



## CELL BIOLOGY – BIOL 3000 – FALL 2014 (revised 8/21/14)

### Course Description

*“In biology, it is one stupefaction after another...For a while things seemed simple and clear; the cell was a neat little machine, a mechanical device ready for taking to pieces and reassembling, like a tiny watch. But just in the last few years it has become almost imponderably complex, filled with strange parts whose functions are beyond today’s imagining.”*

Lewis Thomas (1913-1993) Physician, cancer researcher and self-described Biology Watcher.  
*Late Night Thoughts on Listening to Mahler’s Ninth Symphony*, 1983

How did cells originate? How can some of our cells remain immortal when we’re not? Why would a cell commit suicide? How do cells know when to divide? Why do cells use zip codes? What is our current understanding of these fascinating questions (and many more!) and what are the experimental approaches used to answer them? Welcome to Cell Biology.

### Course Objectives

The overall goal of BIOL 3000 is for you to learn to think like an experimental cell biologist. By the end of this course, you will be able to:

1. Describe and explain fundamental cellular processes.
2. Describe and explain how and why complementary molecular, biochemical and genetic experimental approaches are used to analyze diverse cellular processes.
3. Identify the functions and roles of specific proteins and/or small molecules in the context of individual cellular processes and be able to integrate them into complex interconnected pathways.
4. Predict the specific physiological consequences of perturbing the functions of individual components in multi-step pathways or processes.
5. Interpret experimental results in order to elucidate a specific cellular process.
6. Apply your understanding of multiple cellular processes to explain various human diseases and the therapeutic options available to treat them.

### Important Course Details

#### Meeting Times and Location

Class: 9:00–9:50 AM MWF GIL 130

Discussion Sessions and Exams 1–3: 7:00–9:00 PM Wednesdays, GIL 130.

Exam 1, Sept. 17; Exam 2, Oct. 15; Exam 3, Nov. 12; Exam 4, Tues. Dec. 16, 2-5 PM, GIL 130.

## Instructor Information

**Mike Wormington**, Associate Professor of Biology. My hometown is Overland Park, Kansas, and I attended the University of Kansas (Go Jayhawks!) where I earned my BA with Honors in Biology and my PhD in Biochemistry. I was an NIH Postdoctoral fellow at the Carnegie Institution for Science, Dept. of Embryology, in Baltimore, MD. I joined the UVa Biology faculty in 1989 and have taught Cell Biology since 1992. My longstanding research interest is the regulation of gene expression in a variety of developmental and physiological contexts. When I'm not in the lab or teaching, I spend my time with my wife Susan, who's the Art Director at UVa's Darden School of Business. Our two daughters and sons-in-law live in North Carolina and we are now enjoying life as grandparents. I'm also a search and rescue, disaster relief mission pilot and director of operations for the Virginia wing of the US Civil Air Patrol which is the civilian auxiliary of the United States Air Force.

Office: PLSB 206      Phone: 982-5803      email: [ww2t@virginia.edu](mailto:ww2t@virginia.edu)  
Office Hours: 2:00-4:30 PM Tues. and Thurs. PLSB 200 and by appt.

## Graduate Teaching Assistant

Richard Smindak      Office: PLSB 238      Phone: 924-3943      email: [rjs6dg@virginia.edu](mailto:rjs6dg@virginia.edu)  
Office hours: 11:00 AM –12:30 PM Tues. and 4:00-5:30 PM Weds. PLSB 300 and by appt.

## Prerequisites

BIOL 2010 (or AP), and any two of CHEM 1410, 1420, 1810, 1820. The premise for this course is that you have completed these prerequisites and are familiar with their concepts and principles. Chapters 1,2, 3 and 9 of the Lodish MCB7E text provide an excellent review of pertinent topics covered in both BIOL 2010 and general chemistry, and should be referred to as necessary throughout the entire course.

## Required Text

The required textbook is *Molecular Cell Biol., 7<sup>th</sup> ed., Lodish et al.* (MCB7E). Purchase the least expensive option available to you; new or used; hardcover or digital "e-book". Do not use a previous edition of the text as the material has been extensively revised and reorganized. We will not be using the publisher's "MCB7E BioPortal" this fall so you do not need to purchase the online access to the BioPortal. All online homework will be posted and submitted through Collab.

