Course PM – BB2165 Biomolecular Structure and Function, 7.5 hp

Course coordinator, examiner

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The fall term 2020 course offering is fully digital and given online via the video conferencing tool Zoom.

Overall scope

Structural biology of biomolecules is a cornerstone in modern biotechnology. The principal objective is to provide the students with theoretical and practical knowledge and insight about the foundations of biomolecular structure, and how the structure relates to function. Instructive computer-based exercises and a project based on contemporary cutting edge research offer a teaching concept that is highly interactive and practical in order to increase and deepen the perception and understanding of biomolecular structure-function relationships. You will learn the necessary skills and tools to retrieve, use, understand, and validate structural biology information available in 3D structure databases. You will also develop expertise in using free computational tools to study the interaction of biomacromolecules with ligands and explain the driving force behind their association or binding and able to propose structure from sequence and to validate it.

Intended learning outcomes

1. Describe, formulate, analyze and evaluate fundamental concepts in structural biology. Learning level (a).
2. Suggest, motivate and discuss strategies for solving problems related to the function and applications of biomolecules in biology and biotechnology from a structural perspective. Learning level (b).
3. Based on knowledge and concepts acquired in the course, be able to propose, discuss and evaluate the role of bimolecular structural biology to advance understanding of biological and biotechnological scientific problems. Learning level (c).
4. Use computer software tools and relevant databases to visualize, investigate, analyze, evaluate and validate biomolecular structure information, and to make relevant computations. Learning level (a,b,c).
5. Design, plan, execute and present in written and oral form an independent project focusing on biomolecular structure and function. The student is also able to evaluate and discuss biomolecular structure from the perspective of contributing to a sustainable development. Learning level (a,b,c).
6. Critically evaluate own and others chosen strategies for targeting scientific problems from a biomolecular structure perspective, including assessing published recent advances in the current subject area. Learning level (a,b,c).

Course main content

- Structural biology is a young science and research in this area is moving forward rapidly. The course contents ranges from fundamentals in structural biology to contemporary research, and the precise topics are subjects of change to appropriately reflect the research frontier.
- Basics of protein structure (building blocks, intramolecular and intermolecular interactions, levels of protein structure, canonical protein databases) and other relevant biomolecules.
- Concepts of thermodynamics in the context of protein structure, stability and function (e.g. folding, ligand binding, complex formation).
- Central structure-function concepts in biology (e.g. signal transduction, transcription and translation, molecular transport, molecular motors).
- Overview of methods for experimental structure determination of biomolecules (e.g. crystal structure analysis, single particle cryo-electron microscopy, nuclear magnetic resonance); and biophysical methods for characterization (neutron scattering, circular dichroism, electron paramagnetic resonance, infrared spectroscopy, Raman spectroscopy, optical imaging).
- Computational approaches for modeling of biomolecules and related energetics (e.g. homology modeling, molecular dynamics, Monte Carlo, course-grained approach, molecular docking, free energy calculations, entropy calculations).
- Validation and critical analysis of experimentally derived biomolecular structures.

Lectures

Lectures are not mandatory but we strongly recommend that you attend in order to manage the course. The lectures are also available as recorded videos.

Exercises

The exercises are interactive computer exercises that complement the lectures. Students can attend either of two sessions that fits their schedule (A and B) and do not need to attend both. Exercises are performed individually. All exercises are strictly mandatory.

Project (examination: report and seminar)

The purpose of the project and presentation is to offer training to the students in reading scientific articles on the topic structure biology, and to study in detail a specific case. The project is individual and includes performing relevant literature surveys, interactive computer work, and a written report. The project includes study time also outside scheduled course time in class.

The project ends by presentations (seminars) at the end of the course. There are three 3-hour presentation sessions, and attendance is mandatory on one of these, that is, the day when own project is presented. Attendence lists are kept. To ensure that roughly the same number of students attend each occasion, each student will have to chose one of the occasions in advance. The project is strictly mandatory.

Each student will also peer review one other student's report and prepare questions for the student after the presentation.

Literature

Branden C, and Tooze J., Introduction to Protein Structure, 2nd Ed. Garland Publishing Inc., 1999.

Andrew Leach, Molecular Modeling: Principles and Applications, 2nd Ed. Prentice-Hall.

Handouts and selected articles.

Examination

LAB1 - Laboratory work, 1.5, grading scale: P, F

LIT1 - Literature task, 2.0, grading scale: P, F

TEN1 - Examination, 4.0, grading scale: A, B, C, D, E, FX, F

For the course round 2020, the main examination TEN1 will be adjusted to a digital format. Conceptual knowledge will be examined continuously through Canvas quizzes.

Deadline for notifying the results for the examination is three weeks (15 working days) after the date of the main examination.

Top-up examination

- Grade Fx is given for examination scores that fall below the PASS threshold by a maximum of 5% of level E requirements. Grade Fx will grant you the opportunity to "top-up" your result to reach the PASS level (level E).
- The "top-up" examination cannot normally be used to improve grades higher than E.
- The type of "top-up" task is defined by the examiner. The "top-up" examination is typically a practical computer exercise addressing relevant knowledge, however, other examination forms may be considered depending on the circumstances, and is at the discretion of the examinator.
- The top-up examination must be offered within 6 study term weeks from the original examination date.
- Deadline for returning results of the top-up examination is three weeks after the date for top-up examination.