Biology 3550/Biology 3551(3 Cr)
Physical Principles in Biology

Fall Semester - 2020

Course Mechanics for Fall 2020:

Because of the COVID-19 pandemic, BIOL 3550/3551 is being taught online this semester, as an Instructional Video Conferencing (IVC) class. Class sessions will be held at the scheduled times (Monday, Wednesday and Friday, 9:40 to 10:30 AM) via Zoom. Quizzes and exams will also be administered online. Participation in the course will depend on having access to a computer and broadband internet connection, as well as being able to use Canvas, Zoom and other online resources effectively. Please contact the instructor as soon as possible if you have concerns about these requirements. Further details are provided in the sections below.

Course Description (from the University Catalog):

Principles from physics and chemistry are explored in the context of biological processes, especially at the molecular and cellular level. Topics covered include random walks, thermodynamics, molecular recognition, dynamic processes, optics and spectroscopy. Quantitative treatments are emphasized and computer simulation and applications are used extensively.

Special note for Biol. 3551 (honors):

Biol. 3551 is designated as an Honors class and enrollment is restricted to students in the Honors College. However, the two classes meet together and their requirements and policies are identical. Furthermore, there is no distinction in grading for students enrolled in Biol. 3550 or Biol. 3551. The distinction between the courses is entirely administrative and is intended to ensure that spaces are available to all students.

Course Objectives

This course is designed to help students understand and appreciate the many connections between the physical and biological sciences, and also develop their skills in quantitative problem solving. Many of the most exciting scientific advances now taking place involve the application of principles from chemistry and physics to biological problems, and students who are broadly educated in the sciences will be especially well prepared to participate in these advances. At the end of the course, students will have explored several biophysical concepts in depth and will be able to apply these concepts to new situations, using appropriate quantitative and mathematical tools.

Instructor:

David P. Goldenberg
Office: 306 Aline Skaggs Biology Building (ASB)
E-mail:
[1ex] Office hours (via Zoom):
Tuesdays: 9:30 - 11:00 AM
Wednesdays: 2:30 - 3:30 PM
Other times by appointment. The best way to contact me is by e-mail.

Teaching Assistant:

Madeline Bernardo, madeline.bernardo@utah.edu

Prerequisites:

- BIOL 2020 or BIOL 2021
- CHEM 1220 or CHEM 1221
- MATH 1180 or MATH 1220
- Recommended: PHYS 2020 or PHYS 2120 or PHYS 2220 or PHYS 3220

If you have any concerns about your preparation for this class, please feel free to contact the instructor.

Class Sessions (via Zoom):

Monday, Wednesday, Friday
9:40 –10:30 AM
No classes on: Monday, 7 Sept. (Labor Day), Friday, 27 November (Thanksgiving Day break).
During the periods of 28 September through 9 October and 30 November through 3 December (the last day of classes), all University of Utah classes will be online. For this class, there will be no change in format during these periods.
All class sessions will be held via video conferencing, using Zoom, and regular attendance is expected. The class sessions will have a mixed lecture-discussion format, and engaged participation is essential for learning. However, the Zoom sessions will be recorded and made available online to accomodate unavoidable absences. In addition, slides from the lectures will be posted on Canvas (after the class session). But, these resources should not be viewed as a general substitute for attending class.

Excused Absences

If you must miss a class session because of illness, family emergency or an official University of Utah activity, please notify the instructor. Any clicker points missed because of an authorized absence will not be included in calculating the average for your clicker responses.

Technical Requirements:

To effectively participate in the Zoom class sessions and to complete the class assignments, you will need to have an adequate desktop or laptop computer and access to a broadband internet connection. As a very rough guideline, a computer manufactured in the past five years should be fine. Laptops are available for checkout from the Marriot Library for the semester, depending on availability:
https://lib.utah.edu/coronavirus/checkout-equipment.php.
You will also need to be ably to smoothly navigate Canvas and Zoom.
If you have concerns about any of these requirements, please contact the instructor as soon as possible.

Electronic Device Policy
Under normal circumstances, I do not allow the use of cell phones, tablet computers or laptop computers in my classes. This policy is meant to encourage student engagement and create a more effective learning environment for everyone, the use of cell phones, tablet computers or laptop computers will not be allowed during class. This rule is obviously impossible to implement in an online class environment, but I still ask that you avoid distractions, electronic or otherwise during the class sessions.