## BIOL 3000 Collab Website

The BIOL 3000 Collab Course site is an important resource that you will need to use. The Resources section will contain pptx files of slides to be presented in class. These will be available for downloading at least two days before we cover the material in class. Note: The information on the slides posted on collab may not necessarily be the same as what I show in class so plan to take notes! Specific reading assignments within MCB7E chapters, supplementary reading material such as brief review articles from the scientific literature, and learning objectives for each unit of the course will also be posted with the slides. You will be notified by email when new materials have been posted on Collab. The course homepage also contains quicktime movie files and links to interesting websites. Previous years' exams will not be posted, but will be the main source of homework questions.

## iClickers

iClickers will be used in virtually every class and discussion session to facilitate active learning and to help you assess your understanding of concepts and your ability to apply them in various contexts. iClicker questions will *not* be posted ahead of time or made available after class or discussion sessions. They are *solely* a resource to enhance active learning during class and will not contribute to your course grade. You do not need to register your iClicker since your answers will not be tracked or graded.

## Online Homework Assignments



*"Do or do not. There is no try."* Yoda

We will *not* be using the publisher's MCB7E BioPortal for online homework this fall. Instead, questions will be posted on Collab. The homework will consist of a combination of "preview" and "review" questions all of which are derived from previous year's exams. The best way to learn cell biology is to do it. Unfortunately, we cannot provide a practical lab experience with BIOL 3000 that allows you to apply what we cover in class. Therefore, the next best option is to give you opportunities to be better prepared for class and to regularly self-assess your familiarity with the topics we're covering *before* you're tested on your understanding on each of the four exams. There are two incentives for you to take advantage of the online homework exercises. First, the online homework constitutes 15% of your final course grade. That alone can make the difference in a letter grade. Second, by doing these exercises, you will be better able to assess your comprehension of the assigned reading and adjust your approaches to learning the material in such a way that you'll perform better on the four exams *and* remember the material after the course is over. In addition to the homework, the graduate TA, Rich Smindak, will also post weekly practice questions that address aspects of the topics covered in class. These will complement the online homework assignments, but will not be graded. They afford additional opportunities for "hands on" problem solving and will provide the basis for the Weds. evening discussion sessions. Take advantage of all of these opportunities and you should be well prepared for the exams.

The online homework assignments will typically consist of 4-8 multiple choice questions that will allow you to "preview" material that will be covered in the upcoming class and "review" material presented in the previous class. "Preview" questions will be more general and focus on the most important concepts to be covered in the upcoming class so you'll be familiar with them beforehand. "Review" questions will be more specific and allow you to assess your comprehension of topics covered in the immediately preceding class. Both types of questions will cover material presented on the slides, the MCB7E text, and any additional assigned reading. For example the homework posted on a Monday afternoon will contain "review" questions addressing topics covered in that morning's lecture and "preview" questions for topics to be covered in class Weds. You'll receive an email from Collab letting you know when a new homework assignment has been posted. You'll have a maximum of one hour to complete the homework assignment once you log on to the "Tests & Quizzes" page on Collab. Homework is due at 8 AM each class day (e.g., Mon. homework is due 8 AM Weds.; Weds. homework is due 8 AM Weds. & Fri. homework is due 8 AM Mon.). Answers will be posted at that time. There will be

no homework assignments due on the Weds. exam days. Homework assignments are open book, open note format. Refer to the pertinent material, including the pptx slides, in order to complete the assignments. However, *homework must be completed and submitted individually*. You're certainly welcome and encouraged to discuss the questions and answers with your peers *after they have been submitted*, in order to study and prepare for the exams. Again, I cannot overemphasize that you are required to complete the homework on collab *individually* and not work with other students while you are doing these graded assignments. Why? Learning is indeed collaborative, but assessment is necessarily individualistic.

## Weekly Discussion Sessions

Weds. 7–9 PM GIL 130 *beginning Sept. 3*. Attendance is optional, but highly encouraged. Rich will review material from the lectures, go over practice exam questions homework assignments, answer specific questions you have, and present complementary material on experimental approaches and current research problems in the topics we'll cover in class.

