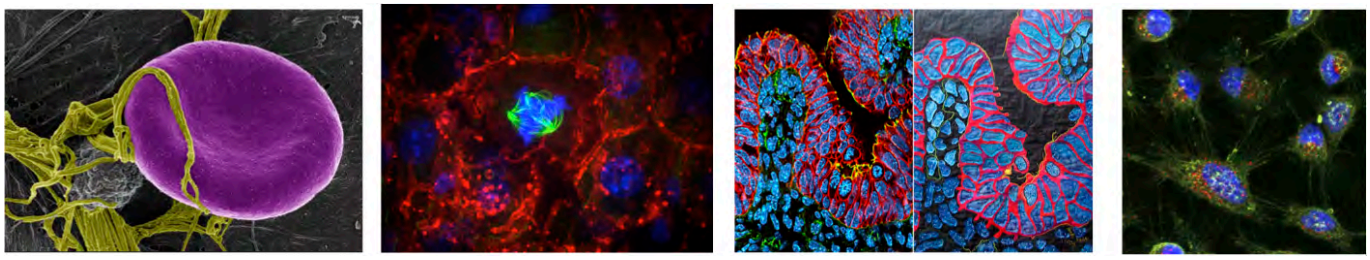

CELL BIOLOGY – BIOL 3000 – FALL 2015 (updated 8/24/15)

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 UPDATED 8/24/15

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. 16, Exam 2, Oct. 14, Exam 3, Nov. 11 Exam 4, Tues. Dec. 15, 2:00-5:00 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 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 live in North Carolina and our three year old granddaughter Sophie keeps 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
Office Hours in PLSB 200: 2–4 PM Tues., and 2–4 PM Thurs., and by appt.

Graduate Teaching Assistant **UPDATED 8/24/15**

Yunlu Zhu Office: PLSB 334 Phone: 242-7311 email: yz4dn@virginia.edu
Office hours in PLSB 200 1–3 PM Mon. & Weds., 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., 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 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.

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 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 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.

The online homework assignments will typically consist of 5 multiple choice questions that will allow you to assess your understanding of the topics covered in the preceding class. The questions are primarily derived from previous year's exams. The questions will variously cover material presented on the slides, the MCB7E text, and any additional assigned reading. You'll receive an email from Collab letting you know when a new homework assignment has been posted. There is no time limit to complete the homework once you log on to Collab, before the submission deadline of 8 AM each 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, but you can only submit your answers once. Partially completed assignments will be automatically submitted at 8AM on each due date. Answers will be posted at that time. There will be no homework assignments due on 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. By enrolling in this course, you are affirming on your honor that you have neither received nor given aid while completing the homework assignments.* You're certainly welcome and encouraged to discuss the questions and answers with your peers *after the submission deadline,* in order to study and prepare for the exams. Again, I cannot overemphasize that 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 **(UPDATED 8/24/15)**

Weds. 7–9 PM GIL 130 *beginning Sept. 2*. Attendance is optional, but highly encouraged. Yunlu 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. He will also answer any specific questions you have.

Exam Schedule Exams 1, 2, 3; Weds. Sept. 16, Oct. 14, Nov. 11, 7–9 PM GIL 130; Exam 4 will be during the scheduled final exam period; Tues. Dec. 15 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. There will be no question/answer review session before the 4th exam. 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 such as concerts or athletic events. Students participating in the SDAC need to contact me as early in the semester as possible to accommodate your situation. As 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, 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. 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 90% couldn't be an 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 numerical scores within each letter grade bracket and will not be determined until the course is completed. The mean cumulative percentile score for fall, 2014 (N = 312) was 78% = 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 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 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 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 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. If you believe than an honor violation has been committed, it is *your* responsibility to initiate an honor case irrespective if I am aware of it or not and you can do this without bringing it to my attention. If, in my judgment, it is beyond a reasonable doubt that a student has committed an honor violation with regard to a graded exam or 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 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' 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. 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. *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 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. 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. Finally, *get to know your professors in all of your classes.*

