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 analysis, 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 process. 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?
1. W 9/16 Course Logistics & Introduction to Cell Architecture Chapter 1
2. Th 9/17 Microscopy Chapter 18
3. F 9/18 Microscopy Chapter 18

How do we analyze cells?
4. M 9/21 Protein Structure & Function Chapter 2
5. W 9/23 Experimental Approaches Chapter 18
   Th 9/24 Optional Review/Q & A
6. F 9/25 Experimental Approaches Chapter 18

How are cell compartments built?
7. M 9/28 Thermodynamics & Enzymes Chapter 3
   W 9/30 Online Quiz – Material through 9/28, including Chemistry
8. W 9/30 Membrane Structure and Composition Chapter 4
9. Th 10/1 Transport Across Membranes Chapter 4
10. F 10/2 Transport Across Membranes Chapter 4
    M 10/5 Optional Pre-Exam Review/Q & A
    T 10/6 Please note that today is the Dartmouth Life Science Symposium
        The topic is “Signal Transduction in Development and Disease”
        You are not required to attend, but if you have time, you may find the topics interesting and
        they will be relevant to what we will be discussing later in the term.
    W 10/7 EXAM 1, 8:00-9:50 AM, Lectures #1-10 (including Chemistry)

How do cells generate and utilize energy?
11. Th 10/8 Glycolysis & Aerobic Respiration Chapters 3, 5
12. F 10/9 Photosynthesis Chapter 6

How do proteins know where to go in the cell?
13. M 10/12 Protein Sorting Chapter 8
14. W 10/14 Protein Sorting Chapter 8
    Th 10/15 Optional Review/Q & A
15. F 10/16 Protein Sorting Chapter 8
16. M 10/19 Protein Sorting Chapter 8
    W 10/21 Online Quiz—Material through 10/19

How do cells receive, integrate and process information?
17. W 10/21 Cell Signaling Chapter 15
18. Th 10/22 Cell Signaling Chapter 15
19. F 10/23 Cell Signaling Chapter 15
    M 10/26 Optional Pre-Exam Review/Q & A
    W 10/28 EXAM 2, 8:00-9:50 AM, Emphasis on Lectures #11-19

How do cells regulate cell shape and motility?
20. Th 10/29 Cytoskeleton – Intermediate Filaments Chapter 9
How do cells duplicate?
25. M 11/9 The Cytoskeleton in Action during Cell Division Chapter 14
   W 11/11 Online Quiz—Material through 11/9

How do cells form tissues?
27. Th 11/12 The Cell Cycle Chapter 14

What happens when cell biology “fails”?
28. F 11/13 Connections between Cells Chapter 7

Final Exam Review Session TBA
Su 11/22 FINAL EXAM, 8:00-11:00 AM, Emphasis on Lectures #20-29

I am instituting a no computer use policy for Bio12 this term. I will discuss the rationale for this policy in class. Please do not use laptops or other electronic devices in class.

Professor Bickel’s OFFICE HOURS: Tuesdays 4:30-5:30 PM, Wednesdays 3:30-4:30 PM
LSC 237 (my office) or 238 (the conference room close to my office)

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

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
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

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
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 first 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

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, 37 Dewey Field Rd).

Additional Textbooks on Reserve: For those wishing to supplement the lectures and assigned readings in Karp, the following books 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.

METHODS OF ASSESSMENT AND GRADES

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<thead>
<tr>
<th>Component</th>
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<tbody>
<tr>
<td>Exam 1</td>
<td>21%</td>
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<td>Exam 2</td>
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<td>Final Exam</td>
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<tr>
<td>Lab grade</td>
<td>25%</td>
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<tr>
<td>Quizzes</td>
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<tr>
<td>Participation</td>
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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.

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), I highly recommend the book “Making it Stick: The Science of Successful Learning” by Brown, Roediger III, and McDaniel.
**Online Quizzes**
One effective study strategy is called “retrieval practice.” The actual act of retrieving information (like during a quiz) helps you to solidify your knowledge/memory and enhances your ability to retrieve the information in the future. I encourage you to build retrieval practice into your study routine. To further facilitate the advantages of this strategy, I will administer three low-stakes on-line quizzes during the term, each scheduled approximately one week before an exam.

