DEPARTMENT OF MEDICAL BIOCHEMISTRY AND BIOPHYSICS

C2F2214, Redox Regulation, Oxidative Stress and Selenoproteins, 3 credits (hec)

Redoxreglering, oxidativ stress och selenproteiner, 3 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by the The Committee for Doctoral Education on 2023-10-31, and was last revised on 2024-09-16. The revised course syllabus is valid from spring semester 2025.

Responsible department

Department of Medical Biochemistry and Biophysics, Faculty of Medicine

Prerequisite courses, or equivalent

No prerequisite courses, or equivalent, demanded for this course.

Purpose & Intended learning outcomes

Purpose

The purpose of the course is to give doctoral students and post docs a good understanding of redox biology as well as redox biochemistry in living cells and organisms. The course is also designed to give the participants experience in scientific networking, and to increase generic skills in understanding, presenting and discussing frontline research topics.

Intended learning outcomes

After the course, each student should **understand** and be able to **explain**:

- key concepts of redox biochemistry (reduction, oxidation, redox potential, redox state, oxidative stress)
- structure-function relationships for the major low molecular-weight antioxidant compounds found in cells (GSH, Ascorbate, tocopherol)
- the major enzymatic antioxidant systems of cells (glutathione-dependent enzyme systems, the thioredoxin system, peroxiredoxins, methionine sulfoxide reductases, catalase, superoxide

dismutase)
- redox regulatory systems and redox modulated signaling pathways (Nrf2/Keap1, Yap1, peroxiredoxins in redox signaling, NADPH oxidases, NO and nitrosylation, glutathionylation, PTP regulation)
- selenoprotein synthesis and selenoprotein function

After the course, each student should also have the skill to present and discuss a redox-related research project at a level generally expected for presentations held at international cutting-edge conferences in the subject.

Course content

This course was held for the first time in 2010 and is typically organized once per year. It is conducted as a joint **international** training course, encompassing participation with students and lecturer's coming from universities and institutions in both Europe and USA. Primarily attendees and lecturers come from Karolinska Institutet, the Medical University of South Carolina (MUSC), USA, the Redox Biology Center of the University of Nebraska in Lincoln (UNL), Nebraska, USA, the National Institute of Oncology, Budapest, and the University of Debrecen, both in Hungary.

The course is rather **intense** and held at full time during one week, encompassing both events daytime as well as several evening events. For this reason the course gives **3.0 credits** to all participants that pass the course. To attend, many of the students and lecturers will also need to travel during the weekends before and after the course, as it rotates annually between the participating universities, with one of the universities acting as the annual host for the course.

Lectures during the course typically cover subjects such as the following examples:

- Glutathione S-transferases in redox regulation and glutathione dependent catalysis
- Nitric oxide (NO) signaling in relation to redox state
- Calcium signaling in oxidative stress and in relation to apoptosis
- Glutaredoxin and thioredoxin systems
- The concepts and effects of redox cycling and selenoprotein reactivity
- Selenoproteomes and dedicated Cys- and/or Sec-dependent redox systems
- Using protein crystallography to probe the function of redox active enzymes
- Redox activities of proline in a cellular context
- The effects of metals on metabolism and oxidative stress in human disease
- With the sight on redox: glutaredoxin and thioredoxin systems in the ocular lens and their relation to cataract
- Redox control of ion channels
- How oxygen can be sensed in the carotid body
- Mitochondrial production of reactive oxygen species in relation to human disease

In addition, the course entails **poster sessions**, **student presentations**, **career discussions**, a **written exam**, and several **social events**.

For the poster session, each participant will need to prepare a poster before the start of the course, which should describe the main research project(s) conducted by this participant at the

moment. The student presentations entail student groups describing predefined topics in redox biology, with both groups and topics being assigned during the course. The written exam covers key topics in redox biology with addition of questions based upoin lectures given during the course. The social events are networking opportunities and all participants are expected to attend. Detailed information about these parts of the course are sent to the admitted course participants. Please also see the course questionaire results from prior courses for further information.

Forms of teaching and learning

The course it is built upon a pedagogic framework of discussions between graduate students in redox biology with leading experts in the field, combined with cutting-edge lectures, training in oral presentation, career counceling sessions and a written exam for control of detailed basic knowledge in redox biology. It is the firm belief of the course organizers that this pedagogic framework should well support the students to obtain the learning objectives of the course. It should furthermore help the students to prepare for their next level of a career beyond the doctoral examination.

The type of teaching will be:

- Morning sessions with lectures in basic concepts as well as cutting-edge front-line research findings in the field
- Afternoon sessions with student presentations followed by discussions between lecturers and students
- Career discussions and future perspectives in the field of redox biology

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

Absence from any part of the course (lectures, student presentations, career discussions, exam and award ceremony) is generally not accepted but could in special cases be compensated by an individually tailored additional discussion and a special written examination organized by the course committee.

Forms of assessment

The student skills are examined as follows:

- Evaluation of the degree of participation in student-lecturer discussions and the level of

initiated comments and questions during those discussions (grade pass/not pass)
- Evaluation of the presentation of the student's own project (grade pass/not pass)
- Results at written examination

Passing the course

To pass the course the student must meet the specified learning outcomes. These will be evaluated trough the following methods:

- Student-lecturer discussions
- Presentation of the student´s own research project
- A written examination at the end of the course, requiring at least 60% correct answer

Course literature

Recommended Textbook: "Redox Biochemistry", Banerjee, R. (Ed.), Wiley-Interscience

Additional literature: Course program and powerpoint presentations from lectures (distributed during the course).