



UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF BIOLOGICAL SCIENCES
COURSE OUTLINE

1. **Course:** BIOCHEMISTRY 553 – MOLECULAR BIOPHYSICS

Lecture Sections: L01 MWF 11:00-11:50 MS 211 WINTER 2017

Course Coordinator/Instructor: Dr. S.Y. Noskov BI 447 210-7971 snoskov@ucalgary.ca

Course website or Desire 2 Learn (D2L): W2017BCEM553L01
Biological Sciences Department BI 186; (403) 220-3140; biosci@ucalgary.ca

2. **Prerequisites:** Biochemistry 341 or 393; and Biochemistry 471 or Chemistry 371.

Note: Prior completion of Biochemistry 555 is strongly recommended.

See section 3.5.C in the Faculty of Science section of the online Calendar
(<http://www.ucalgary.ca/pubs/calendar/current/sc-3-5.html>)

3. **Grading:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Assignments (5)	40 %
Midterm I	25 % (In class exam – Feb. 17/17)
Final Examination	45 % (Written exam/In-class presentations, April, 2017)

Conversion between course percentage and letter grade for BCEM553

Letter Grade	Course Percentage
A+	>95%
A	87.5
A-	82.5
B+	77
B	74
B-	71
C+	68
C	65
C-	60
D+	55
D	50
F	<50

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations. See also Section E.6 of the University Calendar

5. **Scheduled out-of-class activities:** N/A

REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a clash with this out-of-class-time-activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

6. **Course Materials:**

Recommended Reading: **Text:** Phillips, Kondev, Theriot, Physical Biology of the Cell. Garland Science, 2008 +
Additional materials available on D2L course site in the course documents section.

7. **Examination Policy:** Calculators and open-book allowed during examination. Students should also read the Calendar, [Section G](#), on Examinations.

8. **OTHER IMPORTANT INFORMATION FOR STUDENTS:**

(a) **Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties.

(b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).

(c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf.

Students needing an Accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of Biological Sciences, Dr. H. Addy by email addy@ucalgary.ca or phone 403 220-3140.

(d) **Safewalk:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

(e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also <http://www.ucalgary.ca/secretariat/privacy>.

(f) **Student Union Information:** VP Academic Phone: 403 220-3911 Email: suypaca@ucalgary.ca
SU Faculty Rep. Phone: 403 220-3913 Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca;
Student Ombuds Office: 403 220-6420 Email: ombuds@ucalgary.ca; <http://ucalgary.ca/provost/students/ombuds>

(g) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

(h) **U.S.R.I.:** At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

Department Approval _____ ORIGINAL SIGNED _____ Date _____
C553 co W17; 11/18/2016 11:43 AM

LEARNING OUTCOMES

Students enrolling in this course should be able to demonstrate achievement of the learning outcomes for the advanced-level course in Biochemistry curriculum with a particular emphasis on the biophysical foundations universal to all temporal and spatial scales in modern biology.

The passing grade in the course corresponds to the following minimal goals:

Upon completion of the course students will be able to:

1. Evaluate applicability of molecular, cell, tissue- and system-level models including Boltzmann distribution, two- and three-state models, entropy maximization analysis in protein sequence alignments
2. Select appropriate thermodynamic equations and models to calculate, analyze, and predict the properties and interactions in protein folding and macromolecular assembly formation.
3. Develop basic understanding of key physical principles used in the analysis of large and noisy data sets in biochemical experiments, including proteomics, gene-regulatory network mapping and metabolomics as examples.
4. Understand key models used to describe time-dependent processes in biological systems with special emphasis on biochemical kinetics, rates of biological processes and applications to bioenergetics.
5. Perform critical review of available scientific literature using biophysical models discussed in the class.

TENTATIVE LECTURE SCHEDULE

We will have Professors J. McCallum (CHEM) and I. Lewis (BCEM) as guest lecturers.

Jan-9	L1. Introduction to the Course
Jan-11	L2. Models, Hierarchy of Models and Levels of Approximation
Jan-13	L3. Introduction to biological energy conversion: Mechanical, Electrical and Chemical Equilibrium in Cells
Jan-16	L4. Part 1. Mechanical and Chemical Equilibrium: Coupling, Chemical machines
Jan-18	In-class tutorial
Jan-20	L5. Part 2. Cells as minimizers of free energy. (<i>Assignment 1 is posted</i>)
Jan-23	L6. Random world – Distribution in Biological Chemistry. Relevance to Entropy
Jan-25	L7. Entropy, Constraints and Entropy for Protein/DNA Sequences Alignments
Jan-27	In-class tutorial/Journal Club
Jan-30	L8. Boltzmann Distribution (<i>Assignment 1 is due, Assignment 2 is posted</i>)
Feb-1	L9. Boltzmann Distribution: Application to Biological Problems
Feb-3	In-Class Tutorial
Feb-6	L12. Foundation of Biological Structure: Proteins, Equilibrium Theories of Folding (MacCallum)
Feb-8	L13. Foundation of Biological Structure: Theories of Folding (MacCallum)
Feb-10	Folding Tutorial (MacCallum) (<i>Assignment 2 is due, Assignment 3 is posted</i>)
	L10. Boltzmann Distribution: Allosteric Systems, Helix-Coil Transition
Feb-13	Practice problems
Feb-15	Review for Part 1
Feb-17	In-Class midterm
Feb-27	L14. Time is important: Kinetics of biological processes
Mar-1	L15. Transition State Theory and Enzyme Kinetics (<i>Assignment 3 is due, Assignment 4 is posted</i>)
Mar-3	In-Class tutorial
Mar-6	L16. Rate Equations and Dynamics in the Cell
Mar-8	L17. Generation of Biological Electricity: Pumps and Active Proton Transport (Assignment 1 is due)
Mar-10	In-class tutorial
Mar-13	L18. The Hodgkin-Huxley Model of the Action Potential: Cell Level Models
Mar-15	L19. Models of Molecular Motors Dynamics (<i>Assignment 4 is due, Assignment 5 is posted</i>)
Mar-17	In class tutorial
Mar-20	L20. Models of biological networks – Gene Regulatory Networks
Mar-22	L21. Models of biological networks – Gene Regulatory Networks
Mar-24	In-class tutorial/Journal Club
Mar-27	L22. Applications to metabolomics L1 (I. Lewis)
Mar-29	L23. Applications to metabolomics. L2 (I. Lewis)
Mar-31	L24. Biological Patterns. What to make of them (I. Lewis problem solving)
April-3	Written assignment for take-home examination due on April 15 th (posted)
April-12	Written assignment returned