

Bio12: Cell Structure and Function

Spring 2018

M, W, F 8:50-9:55 AM, X-hour: Th 9:05-9:55 AM
Room 200, Class of 1978 Life Sciences Center (LSC)

Professors Sharon E. Bickel, Ph.D. and **Magdalena Bezanilla**, Ph.D.
Laboratory Directors: **Amanda Socha**, Ph.D. and **Katherine Price**, Ph.D.
Teaching Fellow: **Joe Minichiello**, '17

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Ryan O'Toole and **Jianping Wu**

COURSE GOALS & LEARNING OBJECTIVES

- 1. Become conversant in Cell Biology.** This will involve learning a vocabulary relating to this field of study and using this vocabulary correctly. 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 quickly make mental connections that lead to new insights and facilitate problem solving.
- 2. Understand the experimental methods used to study cells.** We will discuss a broad range of techniques including different types of microscopy, biochemical and molecular analyses, and genetic approaches—all of which are routinely used by scientists to dissect how cells function. You will need to develop a thorough understanding of the underlying theory as well as the technical application of these techniques. A solid background in this area will allow you to apply this information to a diverse set of circumstances, including interpretation of experimental data and the ability to propose new experiments to answer specific questions.
- 3. Gain a working knowledge of cellular organization and function.** Our work in this course will allow you to gain a mastery of membrane structure and function and how cellular compartments are formed, how cells generate and utilize energy, how proteins are trafficked to the correct location and/or organelle within the cells, how cells respond to their environment, how signaling pathways within the cell elicit specific cellular responses, how cytoskeletal components are assembled and how they regulate cell shape and motility, how the cell duplicates and divides, how cells are organized into tissues, and how disruption of many of the above cellular processes can lead to cancer.
- 4. Develop the analytical skills of a Cell Biologist.** Cell Biology is a science and we will be asking you to think like scientists, whether it be critical analysis of data or the execution and/or interpretation of a scientific experiment. Furthermore, you will gain experience approaching cell biology as a problem-solving endeavor in which you interpret microscopic images and/or utilize your knowledge of the mechanistic details of cellular processes. Class discussion and exam questions will give you the opportunity to take what you have learned about a normal cellular process and predict a logical outcome when specific parameters are altered (i.e. by experimental manipulation, mutation, drugs).
- 5. Discover the inner beauty of the cell.** Cells are incredibly complex but also innately beautiful. Throughout the term you will frequently be viewing amazing images (and movies!) generated by diverse microscopy techniques. Even without a molecular understanding of how cells work, one can appreciate their beauty. Learning about their structure and function adds an extra dimension to this beauty.

CLASS SCHEDULE

How do we view cells?

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|----|----|------|--|------------|
| 1. | M | 3/26 | Course Logistics & Introduction to Cell Architecture | Chapter 1 |
| 2. | W | 3/28 | Microscopy (<i>SEB</i>) | Chapter 18 |
| 3. | Th | 3/29 | Microscopy (<i>SEB</i>) | Chapter 18 |

How do we analyze cells?

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|----|----|------|--|------------|
| 4. | F | 3/30 | Protein Structure & Function (<i>MB</i>) | Chapter 2 |
| 5. | M | 4/2 | Experimental Approaches (<i>MB</i>) | Chapter 18 |
| 6. | W | 4/4 | Experimental Approaches (<i>MB</i>) | Chapter 18 |
| | Th | 4/5 | Optional Review/Q & A | |

How are cell compartments built?

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|-----|----|------|---|-----------|
| 7. | F | 4/6 | Thermodynamics & Enzymes (<i>MB</i>) | Chapter 3 |
| 8. | M | 4/9 | Membrane Structure and Composition (<i>SEB</i>) | Chapter 4 |
| 9. | W | 4/11 | Transport Across Membranes (<i>SEB</i>) | Chapter 4 |
| 10. | Th | 4/12 | Transport Across Membranes (<i>SEB</i>) | Chapter 4 |
| | F | 4/13 | Optional Review/Q & A | |

M 4/16 EXAM 1, 8:00-9:55 AM, Lectures #1-10 (including Chemistry)

How do cells generate and utilize energy?

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|-----|----|------|--|---------------|
| 11. | W | 4/18 | Glycolysis & Aerobic Respiration (<i>MB</i>) | Chapters 3, 5 |
| 12. | Th | 4/19 | Photosynthesis (<i>MB</i>) | Chapter 6 |

How do proteins know where to go in the cell?

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|-----|----|------|--------------------------------|-----------|
| 13. | F | 4/20 | Protein Sorting (<i>SEB</i>) | Chapter 8 |
| 14. | M | 4/23 | Protein Sorting (<i>SEB</i>) | Chapter 8 |
| 15. | W | 4/25 | Protein Sorting (<i>SEB</i>) | Chapter 8 |
| | Th | 4/26 | Optional Review/Q & A | |
| 16. | F | 4/27 | Protein Sorting (<i>SEB</i>) | Chapter 8 |

How do cells receive, integrate and process information?