BIOL 3000 – FALL 2015 – *TENTATIVE CLASS SCHEDULE

Unit 1 Cellular Origins and the Problems of Being Eukaryotic

Class #	Date	Day	Subject
1	8/26	W	Cellular Origins, Prokaryotes vs Eukaryotes
2	8/28	F	Multicellularity: Eukaryotic Complexity: Model Organisms
Unit 2 Plasma Membrane Structures and Properties			
3	8/31	M	The Plasma Membrane: Lipids
4	9/2	W	Lipids: Integral Membrane Proteins
5	9/4	F	Integral Membrane Proteins; Overview of Transport
Unit 3 Transport of Small Molecules and Ions			
6	9/7	M	Glucose and Ion Transport
7	9/9	W	Ion Channels and Na^+/K^+ ATPase
8	9/11	F	Glucose Transcytosis
Unit 4 Protein Trafficking			
9	9/14	M	Protein Localization: Experimental Approaches
EXAM 1	**9/16**	**W**	**7–9 PM (Units 1-3) Review 9 AM**
Unit 4 Protein Trafficking cont'd			
10	9/18	F	Protein Localization: Experimental Approaches
11	9/21	M	The Secretory Pathway: Insertion of Proteins into the ER
12	9/23	W	Integral Membrane Protein Topology; Protein folding
13	9/25	F	Protein Folding in the ER: CFTR and Mdr1

14	9/28	M	The Secretory Pathway: ER resident proteins and glycosylation
15	9/30	W	Secretion: Vesicle Trafficking, Lysosomal Targeting
16	10/2	F	Lysosomal Targeting
NO CLASS	**10/5**	**M**	**FALL READING DAY**
Unit 5 Receptor-Mediated Endocytosis and Autophagy			
17	10/7	W	Receptor-Mediated Endocytosis: LDL Receptor
18	10/9	F	RME: LDL Receptor: Autophagy
Unit 6 Cytoskeleton			
19	10/12	M	Cytoskeleton Overview: Microfilament Structure/Dynamics
EXAM 2	**10/14**	**W**	**7–9 PM (Units 4 and 5) Review 9 AM**
20	10/16	F	Microfilaments and Cell Morphology: Microtubules
21	10/19	M	Microtubule Structure and Dynamics
22	10/21	W	Microtubule Motor Proteins
Unit 7 Cell Signaling			
23	10/23	F	Cell Signaling: Overview, G-Protein Coupled Receptors
24	10/26	M	Cell Signaling: G-Protein Coupled Receptor Pathway
25	10/28	W	Cell Signaling: G-Protein Coupled Receptor Pathway
26	10/30	F	Cell Signaling: G-Protein Coupled Receptor Pathway
Unit 8 Cell Cycle Dynamics and Regulation, Mitosis			
27	11/2	M	The Cell Cycle: Regulating Cyclins and CDKs
28	11/4	W	The Cell Cycle: Regulating Cyclins and CDKs
29	11/6	F	Mitosis: Making and Breaking the Spindle
30	11/9	M	Mitosis: Making and Breaking the Spindle
EXAM 3	**11/11**	**W**	**7–9 PM (Units 6 and 7) Review 9 AM**
31	11/13	F	Mitosis: Chromosome Segregation
Unit 9 Cancer			
32	11/16	M	Receptor Tyrosine Kinase Signaling and Cell Proliferation
33	11/18	W	Receptor Tyrosine Kinase Signaling and Cancer Connection
34	11/20	F	The Genetic Basis of Cancer
35	11/23	M	The Genetic Basis of Cancer
NO CLASS	**11/25**	**W**	**THANKSGIVING BREAK**
NO CLASS	**11/27**	**F**	**THANKSGIVING BREAK**
36	11/30	M	Cancer and p53 Tumor Suppressor Function
37	12/2	W	The Transformed Phenotype and Tumor Progression
38	12/4	F	Hallmarks of Cancer
39	12/7	M	Hallmarks of Cancer
EXAM 4	**12/15**	**Tues.**	**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: Tues. Sept. 8
- Drop Deadline: Weds. Sept. 9
- Fall Reading Day: Mon. Oct. 5 (No class)
- Withdrawal Deadline: Tues. Oct. 20
- Thanksgiving Break: Weds. Nov. 25 and Fri. Nov. 27 (No class)