

Bio12: Cell Structure and Function

Spring 2013

M, W, F 8:45-9:50 AM, X-hour: Th 8:45-9:50 AM
Room 200, Class of 1978 Life Sciences Center (LSC)

Instructor: **Professor Sharon E. Bickel**, Ph.D.
Lab Instructor: **Cori Anderson**, Ph.D. & **Nicholas Sylvain**, Ph.D.
Graduate Teaching Assistants: **Moises Chavez**, **Lei Chen**, **Iviana Torres**,
Matthew Ung, **Todd Warczak**

LECTURE SCHEDULE

How do we view cells?

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|----|----|------|-----------------------------------|------------|
| 1. | M | 3/24 | Introduction to Cell Architecture | Chapter 1 |
| 2. | W | 3/26 | Microscopy | Chapter 18 |
| 3. | Th | 3/27 | Microscopy | Chapter 18 |

How do we analyze cells?

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|----|----|------|----------------------------------|------------|
| 4. | F | 3/28 | Protein Structure & Function | Chapter 2 |
| 5. | M | 3/31 | Experimental Approaches | Chapter 18 |
| 6. | W | 4/2 | Experimental Approaches | Chapter 18 |
| | Th | 4/3 | <i>Optional Review/Q & A</i> | |

How are cell compartments built?

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|-----|----|------|------------------------------------|-----------|
| 7. | F | 4/4 | Thermodynamics & Enzymes | Chapter 3 |
| 8. | M | 4/7 | Membrane Structure and Composition | Chapter 4 |
| 9. | W | 4/9 | Transport Across Membranes | Chapter 4 |
| | Th | 4/10 | <i>Optional Review/Q & A</i> | |
| 10. | F | 4/11 | Transport Across Membranes | Chapter 4 |

M 4/14 8:45 AM Exam Review Session

M 4/14 EXAM 1, 6:30-8:30 PM, Lectures #1-10: Oopik Auditorium, LSC

How do cells generate energy?

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|-----|----|------|----------------------------------|---------------|
| 11. | W | 4/16 | Glycolysis & Aerobic Respiration | Chapters 3, 5 |
| 12. | Th | 4/17 | Photosynthesis | Chapter 6 |

How do proteins know where to go in the cell?

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|-----|----|------|----------------------------------|-----------|
| 13. | F | 4/18 | Protein Sorting | Chapter 8 |
| 14. | M | 4/21 | Protein Sorting | Chapter 8 |
| 15. | W | 4/23 | Protein Sorting | Chapter 8 |
| | Th | 4/24 | <i>Optional Review/Q & A</i> | |
| 16. | F | 4/25 | Protein Sorting | Chapter 8 |

How do cells integrate and process information?

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|-----|----|------|----------------------------------|------------|
| 17. | M | 4/28 | Cell Signaling | Chapter 15 |
| 18. | W | 4/30 | Cell Signaling | Chapter 15 |
| | Th | 5/1 | <i>Optional Review/Q & A</i> | Chapter 15 |
| 19. | F | 5/2 | Cell Signaling | |

M 5/5 8:45 AM Exam Review Session

M 5/5 EXAM 2, 6:30-8:30 PM, Lectures #11-19: Oopik Auditorium, LSC

How do cells move and change shape?

20.	W	5/7	Cell Motility & Shape – Intermediate Filaments	Chapter 9
21.	Th	5/8	Cell Motility & Shape – Actin	Chapter 9
22.	F	5/9	Cell Motility & Shape – Actin	Chapter 9
23.	M	5/12	Cell Motility & Shape – Microtubules	Chapter 9
24.	W	5/14	Cell Motility & Shape – Microtubules	Chapter 9
	Th	5/15	<i>Optional Review/Q & A</i>	

How do cells duplicate?

25.	F	5/16	The Cytoskeleton in Action during Cell Division	Chapter 14
26.	M	5/19	The Cell Cycle	Chapter 14
27.	W	5/21	The Cell Cycle	Chapter 14

How do cells form tissues?

28.	Th	5/22	Connections between Cells	Chapter 7
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What happens when cell biology “fails”?

