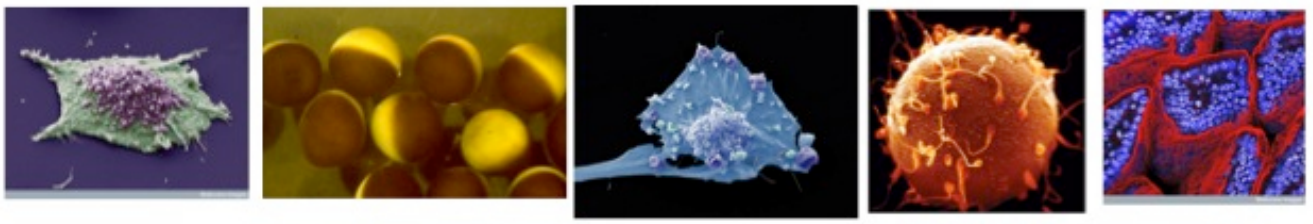

CELL BIOLOGY – BIOL 3000 – FALL 2013 (rev. 8/12/13)

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 this course 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/Review Sessions and Exams 1–3: 7:00–9:00 PM Wednesdays, GIL130.
Exam 1, 9/18; Exam 2, 10/16; Exam 3, 11/13; Exam 4, Mon. 12/16, 2-5 PM, GIL130

Instructor Information

Mike Wormington, Associate Professor and Associate Chair of Biology. I was born in Kansas City, Missouri, and attended the University of Kansas (Go Jayhawks!) where I earned a BA with Honors in Biology and a 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 and more recently the mechanisms that drive neuronal cell cycle re-entry in Alzheimer's Disease. 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.

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Office Hours: 2:00-4:30 PM Tues. and Thurs. PLSB 206 or PLSB 200 and by appt.

Graduate Teaching Assistant

Richard Smindak Office: PLSB 238 Phone: 924-3943 email: rjs6dg@virginia.edu
Office hours: 11:00 AM –12:30 PM Tues. and 4:00-5:30 PM Weds. PLSB 330

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 text provide an excellent review of pertinent topics covered in BIOL 2010 and general chemistry and should be referred to as necessary throughout the entire course.

Required Text and Online Learning Program

The required textbook is: *Molecular Cell Biol., 7th ed., Lodish et al.* (MCB7E). The associated online learning resource is the *BioPortal Online for Molecular Cell Biology Seventh Edition*. The *BioPortal* provides many learning tools, including pre-class "warm-up"exercises, weekly "*Learning Curve"* homework problems and additional optional practice problems. The *BioPortal* Access Card includes the interactive ebook version of MCB7E that you can access from any computer, iPad or tablet. This is the least expensive textbook option for the course and eliminates the need for a separate hardcover text. However, if you want to have a hardcover text, you'll need to "bundle" that purchase (new or used) with the *BioPortal* Access card. Do not use an earlier edition of MCB.

Collab Homepage

The course collab website 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 ahead of time. 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 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 one of the sources of

"warm up" and *Learning Curve* homework questions to be reviewed at the weekly discussion session.

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. Although I want you to register your iClicker on the collab website, your responses will not contribute to your course grade. As the semester progresses, I will also start incorporating the new *Learning Catalytics* web-based system which is more versatile than iClickers and can be accessed from any wifi-enabled device, including smartphones, laptops, tablets and iPads. I'll provide information on how to register on the free *Learning Catalytics* website when we get closer to using it in class.

Weekly Discussion Sessions

Weds. 7–9 PM GIL 130 *beginning Weds 9/4*. Attendance is optional, but highly encouraged. Rich will review material from the lectures, go over practice exam questions, answer specific questions you have, and present complementary material on experimental approaches and current research problems in the topics we'll cover in class.