Clickers
The iClicker audience response system will be used to facilitate interactive learning during the IVC sessions. Some responses will be graded and, together with other activities, will count for 5% of the course grade. For some questions, credit will be given for any answer, but for others points will only be given for correct answers. If you do not already have an iClicker Reef account, you will need to create one Before classes begin, following the instructions at:

How-to-Create-an-iClicker-Reef-Student-Account

Then, add this course to your account, as described here:

add-Your-Instructor-s-Course-in-Reef

The course should be listed with the title, "Physical Principles in Biology", and the course ID, "Biol 3550/3551".
When you create a new iClicker Reef account, you will receive a free two-week trial license. At the end of this period, however, you will need to purchase a license. A license for six months costs $15.99, and other pricing options are listed here:

`https://www.iclicker.com/pricing`

To submit your responses during class, you can either install the iClicker Reef app on a mobile device or use the web interface. Links to the app for iOS and Android devices are found here:

`https://www.iclicker.com/students/apps-and-remotes/apps`

To use the web interface, login to your Reef account at:

`https://app.reef-education.com/#/login`

Other ways to earn points

- **Group problem solving sessions.** Every two weeks or so, part of the lecture time will be devoted to problem solving, with students working in groups of two or three. Points for these activities will be recorded and combined with those from the other clicker points.

- **Special homework assignments** There will be one or a few short homework assignments, in addition to the bigger ones described below. Points for these assignments will be added to the clicker points.

- **Catch out the prof!** Extra clicker points will be given for finding errors in the lecture notes or the slides used class, with the number of points determined by the significance of the error (as judged by the instructor). To count for points, errors on the lecture slide have to be caught before the instructor catches them in class!

Discussion Sessions

There will be at least one scheduled discussion sessions per week, led by the teaching assistant and held via Zoom. These sessions will be devoted to working on problems, especially those that are on the quizzes and exams from previous years¡/a¿, which are posted on the web (http://goldenberg/courses/biol3550/quiz.shtml). You should come to these sessions prepared to work on the problems, not merely to be told the answers!

The discussion sessions will be scheduled, based on polling of the class, during the first week of classes

Text:

There is no textbook for this course, but a set of detailed lecture notes is provided electronically and can be downloaded from the Canvas site. These notes/text are very much a work in progress, and the chapters will likely be updated during the semester. These updates will be announced on Canvas.

Canvas:

Nearly all of the material for this course will be distributed through Canvas, which will also be used for submitting homework assignments and recording grades.

Course Web Site:

In addition to the Canvas site, there is a course web page:
http://goldenberg.biology.utah.edu/courses/biol3550
Much of the information in this syllabus is also posted there, and there are some additional resources that are not so easily included in Canvas. But, this web site will not be updated as regularly as Canvas, which will be the primary means of communication.

Homework Assignments:

Problem solving is a major element of this class. Approximately 6 graded problem sets will be assigned during the course of the semester. Each problem set will be graded for a total score of 50 points. Problem sets may be turned in up to 5 days late, but 10 points will be deducted from the score for each day late.

Homework will be submitted electronically via Canvas and must be typed. **Do not submit scans of handwritten work! Work submitted this way will not be graded.** Entering mathematical expressions on a computer can be difficult at first, but it is an important skill and will be required for this class. Your work must be clear and legible! The instructor and TA reserve the right to refuse to grade work that is too difficult to read.

Students are encouraged to work together on the homework assignments and to use outside resources, including the internet. However, the work you turn in must be your own! Any text must be clearly distinguishable from that of other students, and other sources must be properly cited. Text from other sources must be clearly identified by quotation marks. Furthermore, extensive quotations, even with proper citation, will not be considered satisfactory answers to questions. Copying and pasting does not demonstrate mastery of the material!

If two or more students turn in work that that is identical, their action will be considered academic misconduct and appropriate sanctions will be imposed. At a minimum, the sanction will include the loss of credit for the copied work, and more severe sanctions may be imposed for more extensive infractions. (See additional information below regarding Academic Conduct.)

Quizzes and Exams:

- There will be five 25-minute quizzes, given during the regular lecture sessions on the following dates:

  Friday, 4 Sept.
  Friday, 25 Sept.
  Friday, 23 Oct.
  Friday, 6 Nov.
  Friday, 20 Nov.

  Each quiz will cover the class material presented since the previous quiz (or mid-term exam). The lowest quiz score will be dropped in calculating the final grade.

- There will be one mid-term exam, on Friday 9 October. This exam will cover all of the material previously presented in class.

- A final exam will be given during the regularly-scheduled 2-hour exam period: 8:00–10:00 AM, Friday, 11 December. This exam will cover everything covered in class.

- **All of the quizzes and exams will be administered via Canvas, and all will be subject to an honor code. For each quiz or exam, students will be required to sign an honor-code statement, stating that they have not communicated with anyone during the exam period or used any online or other resources. Violations of this honor code will be considered academic misconduct and appropriate sanctions will be imposed. At a minimum, a grade of zero will be recorded for the quiz or exam. If the grade is for a quiz, it will be dropped from the course average. Repeated offence will be subject to additional sanctions.** (See additional information below regarding Academic Conduct.)