29.	F	5/23	Cancer	Chapter 16
	M	5/26	MEMORIAL DAY-Pre-Examination Study Day	
30.	W	5/28	Cancer	Chapter 16

TBA **Final Exam Review Session**
Sunday, June 1 **FINAL EXAM, 8:00-11:00AM, Lectures #20-30**

Professor Bickel's OFFICE HOURS: Wednesdays 4-5 PM, Thursdays 12:30-1:30 PM
LSC 237 (my office) or 238 (the conference room close to my office)

Note that I am generally available before and after lecture. The scheduled X-hour review/Q&A sessions are also good times to have your questions answered.

Note to Students with Physical or Learning Disabilities:

I encourage students who may need disability-related academic adjustments to see me privately as early as possible in the term, preferably before the end of the second week. Students requiring disability-related academic adjustments or services must consult the Student Accessibility Services (SAS) office (301 Collis Student Center, student.accessibility.services@dartmouth.edu). Once SAS has authorized adjustments or services, I will need to view the originally signed SAS Services and Consent form and/or a letter on SAS letterhead. If you have questions about whether you qualify to receive academic adjustments or services, please contact the SAS office directly. All discussions will remain confidential.

Religious Observances:

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in this course, please speak with me as soon as possible to discuss appropriate accommodations.

TEXTBOOK (3 different versions are available)

Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp, 7th Edition

(Two copies of this textbook have been placed on reserve in Dana library.)

Hardcover

ISBN [978-1-1182-0673-7](#)

January 2013, ©2013

Hardcover, 864 pages

Binder Ready Version

ISBN [978-1-1183-0179-1](#)

January 2013

Paperback, 864 pages

E-book

ISBN [978-1-1185-4961-2](#)

December 2012

Wiley E-Text, 864 pages

(Note: for the e-book, there may be limitations as to how long you may access the e-book, and/or how many pages you may print.)

Additional Textbooks on Reserve

For those wishing to supplement the lectures and the assigned readings in Karp, I have listed below several textbooks that are suitable for other perspectives on the topics. All reading in these textbooks is optional. The following books are on reserve in Dana Library:

Cell Biology, 2nd edition, by Pollard and Earnshaw (2008) This textbook has spectacular figures.

Essential Cell Biology, 3rd edition (2009) by Alberts et al. This text has been the Bio12 textbook in past years but is in many ways too simplistic. If you need more background before diving into Karp, try this book.

Molecular Biology of the Cell, 5th edition (2008) by Alberts, et al. This textbook contains even more material than Alberts et al *Essential Cell Biology* or Karp *Cell and Molecular Biology*.

Molecular Cell Biology, 6th edition (2007) by Lodish et al. This textbook also contains more material than Karp. Some students, particularly those eager to learn more, have really enjoyed reading this textbook.

CLICKERS

I will be utilizing interactive technology in Bio 12 that will require you to have a hand-held device (a "clicker"). "Clickers" can be obtained at the computer store, where you will be charged a fee (\$30 on DA\$H card) at the beginning of the term. If you return the "clicker", you will receive a \$20 credit.

If you do not already have one, please obtain a "clicker" today and bring it to class for the rest of term. One important benefit of using clickers is that I can learn more about your understanding of the material as it is being delivered and therefore be more effective as an instructor. Additionally, clickers will help you think about the material actively during class which will help you synthesize and learn.

5% of your grade will be based on **class participation**, which will be determined based on your clicker participation. If you answer questions in >85% of the class meetings (**starting on Wed, March 26**), you will receive full class participation credit. If you answer questions in less than 85% of the classes, you will receive a fraction of the full credit that is proportional to your actual participation.

To obtain credit for your clicker participation, you must register your clicker on the Bio 12 Blackboard site. Please do this before March 26. Even if you have registered your clicker before for another class, you need to register your clicker for Bio 12.

METHODS OF ASSESSMENT AND GRADES

Exam 1	23%
Exam 2	23%
Final Exam	24%
Lab grade	25%
Clickers	5%

Exams will be an even mixture of testing your mastery of the information and applying your knowledge to problem solving.

Barring documented illness, family emergency or academic conflict, **failure to take an exam at the scheduled time will result in a grade of zero.** Documentation of illness requires that you contact Dick's House and determine if you need treatment. You must alert me in advance of the exam if you are unable to take the exam at the scheduled time.