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|-----|----|------|------------------------------|------------|
| 17. | M | 4/30 | Cell Signaling (<i>MB</i>) | Chapter 15 |
| 18. | W | 5/2 | Cell Signaling (<i>MB</i>) | Chapter 15 |
| 19. | Th | 5/3 | Cell Signaling (<i>MB</i>) | Chapter 15 |
| | F | 5/4 | Optional Review/Q & A | |

M 5/7 EXAM 2, 8:00-9:55 AM, Emphasis on Lectures #11-19

How do cells regulate cell shape and motility?

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|-----|----|------|--|-----------|
| 20. | W | 5/9 | Cytoskeleton – Intermediate Filaments (<i>SEB</i>) | Chapter 9 |
| 21. | Th | 5/10 | Cytoskeleton – Actin (<i>SEB</i>) | Chapter 9 |
| 22. | F | 5/11 | Cytoskeleton – Actin (<i>SEB</i>) | Chapter 9 |
| 23. | M | 5/14 | Cytoskeleton – Microtubules (<i>SEB</i>) | Chapter 9 |
| 24. | W | 5/16 | Cytoskeleton – Microtubules (<i>SEB</i>) | Chapter 9 |
| | Th | 5/17 | Optional Review/Q & A | |

How do cells duplicate?

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|-----|---|------|---|------------|
| 25. | F | 5/18 | The Cytoskeleton in Action during Cell Division (<i>MB</i>) | Chapter 14 |
| 26. | M | 5/21 | The Cell Cycle (<i>MB</i>) | Chapter 14 |
| 27. | W | 5/23 | The Cell Cycle (<i>MB</i>) | Chapter 14 |

How do cells form tissues?

28. Th 5/24 Connections between Cells (MB)

Chapter 7

What happens when cell biology “fails”?

29. F 5/25 Cancer (MB)

Chapter 16

M 5/28 MEMORIAL DAY -- no class

W 5/30 Review/Q & A

We may need to use this class period to finish lecture material

Final Exam Review Session→ TBA

FINAL EXAM, Monday, June 4: 8:00-11:00 AM, Emphasis on Lectures #20-29

We are instituting a no computer use policy for Bio12 this term. We will discuss the rationale for this policy in class. Please do not use laptops or other electronic devices in class. The only exception will be the use of cell phones for “communicating” your answers to “clicker” questions (see below). At all other times, your cell phone should remain face down on your desk or put away.

Professor Bickel’s OFFICE HOURS:

Wednesdays 3:30-4:30 PM, Thursdays 1:30-2:30 PM

LSC 237 (my office) or 238 (the conference room close to my office)

Professor Bezanilla’s OFFICE HOURS:

Tuesdays 11:00 AM-12:00 PM, Fridays 1:30-2:30 PM

LSC 334 (my office) or 336 (breakout room close to my office)

Note that we are generally available to answer questions after lecture.

The scheduled review/Q&A sessions are also good times to have your questions answered.

EXPECTATIONS

Here’s what we expect from you:

- 1) To print out the powerpoint slides and bring them to class to take notes
- 2) To come to every class, mentally prepared to think about Cell Biology
- 3) To be willing to ask questions and participate in class discussions and exercises
- 4) To listen to pre-lecture recordings BEFORE class, when required
- 5) To utilize active learning techniques to master course material
- 6) To arrive to laboratory exercises on time, and prepared
- 7) To use your cell phone during class ONLY for course related activities

Here’s what you can expect from us:

- 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

Note to Students with Physical or Learning Disabilities:

We encourage students who may need disability-related academic adjustments to see one of us (Professor Bickel or Professor Bezanilla) privately as early as possible in the term, preferably before the end of the first week. Students requiring disability-related academic adjustments or services must consult the Student Accessibility Services (SAS) office (Carson Suite 125, student.accessibility.services@dartmouth.edu). Once SAS has authorized adjustments or services, we 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 one of us as soon as possible to discuss appropriate accommodations.

Mental Health:

We recognize that the academic environment at Dartmouth is challenging, that our terms are intensive, and that classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including:

your undergraduate dean (<http://www.dartmouth.edu/~upperde/>),
Counseling and Human Development (<http://www.dartmouth.edu/~chd/>),
and the Student Wellness Center (<http://www.dartmouth.edu/~healthed/>).

We want you to be aware of these resources and encourage you to use them as needed.

TEXTBOOK**Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp, 7th or 8th Edition**

(Two copies of the 7th edition have been placed on reserve in Dana library, 37 Dewey Field Rd).

An important note about the textbook: We are not requiring that you purchase the textbook. Exams will cover material that is presented in class, provided in pre-lecture recordings, or covered in the classroom exercises. The textbook can be used as a reference to help clarify your understanding of this material. Some students find this very helpful, other students don't use the textbook at all. In deciding whether or not to purchase the textbook, consider what study strategies are most productive for you. Also, if you intend to apply to med school, vet school or graduate school then you may find having the textbook will be useful as a familiar source of information when you begin to review what you have learned in preparation for the MCAT or GRE exams.