I am hoping that this will provide you with at least three benefits: 1) you will not be able to put off studying (cramming) until the exam; 2) your learning and retention will actually be strengthened by having to practice retrieval during the quiz and 3) you will get some feedback about areas on which you need to focus more time/effort.

**Participation Grade**
Another 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 I will ask you to write down what you think were the ~2 most important take away messages and also to write down 1 or 2 questions or topics that you found confusing.

Why am I doing this? 1) I 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 I can revisit these points in the following lecture and/or review sessions.

Class participation will begin on Thursday, September 17 for a total of 28 lectures. You may miss up to 5 lectures and still receive the full participation grade. If you miss more than five lectures, you will receive zero credit for the participation grade.

**Clicker Questions**
Throughout the term, 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 purpose of using clicker questions is that it allows me to gauge your understanding in real time. The best way for me 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—I will not see what answers you give. The data will be tabulated for the group, not for individual students. Although your grade will not depend on clicker question participation, I hope all of you will participate fully throughout the term. Although you can mentally participate without a clicker, the only way that I will have “access” to your understanding level and be able to address widespread confusion in real time is if you use a clicker during class.

**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 Canvas site. Review this answer key and be sure to understand the errors in your exam and why you made them.
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. 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).

Error correction requests: must be hand-delivered to the Bio12 drop box before these deadlines:

First Exam: 12:00PM (Noon) on October 21
Second Exam: 12:00PM (Noon) on November 11

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. 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 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, my experience suggests 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). However, if the median grade is 94% then a grade of 94% for the course is an A/A- (see rule [i] above).
HOW TO BE SUCCESSFUL IN BIO12

Please also see the powerpoint entitled “Strategies for Success in Bio12” which is posted on Canvas

1) Preview the reading assignment and powerpoint slides 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. 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) Review 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 and redrawing figures is an excellent “active” method for “learning” the material.

4) Use the textbook to fill in gaps in your notes and/or clarify topics discussed in class. Exams will be based on information covered in class, NOT details in the text that we do not discuss in class.

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. This is the essence of practicing “retrieval.”

7) Practice applying information to new situations. What would happen if………?

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

RESOURCES FOR ASSISTANCE WITH CLASS MATERIAL

1) Class recordings: While technology may not be 100% reliable, my plan is to provide ECHO 360 recordings of the lectures available on the Canvas site.

2) 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.

3) Piazza Discussion on Canvas: There will be a link on the Canvas site where you may post questions about class material (anonymously if you wish) and these questions will be answered so everyone can see the answers and also learn. I encourage students to “dialogue” about course material using this forum. Individual email questions about lecture material will not be answered.

4) Course Teaching assistants: The Bio12 TAs are Ph.D. students in the Molecular and Cellular Biology graduate program and an excellent resource for information. Andrew Crowley, Rufus Hards, and Xue “Sherry” Xia will be attending the lectures for our section of Bio12.

5) “T” Kienemund, ’15, will serve as a Teaching Science Fellow for Bio12 this term. She will be hosting bi-weekly office hours (Tues 7-9PM, Sun 7-9PM in Silsby 113), providing supplementary study material for the course, and acting as a peer-mentor resource for the class to help with mastery of material. Feel free to contact her with questions or concerns about the course, or to set up a time to meet outside of office hours. You may email her at: T.Kienemund@dartmouth.edu

6) Join a study group through the Academic Skills Center or form your own.
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 (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) On-line quizzes are to be completed by each student independently. A major goal of the quiz is to give you an opportunity to practice the retrieval of information. Research shows that the act of retrieval actually enhances learning by embedding information more securely in our memory. Therefore, students must complete all on-line quizzes without referring to any materials (no textbook, no notes, no internet, no outside sources of any kind, no conversation with anyone). The answers that you provide must be entirely your own work.

d) 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 is prepared by you individually without the assistance of anyone else.

e) 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. Attending 23 of 28 lectures starting on September 17 will result in full participation credit. Therefore, 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

A complete laboratory syllabus is available on the Canvas BIOL.012.Lab.FA15 website. Please read it carefully. You are responsible for its contents. Below is a brief summary of lab information for this course.