Grading Policy For Exams:

The following points summarize the grading procedures with respect to exams:

- [1] After the exam has been graded and returned, a copy of the answer key will be posted on the Bio12 Blackboard site. Review this answer key and be sure to understand the errors in your exam and why you made them.
- [2] The number of points given for each answer is final. If, after reviewing your answers and comparing them to the posted answer key before the announced deadline (see below), you find an arithmetic error or detect an omission by the grader for one of the questions, you must observe the following procedures for error correction:
 - a) Do not write on the exam. Exams that have been written on will NOT be corrected. **Any alteration of the answers between the time when the graded papers were returned to the student and the time when the paper was submitted for re-grading constitutes a breach of the Academic Honor Principle. To deter this practice, we scan exams before grading them.**
 - b) Prepare a typed cover page with your name and HB number.
 - c) If you find an addition error, indicate on the cover page that an addition error has occurred. Specify the page and question numbers.
 - d) If you determine that your answer contains all of the information indicated in the key, but you did not receive full credit, simply indicate the number of the question to be re-evaluated and state in one or two short, descriptive sentences (typed) what makes your answer correct. The citation of a text page, diagram, or reference to a lecture date/number may also be helpful.
 - e) Attach the typed cover sheet to your complete exam and return it before the announced deadline to the Bio12 drop box located outside the lab (LSC 202). We will not accept questions regarding errors in grading after these deadlines. The error correction process will take a few days. You will be notified of the place and time to pick up exams after the re-evaluation is completed.

Error correction requests:

must be hand-delivered to the **Bio 12 drop box** before these **deadlines**:

First Exam: 12:00PM (Noon) on April 30

Second Exam: 12:00PM (Noon) on May 19

We will not accept questions regarding errors in grading after these deadlines.

The error correction process will take a few days. You will be notified of the place and time to pick up exams after the re-evaluation is completed.

A final word about grades and exams:

You are not competing against each other for grades in Bio 12. Let me be very clear about that and reiterate this point: You are not competing for grades in this class with anyone but yourself. All grades, up until the final letter grades are decided, are recorded as numerical grades, from 0% to 100%. I do NOT assign letter grades to individual exams. Here are three important points about grades in Bio 12:

[i] **A grade of 90% or above will always be at least an A minus** No one is ever penalized for learning what we teach them. Thus, it is entirely possible for everyone in the class to receive a grade of A minus or better. However, my experience suggests to me that this will not happen.

[ii] **In order to receive a D, you have to achieve a final grade of at least 50%.** In other words, a final grade less than 50% is an E.

[iii] **The median grade of Bio 12 will mostly likely be a B.** That means if the median numerical score for the course were 62%, then a grade of 62% is a B. If the median were 29%, then a grade of 29% is a B (hence negating rule [ii] above). If the median grade is 94% then a grade of 94% for the course is an A/A- (see rule [i] above).

COURSE GOALS & LEARNING OBJECTIVES

1. To become conversant in Cell Biology. This will involve learning a vocabulary relating to this field of study (ATP Synthase, heterotrimeric G-protein, refractive index, to name only a few terms you will encounter) and using this vocabulary correctly. I am sometimes asked why I consider such memorization an important skill. For those going on the medical school, memorization is a key skill to develop, and is emphasized in medical programs for the obvious reason that one has to know what to do in immediate response to a crisis, without losing the time it would take to look something up in a text or on-line. ***However, memorization is only the first step for biologists.*** Developing a complete vocabulary is necessary to discuss cellular processes accurately. Moreover, having information readily available in one's mind is required in order to make mental connections that lead to new insights. For this reason, exam questions may ask you to apply information from the course to new questions not discussed in class.

2. To think like a Cell Biologist. Cell Biology is a science and we will be asking you to think like scientists, whether it be in the critical analysis of data or the execution and interpretation of a scientific experiment. Furthermore we ask you to think like not just any scientist, but as a Cell Biologist, one who can put together the mechanistic details of a cellular process as well as interpret microscopic images of the cell.

3. To find the joy of Cell Biology. I could call this simply the joy of understanding, for to me there is a great satisfaction in learning how something works mechanistically within my own body. There is also a lot of innate beauty in Cell Biology (we will frequently be looking at amazing images taken using a variety of microscopy techniques) that can be appreciated even without that level of understanding, but understanding adds an extra dimension to this beauty.

