

# Methodological advances in molecular and structural biology

Academic year 2022/2023

Course coordinators: Janusz M. Bujnicki, Andrzej Dziembowski, Gracjan Michlewski

Lecture language: English

Type: stationary

Time: Tuesdays 14:00-15:30

Place: Institute of Biochemistry and Biophysics of the Polish Academy of Sciences, Pawińskiego 5a, Warsaw, conference room A (room 7 in block A)

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## Winter semester

### Methodological advances in molecular and structural biology I

ECTS: 3 points

11.10.2022\* – J.M. Bujnicki – Introduction to scientific methodology and reasoning

\*exceptional time and location: 10:00, International Institute of Molecular and Cell Biology in Warsaw, 4 Ks. Trojdena Street, conference room 012

18.10.2022 – A. Dziembowski – Origin of molecular biology, plasmids, restriction enzymes, ligases. Modern cloning techniques

25.10.2022 – O. Gewartowska – Principles for mouse line generation using CRISPR/Cas9 method

08.11.2022 – (to be confirmed) – PCR reactions, qPCR and modern techniques

15.11.2022 – D. Adamska – Library preparations for Illumina sequencing

22.11.2022 – E. Kołodziejczyk – scRNA-seq

29.11.2022 – M. Bochtler and H. Czapińska – Theory on sequence methods and a tutorial how to analyse sequencing data: quality control, barcode removal, mapping to a chromosome, etc

06.12.2022 – M. Bochtler and H. Czapińska – Computational methods and data analysis in genomics and transcriptomics. Theory and a live demonstration for a chromatin mapping project and an mRNA differential expression analysis

13.12.2023 – P. Krawczyk – Single molecule DNA and RNA sequencing and sequencing data analysis: Nanopore, PacBio, experiment and data analysis

20.12.2023 – A. Dziembowski and M. Figiel – Introduction to experimental design of wet-lab work with proteins and nucleic acids

03.01.2023 – M. Figiel – Purification of proteins and their complexes; examples of activity assays of selected enzymes

10.01.2023 – K. Skowronek – Biophysical methods in studies of macromolecular assemblies, aimed at size determination and intermolecular interactions. Important concepts and terms and most popular biophysical techniques in these fields and their potential uses

17.01.2023 – E. Małecka – One molecule at a time. Single-molecule methods to study structural rearrangements of RNA, RNA-RNA and RNA-protein assembly: experimental design, TIRF microscopy, FRET, data analysis

24.01.2023 – G. Michlewski – Methods to synthesise RNA, analyse structure and interactions in vitro: in vitro T7 transcription, chemical RNA synthesis, RNA ligation, direct and indirect structure probing, EMSA

31.01.2023 – G. Michlewski – Methods that rely on cell extracts towards studying interactions as well as RNA processing - RNA pull down, RNA immunoprecipitation, microRNA processing, minigene splicing

## Summer semester

### Methodological advances in molecular and structural biology II

ECTS: 3 points

- 28.02.2023 – G. Michlewski – Methods that probe RNA structure and interactome in cells (CLIP, RNP Capture, SHAPE) and methods used to analyse macromolecular interactions in cells (e.g. FRET, FISH)
- 07.03.2023 – W. Pokrzywa – Ubiquitin signalling: degrons, in vitro ubiquitylation, proteasome
- 14.03.2023 – (to be confirmed) – Computational methods and data analysis in proteomics and metabolomics
- 21.03.2023 – M. Bochtler – Structural biology and biophysics of nucleic acids (DNA structure, B-DNA, A-DNA, Z-DNA, dsRNA, heteroduplexes, cruciform structures, Holliday junction, RNA and DNA modifications)
- 28.03.2023 – M. Nowotny – Introduction to structural biology and biophysics of nucleic acids. Basic interactions, motifs, examples of biochemical and biophysics studies on nucleic acids and their complexes
- 04.04.2023 – M. Nowotny – Introduction to structural biology and biophysics of proteins. Basic interactions, structural principles, domains, examples of biochemical and biophysics studies
- 11.04.2023 – M. Czarnocki-Cieciura – High-resolution methods of structural biology: macromolecular crystallography (MX), cryo-electron microscopy (cryo-EM) and nuclear magnetic resonance spectroscopy (NMR)
- 18.04.2023 – A. Kołodziejczyk – Single cell multiomics - methods, analysis and interpretation
- 25.04.2023 – J.M. Bujnicki – Structural bioinformatics and protein structure modelling: historical perspective, best approaches, what is currently possible and what is not yet possible
- 09.05.2023 – M. Bochtler – Structural bioinformatics and protein structure modelling: links between AlphaFold and other areas of machine learning
- 16.05.2023 – J.M. Bujnicki – Structural bioinformatics and RNA structure modelling
- 23.05.2023 – F. Stefaniak – What is cheminformatics and why do we need it? Basic concepts of cheminformatics (structural similarity, modelling of 3D structures, partial charges). Prediction of physicochemical parameters of small molecules and why those are important. Tools used for basic cheminformatics operations
- 30.05.2023 – (to be confirmed) – Translational methods / medical applications
- 06.06.2023 – J. Kuźnicki – Best practices in data presentation, writing of scientific papers and grant proposals in the area of biochemistry and molecular biology
- 13.06.2023 – G. Michlewski – Best practices in critical assessment of scientific data in the area of biochemistry and molecular biology

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Requirements for passing the course Methodological advances in molecular and structural biology I and II:

exam successfully passed (tests on the theoretical material from the lectures to be taken online at the end of the winter and summer semesters)