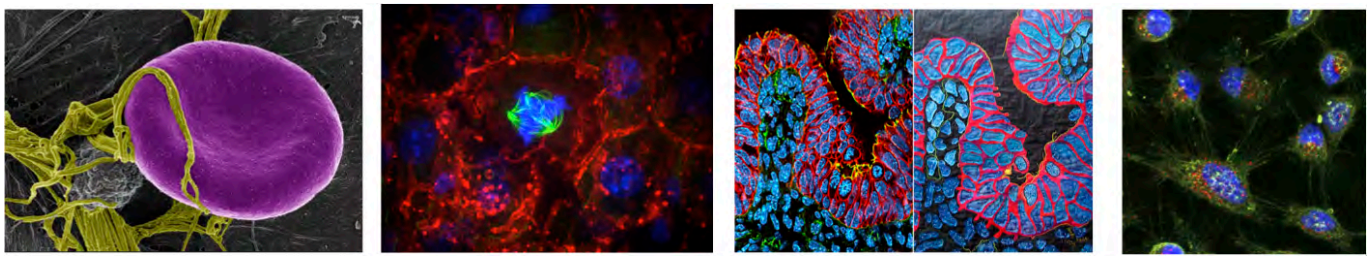


CELL BIOLOGY – BIOL 3000 – SPRING 2016 (Updated 01/20/16)

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 cancer cells continuously evolve? 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.

Meeting Times and Location – NOTE CHANGE BELOW

NEW Class: 9:00–9:50 AM MWF **Gilmer 130**
Discussion Sessions and Exams 1–3**:** Feb.10, Mar. 16, Apr. 6 7:00–9:00 PM Weds., **Gilmer 130.**
Exam 4, Fri. May 6, 2:00-5:00 PM **Gilmer 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 during oogenesis and embryogenesis and the interplay between genetic and metabolic reprogramming. 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 and our three year old granddaughter Sophie keep us busy. 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
Group Office Hours in PLSB 200: 2–4 PM Tues. and Thurs. Individual meetings by appointment.

Graduate Teaching Assistant

Chhavi Sood email: cs7wj@virginia.edu
NOTE CHANGE Office hours in PLSB 200 1–3 PM Mon. **and 1-3 PM Fri.,** and by appointment.

Prerequisites

BIOL 2010 or 2100 (or AP) or BME 2014 , and any two of CHEM 1410, 1420, 1610, 1620, 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 2010/2100 and general chemistry, and should be referred to as necessary throughout the entire course.

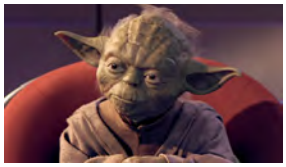
Required Text

The required textbook is *Molecular Cell Biol., 7th 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.

BIOL 3000 Collab Website

The BIOL 3000 Collab Course site is an important resource that you will 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 (the "big questions") 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 are the main sources of homework questions.

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



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 understanding of the topics we're covering *before* you're tested on your knowledge 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 able to assess your understanding of the topics presented in class and adjust your approaches to learning the material in such a way that you'll perform better on the exams *and* remember the material after the course is over.

Each online homework assignment will consist of 5 multiple choice questions that will allow you to assess your understanding of the topics covered in the preceding class. Occasionally there will be a "warm up" question or two addressing a topic to be covered in the next class. For the fall 2015 semester, there were a total of 190 homework questions, including 5 bonus points, that was converted to a final total of 75 points. The homework assignments are open book, open note format. Refer to the pertinent material, including the pptx slides, in order to complete each assignment. The questions will variously cover material presented in lectures, the MCB7E text, and any additional assigned reading. You'll automatically receive an email from Collab when each homework assignment has been posted. Each homework assignment is due 8 AM the following class day (e.g., Mon. homework is due 8 AM Weds. Weds. homework is due 8 AM Fri. & Fri. homework is due 8 AM Mon.). You can log on and off Collab multiple times to complete the homework, (i.e. there's no time limit to complete the assignment) but you can only submit your answers once. Partially completed assignments will be automatically submitted at 8AM. Missed homework assignments cannot be made up. Answer keys and correct answer feedback will be posted at 8:05 AM each due date. There will be no homework assignments due on exam days.