## Exam Schedule

Exams 1, 2, 3; Weds. Sept. 17, Oct. 15, Nov. 12, 7–9 PM GIL 130; Exam 4 will be during the scheduled final exam period; Tues. Dec. 16 2–5 PM GIL 130. An open "question/answer" review session will be held instead of class on exam days. The 4<sup>th</sup> exam review session will be held at 9 AM, Thurs., Dec. 11 in GIL 130. By enrolling in this course you are making a commitment to take the four exams as scheduled! Attendance at all 4 exams is *mandatory* and you *must* be present at the *beginning* of each exam. Alternative exam arrangements will only be given for extenuating circumstances such as a debilitating illness, or for students participating in UVA-sponsored activities or courses such as concerts or athletic events. Students participating in the LNEC need to contact me as early in the semester as possible to accommodate your situation. As per College regulations, the 4<sup>th</sup> exam date and time cannot be rescheduled for *any* reason.

## Evaluation and Grading

Your learning will be assessed by:

- Online homework assignments. 15% of course grade.
- 4 multiple-choice format "scantron" exams as follows:
  - Exam 1: 100 points (50 questions). 20% of course grade. This exam will cover: *Cellular Origins and "Problems of Being Eukaryotic", Plasma Membrane Structure and Properties, Transport of Small Molecules and Ions*.
  - Exam 2: 100 points (50 questions). 20% of course grade. This exam will cover: *Protein Trafficking, Receptor-Mediated Endocytosis, Autophagy*.
  - Exam 3: 100 points (50 questions). 20% of course grade. This exam will cover: *Cytoskeleton, Cell Signaling*.
  - Exam 4: 125 points (63 questions). 25% of course grade. This exam will cover: *Cell Cycle Dynamics and Regulation, Mitosis, Cancer*.

Course letter grades are based on cumulative % out of 500 total points as follows: A = 90–100% B = 80–89% C = 70–79% D = 60–69% F = <60%. *Letter grades are guaranteed for each percentile bracket. These may be slightly expanded* to reflect score distributions, but will *not* be curved to reflect the mean. "+" and "-" will be based on the distribution of numerical scores within each letter grade bracket and will not be determined until the course is completed. The mean cumulative percentile score for fall, 2013 (N = 310) was 80.7% = B–

## Class Attendance and Etiquette

Regular attendance is strongly recommended and encouraged. Information not necessarily provided on the posted slides will be presented in class. In-class discussions will include new and relevant research findings that are not in the textbook. *I ask that you please arrive on time and remain the entire 50 minutes.* The digital clock in the back of GIL 130 is the official “time keeper” for the course. If you must leave early, then please sit in the back of the auditorium so your early departure is not a distraction. **Cell phones should be turned off!** Out of consideration to your fellow students and me, please don’t twitter, text, facebook, surf the web, or engage in distractive conversations in class. You may not think so, but these irrelevant activities do indeed distract your peers and me and I will call out individuals who do this. Most importantly, these behaviors distract *you!* Think not? Check out this short video by UVa Psychology Professor Dan Willingham who demonstrates that “multitasking is wishful thinking.”

<http://www.youtube.com/watch?v=34OZ-dsNkBW> In summary, I hope you will be sufficiently engaged in class to want to come, but if not, please do not attend.

## Recording Policy and Prohibition of Posting Course Materials on 3<sup>rd</sup> Party Websites

UVa policy restricts the recording of class lectures and prohibits posting of course notes and materials on 3<sup>rd</sup> party websites. In brief, *you may make audio recordings of lectures solely for personal use without my written permission. Video or digital recording of lectures and/or discussions, and/or video or digitally recording/photographing slides presented in class is not allowed under any circumstances.* Students cannot post audio or video recordings of classes or discussions, lecture notes or any material that is posted on Collab, on *any* internet site. Many of the resources provided in BIOL 3000 are copyright protected. Fair Use laws allow you to use this material in the context of this course, but prohibit its unlimited copying and distribution. Violation of this policy may result in disciplinary action by the University Judiciary Committee.

## Honor Statement

I trust every student in this course to fully comply with all of the provisions of the UVa honor system. In addition to pledging that you have neither received nor given aid while completing graded homework assignments and exams, your signature also affirms that you have not accessed any notes, study outlines, problem sets, old exams, answer keys, or the textbook while taking an exam and that you have not obtained any answers from another student’s exam. Using a cell phone for any reason during an exam will be considered an honor offense. All alleged honor violations brought to my attention, will be forwarded to the Honor Committee. If, in my judgment, it is beyond a reasonable doubt that a student has committed an honor violation with regard to a given exam or graded assignment, that student will receive an immediate and irrevocable grade of 'F' (0%) for that exam or assignment, irrespective of any subsequent action taken by the Honor Committee.

