Biochemistry 404
CRN 10254
Proteins
Course Outline - Fall 2016

Instructors: Dr. Alisdair ("Al") Boraston (coordinator)
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Dr. Stephen Evans
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Instructors will announce office hours in class.

This course is aimed at understanding the detailed connection between the *structure* and the *function* of macromolecules. Part 1 (Dr. Boraston) is focused on understanding specific methods of quantifying *function.* Part 2 (Dr. Evans) is focused on understanding methods of determining *structure*, and on protein folding.

Part 1 – Dr. Boraston (September 8 – October 20)

Molecular Interactions: Theoretical and Practical Aspects

1. Properties and isolation of proteins (~4.5 hours)
   - Review of general protein properties
   - Amino acid side chain reactivity
   - Recombinant protein production
   - Methods of protein purification
2. Detecting and quantifying protein-ligand interactions. (~7 hours).
   - Overview of protein-ligand interactions.
   - What is a ligand and why is their interaction with proteins important?
   - Overview of high resolution vs. medium vs. low resolution methods
   - Discussion of selected methods.
3. Binding equilibria (~5 hours).
   - Symbolic equilibrium expressions: representing simple and complex equilibria.
   - Mathematical modeling of binding equilibria and analysis of binding data.
   - Thermodynamics for biochemists.
   - Putting structure and function together: a close look at what makes things 'stick' together.
   - The missing link: the role of solvent in molecular interactions.
4. Special topic(s) - TBD

Part 2 - Dr. Evans (October 24 – December 1)

1. Review of protein and peptide structure (1.5 hours)
    - Secondary structures as a structural biologist looks at them. STRUCTURE = FUNCTION, peptide bonds & Ramachandran plots, complementarity and the α-helix: 4-helix bundle, globin fold, β-sheets, β-bulges, γ-turns, antibody fold, Rossmann fold, jellyroll, TIM barrels, etc.
2. Structure determination by protein crystallography (9 hours)
    - Crystal symmetry: What are crystals? Why use crystals?
    - X-ray scattering of a crystal: Bragg's law.
    - Crystal quality & data resolution.
    - What information can be obtained from each determination?
    - The phase problem: Heavy atoms, MAD & molecular replacement.
    - Electron density maps.
    - Data collection & structure fitting.
    - Refinement of protein structures & indicators of 'correctness'.
3. Structure determination by NMR (1.5 hours)
    - Larmour frequency & proton coupling.
    - Comparison of NMR of small molecules and proteins.
    - Fourier Transform methods for data collection.
    - NOE and multi-dimensional NMR.
    - Comparison of X-ray and NMR methods.
4. Concepts of protein folding (3.0 hours)
    - Levinthal paradox & the protein folding problem.
    - Methods to characterize protein folding: UV-Vis; NMR; X-ray scattering, enzyme activity.
    - Isomerization of peptide bonds as a rate-limiting step in protein folding.
    - Disulfide bond formation as a rate-limiting step in protein folding.
    - Cellular strategies: enzymes, chaparones & chaparonins.
    - Simple concepts of proteins folding, including the 'molten globule', nuclear condensation, hydrophobic collapse, etc.
    - Introduction to Φ-value analysis.
5. Real-world examples (3.0 hours)
    - Literature examples of structure determination and examples of how macromolecular structure determines function.

Assessment of Student Performance

(1) **Techniques to be used in assessment of student's performance in course**:

- Grading of multiple choice, short answer and/or essay examination questions.

(2) **BIOC 404 - Evaluation and weighting (undergraduate students)**:

- Midterm – **Thursday, October 20th** 40%
- Class assignment 10%
- Final examination (2 hours): 50%

Both examinations must be written and the assignment completed in order to avoid receiving an "N" grade.

(3) UVic Grading Scheme

A+	90 -100	**B+**	77 - 79	**C+**	65 - 69	**F**	< 50
A	85 - 89	**B**	73 - 76	**C**	60 - 64	**N** **	< 50
A-	80 - 84	**B-**	70 - 72	**D**	50 - 59		

** **N grades**

Students who have completed the following elements will be considered to have completed the course and will be assigned a final grade:

- ***The class test scheduled for Thursday, Oct 20 (40%)***
- ***The class assignment (10%)***
- ***The final exam (50%)***

Failure to complete one or more of these elements will result in a grade of "N" regardless of the cumulative percentage on other elements of the course. An N is a failing grade, and it factors into a student's GPA as O. The maximum percentage that can accompany an N on a student's transcript is 49

ACCESSIBILITY

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, approach the Resource Centre for Students with a Disability (RCSD) as soon as possible (http://rcsd.uvic.ca/.) in order to assess your specific needs.

COURSE EXPERIENCE SURVEY (CES)

I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete a confidential survey regarding your learning experience (CES). The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. When it is time for you to complete the survey you will receive an email inviting you to do so. Please ensure that your current email address is listed in MyPage (http://uvic.ca/mypage) . If you do not receive an email invitation, you can go directly to http://ces.uvic.ca. You will need to use your UVic netlink ID to access the survey, which can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more detailed information nearer the time but please be thinking about this important activity during the course.

DEPARTMENT INFORMATION AND POLICIES

1. The Department of Biochemistry and Microbiology upholds and enforces the University's policies on academic integrity. These policies are described in the current University Calendar. All students are advised to read this section.

2. Cell phones, computers, and other electronic devices must be turned off at all times unless being used for a purpose relevant to the class. Students having a cell phone, tablet, or computer on their person during an exam will be assumed to have it for the purpose of cheating.

3. Any recordings of lectures may only be performed with written permission of the instructor, and are for personal use only. The instructor retains copyright to such recordings and all lecture materials provided for the class (electronic and otherwise); these materials must not be shared or reposted on the Internet.

4. Course materials, such as notes, problem sheets, quizzes, examinations, example sheets, or review sheets, may not be redistributed without the explicit written permission of the instructor.

5. Students are expected to be present for the midterm and final exams. Instructors may grant deferrals for midterm examinations for illness, accident, or family affliction, and students must provide appropriate documentation 48 hours after the midterm exam. The Department of Biochemistry and Microbiology considers it a breach of academic integrity for a student taking a deferred examination to discuss the exam with classmates. Similarly, students who reveal the contents of an examination to students taking a deferred examination are considered to be in violation of the University of Victoria policy on academic integrity (see current University Calendar). Deferral of a final exam must be requested with an Academic Concession form and submitted directly to Undergraduate Records. Deferred final exams for fall term courses will be arranged by the instructor. Deferred final exams for spring term courses will be arranged through Undergraduate Records and must be written before the end of the summer term as stipulated in the University Calendar.

6. Multiple choice scan sheets for machine scoring (bubble sheets) are considered the authentic exam answer paper and will be retained by the department for 1 year.

7. Professors may refuse to review/remark exams not written in indelible ink. In addition, requests for review/remark of a midterm exam must be made within one week of the exam being returned. Students are expected to promptly pick up midterm exams after marking has been completed, either in class or from the instructor.

8. Examination papers that have pages removed, or are mutilated will not be marked.

9. I reserve the right to use plagiarism detection software or other platforms to assess the integrity of student work.

Revised September 2016