Important College Dates

Add Deadline:	Tues. Sept. 10
Drop Deadline:	Weds. Sept. 11
Fall Reading Day:	Mon. Oct. 14 (No class)
Withdraw Deadline:	Tues. Oct. 22
Thanksgiving Break:	Weds. Nov. 27 and Fri. Nov. 29 (No class)

Exam Schedule

Exams 1, 2, 3; Weds. 9/18, 10/16, 11/13, 7–9 PM GIL 130; Exam 4 will be during the scheduled final exam period; Mon. 12/16 2–5 PM GIL 130. An open "question/answer" review session will be held instead of class on exam days. The 4th exam review session will be held at 9 AM, Thurs., 12/12 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, athletic events, or NUIP 4004. *Weds. evening exams will not be rescheduled to accommodate conflicts with Kaplan MCAT prep courses.* The 4th exam date and time cannot be rescheduled for any reason.

Tips to Succeed in Cell Biology

• *MCB7E and the BioPortal 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 "bio"-logical progression, and not necessarily in the order they are presented in the book. The online "warm up" exercises that will be posted before nearly every class, will enable you to assess your initial understanding of the topics before we address them in detail. Go back after each class and

re-read the assigned material to clear up any questions you may still have. The online *Learning Curve* homework assignments will particularly help you self-assess your understanding of the topics throughout the course.

• *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., DandE are both acidic; KandR are both basic; S, T and Y have "free" –OH groups; ILVM 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 happened to give 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, things will always prove 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 "warm up" exercises, 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 several iClicker questions in each class and these questions will 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 Learning Curve questions and attend the weekly discussion sessions.* The questions are *very* similar to the ones you will see on the exams. 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. If you work through the practice and *Learning Curve* questions you will be prepared for the exams.

Evaluation and Grading

Your learning will be assessed by:

- Online "warm up" exercises based on pre-class reading assignments. 10% of course grade.

- Weekly *BioPortal Learning Curve* online homework assignments. 10% of course grade.
- 4 multiple-choice format exams as follows:
    - Exam 1: 80 points (40 questions). 16% 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: 120 points (60 questions). 24% of course grade. This exam will cover: *Cell Cycle Dynamics and Regulation, Mitosis, Cancer.*

The exam format works to your advantage for two reasons: First, as the 1st exam comprises only 16% of your course grade, improvement on subsequent exams has a disproportionately positive impact on your final grade. Second, since you have an extra hour to complete the 4th exam, it's easier to incorporate more questions into the last exam than to include additional questions on either the 2nd or 3rd exams. Although the 4th exam will not be comprehensive, and will not re-examine individual topics covered on the 3 previous exams, it is *integrative*, and you will incorporate your understanding of concepts and mechanisms covered throughout the entire course in the context of cancer. You cannot drop or replace your lowest score by taking a make-up exam. 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, 2012 (N = 250) was 76% = C+

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 included in the textbook. *I ask that you please arrive on time and remain the entire 50 minutes.* 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, or surf the web in class. You may not think so, but these irrelevant activities do indeed distract your peers and me. Most importantly, they 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 3rd Party Websites

UVa policy restricts the recording of class lectures and prohibits posting of course notes and materials on 3rd party websites. This policy is posted on the collab homepage. 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 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 for your use in BIOL 3000 are

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 "warm up" exercises, 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 and dealt with as such. I encourage you to direct any questions or concerns you may have about the Honor System or reporting alleged honor violations, to Sara Weintraub (sew5ft), who is a support officer in the Educator pool for the Honor System. 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.

BIOL 3000 – FALL 2013 – *TENTATIVE CLASS SCHEDULE

Unit 1 Cellular Origins and the Problems of Being Eukaryotic

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
1	8/28	W	Cellular Origins, Prokaryotes vs Eukaryotes (L1, L13)
2	8/30	F	Multicellularity: Eukaryotic Complexity: Model Organisms (L1, L13)

Unit 2 Plasma Membrane Structures and Properties

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
3	9/2	M	The Plasma Membrane: Lipids (L2, L10)
4	9/4	W	Lipids: Integral Membrane Proteins (L3, L10)
5	9/6	F	Integral Membrane Proteins (L3, L10); Overview of Transport (L11)