NOTE *Homework must be completed and submitted individually. You cannot access previous year's exams while completing the homework assignments. By enrolling in this course, you are affirming on your honor that you have neither received nor given aid while completing the homework assignments. Referring to previous year's exams or working collaboratively to complete homework assignments constitutes receiving aid.* You're certainly welcome and encouraged to discuss the questions and answers and study collaboratively with your classmates *after the submission deadline,* in order to prepare for the exams, but you are required to complete the homework assignments *individually* and not work with other students while you are doing them. Learning is indeed collaborative, but assessment is necessarily individualistic.

Weds. Evening Discussion Sessions

Weds. 7–9 PM **GIL 130** *beginning Jan 27*. Attendance is optional, but highly encouraged. Chhavi will review and clarify topics presented in class, covered on homework assignments and recap the "Big Questions" provided on the assigned reading associated with each unit. She will also answer any specific questions you have.

Exam Schedule Exams 1, 2, 3; Weds. Feb. 10, Mar. 16, Apr. 6, 7–9 PM **GIL 130**; Exam 4 will be held during the scheduled final exam period; Fri. May 6 2–5 PM **GIL 130**. An open "question/answer" review session will be held instead of class on each of the 3 Weds. exam dates. 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. Students arriving more than 10' late will not be allowed to take the exam. Alternative exam arrangements will only be given for extenuating circumstances such as a debilitating illness, or for students participating in official UVA-sponsored activities such as concerts or athletic events. Students participating in the SDAC should contact me as early in the semester as possible to accommodate your situation. Per College regulations, the 4th exam date and time cannot be rescheduled for *any* reason.

Evaluation and Grading

Your learning will be assessed by:

- Online homework assignments. **75 points total. 15% of course grade**
- 4 multiple-choice format 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 and Receptor-Mediated Endocytosis*
    - Exam 3: **100 points (50 questions). 20% of course grade.**
      This exam will cover: *Cytoskeleton and Cell Signaling.*
    - Exam 4: **125 points (63 questions). 25% of course grade.** This exam will cover: *Cell Cycle Dynamics and Regulation, Mitosis, and 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. This means that a final cumulative percentile score of 90% guarantees that you will receive at least an A-; 80% guarantees that you will receive at least a B-. It doesn't mean that 89% couldn't be an A or A-, but it just isn't guaranteed! These letter grade brackets **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 scores within each letter grade bracket and will not be determined until the course is completed. The mean cumulative percentile score for fall, 2015 (N = 317) was 79% = B.

Class Attendance and Etiquette

Regular attendance is strongly recommended and encouraged. Information not necessarily provided on the posted slides or found in the textbook will be presented in class. *I ask that you please arrive on time and remain the entire 50 minutes.* The clock in 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 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 Online

UVa policy restricts the recording of class lectures and prohibits posting of course notes and materials on 3rd party websites. Y*ou 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, during discussion sessions or office hour meetings, is not allowed under any circumstances.* Students cannot post audio or video recordings or images obtained in classes or discussions or 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 copying and distribution to anyone not enrolled in BIOL 3000. 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. *By enrolling in this course, you are affirming that you have neither received nor given aid while completing homework assignments and exams. This explicitly means that you cannot access previous years' exams or collaborate with other students when completing the online homework assignments. Your pledge on the exams 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. Remember, it is *your* responsibility to uphold the honor system. If you believe that an honor offense has been committed, *you* have an obligation to report it to an honor advisor irrespective if I am aware of it or not and you can do this without bringing it to my attention. I can only initiate an honor case if I personally observe an honor offense. If, in my judgment, it is beyond a reasonable doubt that a student has committed an honor offense with regard to a graded exam or homework 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. I encourage you to first skim through the assigned reading pertinent to each class before it meets. 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 will enable you to assess your understanding of the topics before the exams. The questions are *very* similar to the ones you will see on exams, as they are in fact previous years' exam questions. Use them to provide a context to organize your notes.