EXPECTATIONS

Here's what I expect from you:

- 1) To preview the reading material before class
- 2) To come to every class, mentally prepared to think about Cell Biology processes
- 3) To bring your clicker to every class meeting
- 4) To be willing to ask questions and participate in class discussions and exercises
- 5) To listen to pre-lecture recordings BEFORE class, when required
- 6) To utilize active learning techniques to master course material
- 7) To arrive to laboratory exercises on time, and prepared
- 8) To turn off your cell phone during class and lab
- 9) To use your laptop during class and lab ONLY for course related activities.

Here's what you can expect from me:

- 1) To bring expertise and enthusiasm to the classroom
- 2) To be willing to answer questions and facilitate classroom discussions
- 3) To challenge you to stretch beyond your comfort zone
- 4) To encourage you to try new approaches for studying and learning that are "active"
- 5) To provide opportunities for you to practice problem solving

HOW TO BE SUCCESSFUL IN BIO 12

Please also see the powerpoint entitled "Strategies for Success in Bio 12" which is posted in the Class Materials Folder on Blackboard

1) Preview each reading assignment the night before class. Look at the figures, read the figure legends, and get a general feel for the vocabulary to be introduced and the topics to be covered in the upcoming lecture. Jot down any questions you have to focus your attention in lecture.

2) Attend lectures on time (class will start promptly at **8:45 AM**), take notes on the material presented in lecture, and ask questions about the things you do not understand. Make sure you have answers to the questions you wrote down the previous night. *If you print out the powerpoint slides, you can easily make notes, draw arrows, circle items, etc. on the actual slide.* This is an example of "active" learning that is much more effective than typing your notes on your computer.

3) Re-read the reading assignment as well as your notes that very same afternoon or evening after the lecture, when it is still fresh in your mind. Correct or add points to your notes as you go along. *Re-writing your notes is an excellent "active" method of "learning" the material.*

4) Review the notes and reading assignments from the previous week's classes sometime during the weekend.

5) Be curious and ask questions in class, in office hours, in lab and with fellow students. Also ask YOURSELF questions and try to challenge yourself to decide if you really understand the material.

6) Test your own knowledge by putting away your notes and drawing out structures and pathways from memory. Your goal is to be able to accurately re-create the details and mechanisms from scratch. *Don't just try to do it in your head. Do it on paper, and then compare your attempt with your notes.*

7) Attend office hours and the scheduled review sessions and don't be shy about asking questions.

RESOURCES FOR ASSISTANCE WITH CLASS MATERIAL

1) Class review sessions: I have scheduled several class meetings to include time for review and Q&A. Plan to come to these class meetings with specific questions to ask.

2) Discussion Board on Blackboard site: there will be a section of the blackboard site to post questions about lecture material (anonymously if you wish) and these questions will be answered so everyone can see the answers and also learn. Individual email questions about lecture material will not be answered.

3) Course Teaching assistants: Your lab TA is a Ph.D. student in the Molecular and Cellular Biology graduate program and an excellent resource for information.

4) Join a study group through the Academic Skills Center

ACADEMIC HONOR:

The Dartmouth College Student Handbook states "Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Students who submit work which is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth."

There are a number of situations in which a student in Biology 12 might find themselves tempted to violate the Academic Honor Principle. These situations include (but are not limited to) the following:

- a) Examinations must be completed without reference to written materials other than those provided with the exam paper and must be completed without communication with anyone else (the only permissible exception is that students may request clarification of any exam question from the course instructor who is present expressly for that purpose). The answers that you provide must be entirely your own work.
- b) Our policy permits the re-submission of exams for potential error correction by the instructor. **Any alteration of the answers between the time when the graded papers were returned to the student and the time when the paper was submitted for re-grading constitutes a breach of the Academic Honor Principle. To deter this practice, we scan exams before grading them.**
- c) Laboratory experiments are performed in pairs or groups, and we encourage collaborative analysis of the data. However, any report submitted for grading must represent the **original** words of the student submitting that report. **Do not share computer files** of work (including text, graphs, tables, etc.) to be submitted for grading! The student misrepresenting the work of another as his or her own is in violation of the Academic Honor Principle, as is likely the student who loaned that information. Thus, it is possible that the Committee on Standards will find the student providing the original file also to be in violation of the Honor Principle.
- d) **Do not share clickers.** If you cannot attend class, **it is a violation of the Honor Principle to have a friend click for you.** Answering questions in 85% of the classes will result in full clicker participation credit, so there is a built-in mechanism so that you will not be penalized for illness or other situations that prevent you from attending every class.

