutting edge technologies used in the study of injury responses, including presentations by leaders in the field about state of the art experimental models. Experimental strategies in regenerative medicine: stem cells and reprogramming. Potential for development of regenerative therapies.

Forms of teaching and learning

Students will be assigned the course-relevant literature a week before the start of the course. Initial self-study and work in the team (corresponding to 2 days), interactive lectures of international experts in the field of central nervous system regenerative medicine, small group discussions, slide presentations and discussions (5 days on site). The initial self-study work in teams will consist of an assigned reading task regarding the course literature and discussion of a relevant manuscript for peer review in teams for later discussion during the examination. The course is scheduled to provide multiple time slots throughout the course program to for teambased learning and to prepare for the examination work.

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

Active participation in the initial project work in an assigned team, the group discussions and presentations is mandatory. Compensation is according to the instructions of the course director.

Forms of assessment

The examination consists of two parts:

Part 1: Manuscript Peer Review: students will in small groups critically evaluate a recent preprint related to the broad area of CNS regenerative medicine and apply the learnings during the course.

Part 2: Lecture Discussions and Daily Reflection: students will provide a reflection on each lecture. In addition to a brief summary, the reflection should include the most interesting or surprising point as well as an "unclear point" (something that was unclear or, if everything was clear, a topic they would like to explore further). During the examination, each member will discuss one main highlight and one main "unclear point." This will be followed by a group discussion. Each student will also share the key takehome message from the course and how it impacts their research.

Course literature

Recommended reads. Some of them will be mandatory to specific teams.
Recent articles in the field, including:
Microglia-organized scar-free spinal cord repair in neonatal mice. Nature, 2020 Nov;587(7835):613-618.
Reducing Pericyte-Derived Scarring Promotes Recovery after Spinal Cord Injury. Cell, 2018 Mar 22;173(1):153-165.
A latent lineage potential in resident neural stem cells enables spinal cord repair. Science, 2020 Oct 2;370(6512):eabb8795
The neurons that restore walking after paralysis. Nature, 2022 Nov;611(7936):540-547.
Rewired glycosylation activity promotes scarless regeneration and functional recovery in spiny mice after complete spinal cord transection. Dev Cell, 2022 Feb 28;57(4):440-450.e7.
CNS remyelination and inflammation: From basic mechanisms to therapeutic opportunities. Neuron, 2022 Nov 2;110(21):3549-3565.
Gene modification after spinal cord injury: Mechanisms and therapeutics. Exp Neurol, 2022 Oct;356:114156.
Microglia coordinate cellular interactions during spinal cord repair in mice. Nat Commun, 2022 Jul 14;13(1):4096.
Astrocytes and oligodendrocytes undergo subtype-specific transcriptional changes in Alzheimer's disease. Neuron, 2022 Jun 1;110(11):1788-1805.