## Tips to Succeed in Cell Biology

- *MCB7E and Collab are valuable resources* that provide an excellent foundation for the topics we will discuss in class and will enable you to self-assess your understanding. I encourage you to first skim through the assigned reading pertinent to each class. Use the slides and reading assignments to “navigate” through the text. The topics we cover will be organized in a biological progression, and not necessarily in the order they are presented in the book. The online

homework that will be posted before nearly every class, will enable you to assess your understanding of the topics both before and after we address them in detail.

- *Understand, don't just memorize.* Details do matter, but always keep the big picture in sight. Think of the biological context of the particular cellular process or component under discussion. Understanding *why* something occurs often makes it easier to appreciate *how* it happens. There's no escaping the fact that cells *are* complicated. That said there *are* some things that you just have to memorize. For starters, the single-letter abbreviations for the amino acids and the functionalities of their R groups. (e.g., D and E are both acidic; K and R are both basic; S, T and Y have "free" –OH groups; I, L, V, M are hydrophobic; Y, F, W are aromatic; etc). You'll have to memorize these structures for Biochemistry anyway so might as well get started on them now.
- *Think like an experimental cell biologist.* Ask; "What would happen if I did this?" "What caused this particular result?" That's how cell biology is really done. Real people do real experiments, interpret them and posit models and mechanisms to explain complex cellular events. This empirical process is continuous and always evolving. New experiments uncover new "players" and unforeseen connections. Invariably, everything turns out to be more complicated than our current level of understanding indicates.
- *Learn the language.* Cell biology has a lot of jargon and some obtuse terminology. In this regard, you have to become fluent in a foreign language. Names, terms, and definitions, matter. A kinase is not a G protein; a phosphatase is not a phosphodiesterase. Rab, Rac, Raf, Ras and Rho are unique proteins with distinct, critical functions. *Use the glossary* if you encounter a word you don't understand.
- *Be engaged in class and feel free to ask questions.* If you do the assigned reading and the homework, you'll have a good idea about what we're going to discuss. Don't try to write down everything I say. Note-taking is a lost art. Don't re-write the text. Bring your iClicker to class as there will typically be a few iClicker questions in each class and these questions will also give you an idea of how to study for the exams. *Ask questions in class!* The **only** question I don't allow is "Do we need to know this for the exam?"
- *Come to office hours and ask questions in person.* Science is a human endeavor. So is learning and this is the best opportunity for us to get to know each other. Please don't text or email your questions. Why? I have no way of knowing if you understand what I'm telling you and you do not have the opportunity to immediately ask a follow-up question. *Get to know your professors in all of your classes.*
- *Do the homework problems and attend the weekly discussion sessions.* The questions are very similar to the ones you will see on the exams as they are in fact previous years' questions. Use them to provide a context to organize your notes. Rich will use iClickers to go through practice questions every week. Take advantage of them and you will be prepared for the exams.

## BIOL 3000 – FALL 2014 – \*TENTATIVE CLASS SCHEDULE

### *Unit 1 Cellular Origins and the Problems of Being Eukaryotic*

<u>Class #</u>	<u>Date</u>	<u>Day</u>	<u>Subject – MCB7E Chapters</u>
1	8/27	W	Cellular Origins, Prokaryotes vs Eukaryotes (L1, L13)
2	8/29	F	Multicellularity: Eukaryotic Complexity: Model Organisms (L1, L13)

### *Unit 2 Plasma Membrane Structures and Properties*

3	9/1	M	The Plasma Membrane: Lipids (L2, L10)
4	9/3	W	Lipids: Integral Membrane Proteins (L3, L10)
5	9/5	F	Integral Membrane Proteins (L3, L10); Overview of Transport (L11)

### *Unit 3 Transport of Small Molecules and Ions*

6	9/8	M	Glucose and Ion Transport (L11)
7	9/10	W	Ion Channels and Na <sup>+</sup> /K <sup>+</sup> ATPase (L11)
8	9/12	F	Glucose Transcytosis (L11)

### *Unit 4 Protein Trafficking*

9	9/15	M	Protein Localization: Experimental Approaches (L3, L9)
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**EXAM 1**    **9/17**    **W**    **7–9 PM (Units 1-3)**    **Review 9 AM**