- The schedule for quizzes and the mid-term exam is subject to change. The date of the final exam is not!

Grading Policy:

The final numerical grade for the class will be based on the homework, quiz and exam scores, weighted as follows:

Clicker responses and other activities: 5%
Homework: 30%
Quizzes: 30%
Mid-term exam: 15%
Final exam: 20%

The following represent maximum cutoffs for determining class letter grades:

A: 92–100% (including A-)
B: 82–91% (including B- and B+)
C: 70–81% (including C- and C+)
D: 60–69%
E: $< 60\%$

Depending on how things go, the grade cutoffs *may* be revised downwards, *i.e.,* to make the grading more generous. The cutoffs will not be moved to make the grading less generous. Grading will be identical for students enrolled in Biol. 3550 and 3551 (honors).

Important Dates:

- First day of classes: Monday, 24 August
- Last day to add, drop (delete), elect CR/NC, or audit classes: Friday, 4 September
- Last day to withdraw from classes: Friday, 16 October (No tuition refund, "W" appears on transcript.)
- Last day to reverse CR/NC option: Friday, 27 November
- Last day of classes: Thursday, 3 December
- Final exam (on-line): Friday, 11 December, 8:00-10:00 AM

Expected Learning Outcomes

What you learn from this class will depend greatly on your preparation and efforts. Students who are well prepared and who put a conscientious effort into all of the class components can expect to gain an appreciation for the connections among mathematics, the physical sciences and biology and should leave with a good understanding of:

- Quantitative problem solving.
- Probability and the nature of random processes.
- Diffusion and its role in biological processes
- Principles of thermodynamics and their applications in biology
- Mechanisms of molecular motors and methods for studying them.

University Policies

Faculty and Student Responsibilities:

All students are expected to maintain professional behavior in the classroom setting, according to the Student Code (http://regulations.utah.edu/academics/6-400.php). Students have specific rights in the classroom as detailed in Section II of the Code (http://regulations.utah.edu/academics/6-400.php#section_2). The Code also specifies expectations of student behavior (Section III, http://regulations.utah.edu/academics/6-400.php#section_3). Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the instructor's duty to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

Special Accommodations, Americans with Disability Act:

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability and Access (https://disability.utah.edu/, 162 Olpin Union Building, 801-581-5020). CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability and Access.

Academic Conduct

In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty. Acts of academic misconduct include cheating, plagiarizing, research misconduct, misrepresenting one's work, and inappropriately collaborating. Suspected cases of academic misconduct will be dealt with according to the procedures found in the Student Code, University Policy 6-400(V)(http://regulations.utah.edu/academics/6-400.php. Instances of academic misconduct will be recorded in a database that may be made available to other University of Utah Departments and Colleges.

Title IX: Addressing Sexual Misconduct:

Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action (http://oeo.utah.edu/, 135 Park Building, 801-581-8365), or the Office of the Dean of Students (http://deanofstudents.utah.edu, 270 Union Building, 801-581-7066). For support and confidential consultation, contact the Center for Student Wellness (http://wellness.utah.edu, 426 SSB, 801-581-7776). To report to the police, contact the Department of Public Safety (http://dps.utah.edu, 801-585-2677(COPS)).

University Safety Statement The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit http://safeu.utah.edu.

Final Note:

This syllabus is not a binding legal contract. It may be modified by the instructor when students are given reasonable notice of the change.

Tentative Lecture Schedule

Week of:	Topic
24 Aug.	Introduction to class; The scale of things - units and dimensions
31 Aug.	Introduction to probability
7 Sept.	More on probability: Plinkos and the binomial distribution (No class on Monday, 7 Sept.)
14 Sept.	Random walks in one, two and three dimensions
21 Sept.	Random walks continued; Distribution of end-to-end distances; The Gaussian distribution
28 Sept.	Diffusion; Fick's laws
5 Oct.	More on diffusion; molecular motions in gasses and liquids
12 Oct..	Biological implications of diffusion: Water loss from plants and chemotaxis
19 Oct.	Thermodynamics: Energy, heat, work and entropy
26 Oct.	Thermodynamics continued: Free energy and chemical thermodynamics
2 Nov.	Water and hydrophobicity
9 Nov.	Lipids and biological membranes
16 Nov.	Protein folding: Energetics, mechanisms and when things go wrong
23 Nov.	Molecular motors
30 Nov.	Molecular motors continued
7 Dec.	Final Exam: Friday, 11 Dec., 8:00 to 10:00 AM