• *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; 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 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. In reality, everything turns out to be even 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. *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 the Weds. evening discussion sessions 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 email me 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. Please do not ask me to repeat an entire lecture during office hours. I expect you to have put some thought into the topics under consideration so we can address specific concepts or mechanisms that are challenging to understand. G*et to know your your professors.*

BIOL 3000 – SPRING 2016 – *TENTATIVE CLASS SCHEDULE

Unit 1 Cellular Origins and the Problems of Being Eukaryotic

Class #	Date	Day	Subject
1	1/20	W	Cellular Origins, Prokaryotes vs Eukaryotes
2	1/22	F	Multicellularity: Eukaryotic Complexity: Model Organisms
Unit 2 Plasma Membrane Structures and Properties			
3	1/25	M	The Plasma Membrane: Lipids
4	1/27	W	Lipids: Integral Membrane Proteins
5	1/29	F	Integral Membrane Proteins, Overview of Transport
Unit 3 Transport of Small Molecules and Ions			
6	2/1	M	Glucose and Ion Transport
7	2/3	W	Ion Channels and Na^+/K^+ ATPase
8	2/5	F	Glucose Transcytosis
Unit 4 Protein Trafficking			
9	2/8	M	Protein Localization: Experimental Approaches
EXAM 1	**2/10**	**W**	**7–9 PM (Units 1-3) Review 9 AM**
10	2/12	F	Protein Localization: Experimental Approaches
11	2/15	M	The Secretory Pathway: Insertion of Proteins into the ER

12	2/17	W	Integral Membrane Protein Topology; Protein folding
13	2/19	F	Protein Folding in the ER: CFTR and Cystic Fibrosis
14	2/22	M	The Secretory Pathway: ER resident proteins and glycosylation
15	2/24	W	Secretion: Vesicle Trafficking, Lysosomal Targeting
16	2/26	F	Lysosomal Targeting
Unit 5 Receptor-Mediated Endocytosis			
17	2/29	M	LDL Receptor-Mediated Endocytosis: Coronaries & Cholesterol.
18	3/2	W	LDL Receptor-Mediated Endocytosis: Coronaries & Cholesterol.
Unit 6 Cytoskeleton			
19	3/4	F	Cytoskeleton Overview: Microfilament Structure/Dynamics
NO CLASS	**3/7**	**M**	**SPRING BREAK**
NO CLASS	**3/9**	**W**	**SPRING BREAK**
NO CLASS	**3/11**	**F**	**SPRING BREAK**
20	3/14	M	Microfilaments and Cell Morphology: Microtubules
EXAM 2	**3/16**	**W**	**7–9 PM (Units 4 and 5) Review 9 AM**
21	3/18	F	Microtubule Structure and Dynamics
22	3/21	M	Microtubule Motor Proteins
Unit 7 Cell Signaling			
23	3/23	W	Cell Signaling: Overview, G-Protein Coupled Receptors
24	3/25	F	Cell Signaling: G-Protein Coupled Receptor Pathway
25	3/28	M	Cell Signaling: G-Protein Coupled Receptor Pathway
26	3/30	W	Cell Signaling: G-Protein Coupled Receptor Pathway
Unit 8 Cell Cycle Dynamics and Regulation, Mitosis			
27	4/1	F	The Cell Cycle: Regulating Cyclins and CDKs
28	4/4	M	The Cell Cycle: Regulating Cyclins and CDKs
EXAM 3	**4/6**	**W**	**7–9 PM (Units 6 and 7) Review 9 AM**
29	4/8	F	Mitosis: Making and Breaking the Spindle
30	4/11	M	Mitosis: Making and Breaking the Spindle
31	4/13	W	Mitosis: Chromosome Segregation
Unit 9 Cancer			
32	4/15	F	Receptor Tyrosine Kinase Signaling and Cell Proliferation
33	4/18	M	Receptor Tyrosine Kinase Signaling and Cancer Connection
34	4/20	W	The Genetic Basis of Cancer
35	4/22	F	The Genetic Basis of Cancer
36	4/25	M	Cancer and p53 Tumor Suppressor Function
37	4/27	W	The Transformed Phenotype and Tumor Progression
38	4/29	F	Hallmarks of Cancer
39	5/2	M	Hallmarks of Cancer
EXAM 4	**5/6**	**Fri.**	**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. I may also change some topics covered throughout the course and these changes will be announced in advance.

Important College Dates

- Add Deadline: Weds. Feb. 3
- Drop Deadline: Thurs. Feb. 4
- Spring Break: Mon. Mar. 7, Weds. Mar. 9 and Fri. Mar. 11 (No class)
- Withdrawal Deadline: Weds. Mar. 16