Additional Textbooks on Reserve: For those wishing to supplement the lectures with reading from additional textbooks, the following are also on reserve in Dana Library. All reading in the following textbooks is optional.

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 Cell Biology, 7th edition (Dartmouth Custom Book) (2013) by Lodish *et al.* This textbook contains more material than Karp. Some students find the additional level of detail in this textbook useful.

VOCABULARY TERMS

In order to help you develop the language necessary to accurately discuss experiments and cellular processes, we will be posting a list of important vocabulary terms for each module. We encourage you to use your lecture powerpoints and the textbook to write out definitions, make sure you understand these terms and can use them appropriately. Many students find flashcards a useful strategy. The online resource "Quizlet" <https://quizlet.com/> will let you easily generate electronic flash cards.

METHODS OF ASSESSMENT AND GRADES

Exam 1	23%
Exam 2	24%
Final Exam	24%
Lab grade	25%
Participation	4%

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 either Professor Bezanilla or Professor Bickel in advance of the exam if you are unable to take the exam at the scheduled time.

FACILITATING YOUR LEARNING PROCESS

Several lines of evidence indicate that certain activities promote learning and retention MUCH better than re-reading your notes. If you would like to learn more about the most effective strategies for studying and learning (and the research underlying these recommendations), we highly recommend the book "**Making it Stick: The Science of Successful Learning**" by Brown, Roediger III, and McDaniel. Joe Minichiello, the Teaching Fellow, has read this book and is happy to talk about its contents, and how to use these strategies in Bio 12.

Participation Grade (4% of final grade)

One effective study strategy utilizes "reflection" as a method to retrieve information and place it within context. Therefore, during the last few minutes of each class we will ask you to write down:

- two important take away messages from lecture and
- one to two points that you found confusing.

Be sure to bring paper and a writing tool to class.

Why are we doing this? 1) We want to encourage and reward class attendance; 2) there is a benefit to immediate reflection on each lecture experience and 3) by obtaining immediate feedback on what points were most confusing we can revisit these points in the following lecture and/or review sessions.

Reflections will begin on Wednesday March 28, for a total of 28 lectures.

These participation points (**3% of final grade**) will be tiered depending on your attendance so that you will not be penalized for a few absences due to illness or other situations that prevent you from attending class:

- Attendance at 25-28 lectures → 3 points (full credit)
- Attendance at 21-24 lectures → 2 points
- Attendance at 17-20 lectures → 1 point
- Attendance at 0-16 lectures → zero points

In addition to end-of class reflections, part of your participation grade (**1% of final grade**) will be based on short quizzes that you will complete after viewing pre-lecture recordings. Short videos will be used to present material that is important for in class discussion and/or classroom exercises. In order to receive credit, you must complete the quiz by 12am on the specified class day. We are using these quizzes 1) to ensure that you watch the assigned videos before class and 2) to help us assess your understanding of the material. While taking the quiz you may refer to any notes you took while watching the video.

Clicker Questions

We also will be utilizing an interactive technology in Bio12 that will allow you to use your cell phone to communicate your answer to clicker questions that we will pose in class throughout the term.

One purpose of using clicker questions is that it allows us to gauge your understanding in real time. The best way for us to gain an accurate appraisal is if the majority of the class answers each of the clicker questions. **Additionally, research has demonstrated that clicker questions help students to actively engage with the course material, and this facilitates learning and synthesis.** You will be “clicking” anonymously—we will not see what answers you give. The data will be tabulated for the entire class, not for individual students. Although your grade will not depend on clicker question participation, we hope all of you will participate fully throughout the term. We will be using a technology that allows cell phone use specifically so that you will not have to purchase a clicker to participate.

EXAMS and GRADING POLICIES

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 Canvas site. Review this answer key carefully 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 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. **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 number.
 - 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).

EXAM Error correction requests:

must be hand-delivered to the **Bio12 drop box** before these **deadlines**:

First Exam: 12:00PM (Noon) on May 2

Second Exam: 12:00PM (Noon) on May 23

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 Bio12. We want to 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%. We do NOT assign letter grades to individual exams. Here are three important points about grades in Bio12:

[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, our experience suggests to us 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 Bio12 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 numerical score is 94% then the median letter grade for the course will be an A or A- (see rule [i] above).

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 Bio12 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 materials other than those provided with the exam paper and must be completed without communication with anyone else, including the internet (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) Science is a collaborative field and we encourage collaboration for many aspects of the course while still requiring demonstration that each individual has an understanding of key concepts. You will work with a partner during the laboratory sessions to perform all in-lab activities including microscopy, data collection, and hypothesis generation. We encourage you to collaborate with your partner and peers in the analysis of your data, including discussion of data presentation and interpretations. **While the ideas and overall interpretations may result from collaboration, we require that the textual and graphical content of any lab report submitted for grading be prepared by you individually without the assistance of anyone else.** Do not copy directly from the lab manual, and do not share electronic data, textual or graphical files.
- d) Your participation grade will be based on your reflection at the end of the class period and submission of a written document. **It is a violation of the Honor Principle to have a friend submit a reflection document for you or for you to submit a document for your friend.**

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.**