Honesty is the foundation of the academic pursuit of knowledge. In recognition of this, the faculty will not overlook any violations of the Academic Honor Principle. Indeed, the Faculty Handbook of Dartmouth College states explicitly that **College faculty are obligated to report potential violations of the Academic Honor Principle to the Dartmouth College Committee on Standards.**

LABORATORY EXERCISES

The Bio 12 lab sections meet from 1:45PM - 5:45PM or 6:30PM-10:30PM (Monday, Tuesday, and Wednesday) in Life Sciences Center, Room 202/204.

Barring documented illness, failure to attend a lab section at the scheduled time will result in a grade of zero on the lab quiz and a zero for any written assignment associated with lab. No arrangements exist for make-up labs. Attendance at ALL of your assigned lab dates is mandatory.

Laboratory 1 – Introduction to Light Microscopy

Week beginning March 31st

This exercise will include training each student in the proper use of the light microscope including proper Köhler illumination, bright-field, phase contrast, DIC, and fluorescence microscopy.

Laboratory 2 – Protein Purification and Quantitative Analysis

Week beginning April 7th

Students will perform ion exchange chromatography to purify proteins from a mixture of proteins. Students will determine the concentration of protein in eluted column fractions using the Bradford assay and characterize the elution profile of a specific protein using an enzymatic assay.

NO LAB week beginning April 14th – Week of Exam 1, Begin to Prepare Lab Report

Laboratory 3 – Qualitative Analysis of Protein Purification

Week beginning April 21st

Continuing from lab 2, students will assess the efficacy of column chromatography for purifying proteins in a mixture by gel electrophoresis using their eluted fractions.

Laboratory 4 – Isolating Chloroplasts - The Hill Reaction

Week beginning April 28th

Students will isolate chloroplasts from spinach using differential centrifugation and measure the normal rate of the Hill reaction compared to the rate in the presence of inhibitors. Rate is ultimately determined spectrophotometrically using the dye DCIP as an electron acceptor.

NO LAB week beginning May 5th – Week of Exam 2, Prepare Lab Report

Laboratory 5 – Cell Motility in *Chlamydomonas*

Week beginning May 13th

Students will assess phototaxis of live *Chlamydomonas reinhardtii* cells using different conditions. Demembrated cell models of *Chlamydomonas* will also be created to assess the effect of varying concentrations of calcium on motility.

Laboratory 6 – Experimental Design Using Fluorescence Microscopy

Week beginning May 20th

Students will design an experiment to test a cell biological hypothesis using live *Ashbya gossypii* cells and several fluorophores.

Laboratory Assignments and Point Breakdown

The laboratory portion of Bio12 counts for 25% of your total Bio12 grade. There are 100 possible points for the lab portion of the course.

1. **Quizzes:** There will be quizzes (5 points each) that begin promptly at the start of labs 1,2,3,4,and 5. Each quiz will end ten minutes into the lab session. The quizzes will count for a total of 25 points of your lab grade
2. **Microscopy in-class assignment** (5pts)
3. **Lab Reports:**
Three lab reports will be written during the term. You will have 1 - 2 weeks from the time you complete your lab to the time the report is due. Detailed instructions for each report will be given during the term. Please note the following dates.
 - a. **Protein Purification Lab Report** (25pts), due week of April 28th
A culminating lab report for labs 2 & 3, Note: in the event of an unexcused lab absence from either Lab 2 or Lab 3, you will still be required to write a lab report. However, your report grade will have a maximum of 15 points.)
 - b. **Hill Reaction Lab Report** (15pts), due week of May 12th
 - c. **Experimental Design Lab Report** (20pts), due week of May 26th
4. **Lab Abstract:**
For lab 5, you will write a short lab abstract. This assignment is worth 5 points and is due the week of May 19th.
5. **Experimental Design Methods**
Before lab 6, you will write out detailed methods of the experiment that you design. This assignment is in place of your lab 6 quiz and will be worth 5 points. Assignments will be due one week prior to lab.