BIOC304 - Contemporary Biochemical Research

Course coordinator: Dr. Jörg Gsponer
Lecturers: Dr. Jörg Gsponer, Dr. Thibault Mayor, Dr. Calvin Yip, Dr. Leonard Foster

Summary

Most proteins have to fold into a well-defined, soluble, 3-dimensional structure, their native state, in order to be functional. Reaching this native state can be challenging so that proteins regularly misfold and sometimes even aggregate. Misfolded and aggregated proteins are believed to be the cause of a variety of diseases, including neurodegenerative diseases such as Alzheimer's and Parkinson's disease. In order to avoid misfolding and aggregation, a sophisticated network of machines and processes has evolved in cells that monitors carefully a protein's fate from the moment of synthesis until degradation. This network is called the proteostasis network. This course will provide detailed insights into the working mechanism of different aspects of the proteostasis network and how its failure can cause disease. We will explain how modern genomic, proteomic, molecular biology and biochemistry techniques are used to map and characterize the proteostasis network, and you will learn how to read and interpret the results of experiments in which these techniques were used.

Course outline

Introduction

1. Introduction to proteostasis and scientific literature (Jan 7)
   (Dr. Gsponer & Dr. Mayor)

Section A: General aspect of proteostasis - Jörg Gsponer (Jan 9 –Jan 23)

2. Protein folding (Jan 9)
3. Protein misfolding and aggregation (Jan 14)
4. Amyloid (Jan 16)
5. Prions (Jan 21)
6. The chaperone network (Jan 23)

Section B: The Ubiquitin Proteasome System – Thibault Mayor (Jan 28 – Feb 6)

7. Intro to the ubiquitin system (Jan 28)
8. Ubiquitination & E3 ligase (Jan 30)
9. The proteasome (Feb 4)

10. Deubiquitination & Specificity (Feb 6)

11. Protein quality control degradation (Feb 11)

12. Guest lecture (Feb 13)

Midterm break (Feb 17-21)

13. **Midterm exam (45% of final grade)** (Feb 25)

Section C: Intro to the autophagy pathway – Dr. Calvin Yip (Feb27 – Mar 13)

14. Lysosome, different types of autophagy (Feb 27)

15. Regulation of macroautophagy (Mar 4)

16. Assays for macroautophagy, Atg proteins (Mar 6)

17. Atg proteins and ubiquitin-like pathways I (Mar 11)

18. Atg proteins and ubiquitin-like pathways II (Mar 13)

19. Guest lecture: (Mar 18)

Section D: Introduction to Proteomics - Dr. Leonard Foster (Mar 20 – Apr 1)

20. Biomolecular mass spectrometry (Mar 20)

21. Proteomics (Mar 25)

22. Quantitative proteomics in biochemical research (Mar 27)

23. Global regulation of the proteome (Apr 1)

24. The interaction & proteostasis networks (Apr 3)

between April 12-30: Final exam