Unit 3 Transport of Small Molecules and Ions

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
6	9/9	M	Glucose and Ion Transport (L11)
7	9/11	W	Ion Channels and Na^+/K^+ ATPase (L11)
8	9/13	F	Glucose Transcytosis (L11)

Unit 4 Protein Trafficking

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
9	9/16	M	Protein Localization: Experimental Approaches (L3, L9)
EXAM 1	**9/18**	**W**	**7–9 PM (Units 1-3) Review 9 AM**

Unit 4 Protein Trafficking

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
10	9/20	F	Protein Localization: Experimental Approaches (L3, L5, L9)
11	9/23	M	The Secretory Pathway: Insertion of Proteins into the ER (L13)
12	9/25	W	Integral Membrane Protein Topology; Protein folding (L13)
13	9/27	F	Protein Folding in the ER: CFTR and Mdr1 (L13)
14	9/30	M	The Secretory Pathway: ER resident proteins and glycosylation (L13)
15	10/2	W	Secretion: Vesicle Trafficking, Lysosomal Targeting (L14)
16	10/4	F	Lysosomal Targeting (L14)

Unit 5 Receptor-Mediated Endocytosis and Autophagy

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
17	10/7	M	Receptor-Mediated Endocytosis: LDL Receptor (L10, L14)
18	10/9	W	RME: LDL Receptor: Autophagy (L10, L14)
19	10/11	F	Cytoskeleton Overview: Microfilament Structure and Dynamics (L17)
NO CLASS	**10/14**	**M**	**FALL READING DAY**
EXAM 2	**10/16**	**W**	**7–9 PM (Units 4 and 5)** **Review 9 AM**

Unit 6 Cytoskeleton

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
20	10/18	F	Microfilaments and Cell Morphology: Microtubules (L17)
21	10/21	M	Microtubule Structure and Dynamics (L18)
22	10/23	W	Microtubule Motor Proteins (L18)

Unit 7 Cell Signaling

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
23	10/25	F	Cell Signaling: Overview, G-Protein Coupled Receptors (L3, L15)
24	10/28	M	Cell Signaling: G-Protein Coupled Receptor Pathway (L15)
25	10/30	W	Cell Signaling: G-Protein Coupled Receptor Pathway (L15)
26	11/1	F	Cell Signaling: G-Protein Coupled Receptor Pathway (L15)

Unit 8 Cell Cycle Dynamics and Regulation, Mitosis

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
27	11/4	M	The Cell Cycle: Regulating Cyclins and CDKs (L19)
28	11/6	W	The Cell Cycle: Regulating Cyclins and CDKs (L19)
29	11/8	F	Mitosis: Making and Breaking the Spindle (L18, 19)
30	11/11	M	Mitosis: Making and Breaking the Spindle (L18, 19)
EXAM 3	**11/13**	**W**	**7–9 PM (Units 6 and 7)** **Review 9 AM**
31	11/15	F	Mitosis: Chromosome Segregation (L18, 19)

Unit 9 Cancer

Class #	Date	Day	Subject – Lodish (L) 7th ed Chapters
32	11/18	M	Receptor Tyrosine Kinase Signaling and Cell Proliferation (L16, L19)
33	11/20	W	Receptor Tyrosine Kinase Signaling and Cancer Connection (L24)
34	11/22	F	The Genetic Basis of Cancer (L24)
35	11/25	M	The Genetic Basis of Cancer (L24)
NO CLASS	**11/27**	**W**	**THANKSGIVING BREAK**
NO CLASS	**11/29**	**F**	**THANKSGIVING BREAK**
36	12/2	M	Cancer and p53 Tumor Suppressor Function (L24)
37	12/4	W	The Transformed Phenotype and Tumor Progression (L24)
38	12/6	F	Hallmarks of Cancer (L24)
EXAM 4 rev.	**12/12**	**Thurs.**	**Review 9 AM**
EXAM 4	**12/16**	**Mon.**	**2–5 PM (Units 8 and 9)**

* 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 Lodish Chapters indicate where the pertinent reading assignments will be found in MCB7E. 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.