### *Unit 4 Protein Trafficking cont'd*

10	9/19	F	Protein Localization: Experimental Approaches (L3, L5, L9)
11	9/22	M	The Secretory Pathway: Insertion of Proteins into the ER (L13)
12	9/24	W	Integral Membrane Protein Topology; Protein folding (L13)
13	9/26	F	Protein Folding in the ER: CFTR and Mdr1 (L13)
14	9/29	M	The Secretory Pathway: ER resident proteins and glycosylation (L13)
15	10/1	W	Secretion: Vesicle Trafficking, Lysosomal Targeting (L14)
16	10/3	F	Lysosomal Targeting (L14)

### *Unit 5 Receptor-Mediated Endocytosis and Autophagy*

17	10/6	M	Receptor-Mediated Endocytosis: LDL Receptor (L10, L14)
18	10/8	W	RME: LDL Receptor: Autophagy (L10, L14)

### *Unit 6 Cytoskeleton*

19	10/10	F	Cytoskeleton Overview: Microfilament Structure/Dynamics (L17)
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**NO CLASS**    **10/13**    **M**    **FALL READING DAY**

**EXAM 2**    **10/15**    **W**    **7–9 PM (Units 4 and 5)**    **Review 9 AM**

20	10/17	F	Microfilaments and Cell Morphology: Microtubules (L17)
21	10/20	M	Microtubule Structure and Dynamics (L18)
22	10/22	W	Microtubule Motor Proteins (L18)

### *Unit 7 Cell Signaling*

23	10/24	F	Cell Signaling: Overview, G-Protein Coupled Receptors (L3, L15)
24	10/27	M	Cell Signaling: G-Protein Coupled Receptor Pathway (L15)
25	10/29	W	Cell Signaling: G-Protein Coupled Receptor Pathway (L15)
26	10/31	F	Cell Signaling: G-Protein Coupled Receptor Pathway (L15)

### *Unit 8 Cell Cycle Dynamics and Regulation, Mitosis*

27	11/3	M	The Cell Cycle: Regulating Cyclins and CDKs (L19)
28	11/5	W	The Cell Cycle: Regulating Cyclins and CDKs (L19)
29	11/7	F	Mitosis: Making and Breaking the Spindle (L18, 19)
30	11/10	M	Mitosis: Making and Breaking the Spindle (L18, 19)

**EXAM 3**    **11/12**    **W**    **7–9 PM (Units 6 and 7)**    **Review 9 AM**

31	11/14	F	Mitosis: Chromosome Segregation (L18, 19)
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### Unit 9 Cancer

32	11/17	M	Receptor Tyrosine Kinase Signaling and Cell Proliferation (L16, L19)
33	11/19	W	Receptor Tyrosine Kinase Signaling and Cancer Connection (L24)
34	11/21	F	The Genetic Basis of Cancer (L24)
35	11/24	M	The Genetic Basis of Cancer (L24)
<b>NO CLASS</b>	<b>11/26</b>	<b>W</b>	<b>THANKSGIVING BREAK</b>
<b>NO CLASS</b>	<b>11/28</b>	<b>F</b>	<b>THANKSGIVING BREAK</b>
36	12/1	M	Cancer and p53 Tumor Suppressor Function (L24)
37	12/3	W	The Transformed Phenotype and Tumor Progression (L24)
38	12/5	F	Hallmarks of Cancer (L24)
<b>EXAM 4 rev.</b>	<b>12/11</b>	<b>Thurs.</b>	<b>Review 9 AM</b>
<b>EXAM 4</b>	<b>12/16</b>	<b>Tues.</b>	<b>2–5 PM (Units 8 and 9)</b>

- The class schedule is tentative in that I may begin a new topic during the preceding class, or continue discussing a given topic into the next class. The MCB7E Chapters (e.g., L24) indicate the specific chapter(s) where the pertinent reading assignments will be found. You do *not* need to read the entire chapter(s) indicated for each class. Specific reading assignments will be posted before we start the corresponding topic. I may also change some topics covered throughout the course and these changes will be announced in advance.

- **Important College Dates**

- Add Deadline: Tues. Sept. 9
- Drop Deadline: Weds. Sept. 10
- Fall Reading Day: Mon. Oct. 13 (No class)
- Withdrawal Deadline: Tues. Oct. 21
- Thanksgiving Break: Weds. Nov. 26 and Fri. Nov. 28 (No class)