Laboratory Section Assignment
By noon on September 18, you will need to fill out an online survey (Canvas BIOL.012.Lab.FA15) to determine your lab section based on your academic schedule. Conflicts of an academic nature will take priority, followed by work and extracurricular activities. **Your lab section assignment will be the same for the entire term and it is your responsibility to ensure that you will be in attendance for all sessions.** Be sure to check all exams and X-hours for your other classes throughout the term.

There will be six Bio12 lab sections: **Monday, Tuesday and Wednesday from 1:45PM - 5:45PM or 6:30PM-10:30PM.**

Laboratory Calendar
Below is a calendar outlining each laboratory session for the term and relevant assignment due dates. This calendar will also be available electronically through Canvas and can be integrated together with your other courses for the term. Be sure to check the Canvas calendar regularly throughout the term for any changes to this calendar.

<table>
<thead>
<tr>
<th>Lab</th>
<th>Dates</th>
<th>Assignments &amp; Lab Reports</th>
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</thead>
<tbody>
<tr>
<td>Lab #1 Microscopy</td>
<td>Sept 21-23</td>
<td>In-lab microscopy assignment</td>
</tr>
<tr>
<td>Lab #2 Ion Exchange Chromatography</td>
<td>Sept 28-30</td>
<td>The assignment for this lab will be due two weeks later at the beginning of Lab #3, the week of Oct 12-14</td>
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<tr>
<td></td>
<td></td>
<td><em>No lab Oct 5-7</em></td>
</tr>
<tr>
<td>Lab #3 Gel Electrophoresis</td>
<td>Oct 12-14</td>
<td>The assignment for this lab will be due at the beginning of Lab #4, the week of Oct 19-21.</td>
</tr>
<tr>
<td>Lab #4 Chloroplasts</td>
<td>Oct 19-21</td>
<td>Lab report due two weeks later at the beginning of Lab #5, the week of Nov 2-4.</td>
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<tr>
<td></td>
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<td><em>No lab Oct 26-28</em></td>
</tr>
<tr>
<td>Lab #5 Cell Motility and Experimental Design Discussion</td>
<td>Nov 2-4</td>
<td>Lab 5 Abstract due at the beginning of Lab #6, Nov 9-11. Lab 6 Methods due two days after your lab section by email to your TA.</td>
</tr>
<tr>
<td>Lab #6 Experimental Design</td>
<td>Nov 9-11</td>
<td>Lab report due at noon, 6 days after lab in the Bio Drop Box outside LSC 202. Sun Nov 15 for lab sections 1-2, Mon Nov 16 for lab sections 3-4, Tues Nov 17 for lab sections 5-6.</td>
</tr>
</tbody>
</table>
Laboratory Grades
Your work in the laboratory will contribute to 25% of your overall grade in Bio12. The lab grade will be composed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Lab Quizzes</td>
<td>25%</td>
</tr>
<tr>
<td>In-Lab Microscopy Assignment (Lab 1)</td>
<td>5%</td>
</tr>
<tr>
<td>Chromatography Assignment (Lab 2)</td>
<td>15%</td>
</tr>
<tr>
<td>Protein Gel Assignment (Lab 3)</td>
<td>10%</td>
</tr>
<tr>
<td>Chloroplast Lab Report (Lab 4)</td>
<td>15%</td>
</tr>
<tr>
<td>Cell Motility Abstract (Lab 5)</td>
<td>5%</td>
</tr>
<tr>
<td>Experimental Design Methods (Lab 6)</td>
<td>5%</td>
</tr>
<tr>
<td>Experimental Design Report (Lab 6)</td>
<td>20%</td>
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</table>