BICD 110: Cell Biology, Fall 2009

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Thursdays 11 am – 12, 4:30 – 5:30 pm &
by appointment
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Class website: http://webct.ucsd.edu

Class meets at
Peterson Hall 110
TuTh 9:30 – 10:50 am

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CELL BIOLOGY: The cell is the fundamental unit of life and is the smallest unit of life. The word itself is derived from the 17th century microscopist Hooke and means "little room." Cell biology is the study of how a cell is born, grows, carries out its essential and unique functions during its fruitful life, reproduces, and eventually dies. The study of cell biology is therefore a paradigm for our own lives, which undergoes the same cycle of birth, growth, life, reproduction (in obvious and subtle ways), and death.

THE TWO AIMS OF THIS CLASS:

1. Achieve a strong foundation in modern cell biology, with an emphasis on pathways and flow of information within a cell. Cell biology today is at the forefront of biological and health sciences. A strong foundation in cell biology is essential for a career in medicine, biological research, or in the ever-expanding number of fields which knowledge of biology is required (journalism, economics, law, politics,…).

2. Develop new skills in analytical reasoning and problem solving. Some of the greatest joys in life involve overcoming obstacles, solving challenges, and being the first to do something-- be it as small as completing a crossword puzzle, to figuring out "who done it" in a murder-mystery, to being observant enough to buy Microsoft stock when it came out, to as large as figuring out how to cure cancer and to find great friends and a partner for life. It gives ones life a tremendous sense of satisfaction and joy. The great thing about cell biology is not just learning neat things about how a cell work but learning about how we learn about those neat things, which involves overcoming obstacles, solving challenges, and being the first. This involves the three-step **scientific method**: make an observation, ask a question (usually called a hypothesis), and design/execute experiments to test that hypothesis. This inductive scientific method is the basis for the technological and scientific revolutions of modern history and is perhaps the single most powerful driving force of economies and advancements in the world today. It is also a powerful tool in many aspects of your own life that you can use to overcome obstacles, solve challenges, and be the first.

This class will therefore balance the accumulation of new information with an understanding of how that information is accumulated, including much practice to

apply that understanding yourself to make a key observation, ask key questions, and then solve key mysteries.

Along the way, we will also engage you in two subaims:
1. The joy of discovery as revealed through the study of cell biology. Human beings are passionately curious, it's "in our DNA and defines us. One might say, "to be human is to be curious and to be curious is to be alive." Why is the sky blue? How can we cure cancer? Does it matter if cows are treated with RBST? How are Brad and Angelina doing? Should steroids be banned from sports? What's in suitcase #2 (Deal or No Deal)? Who murdered Sarah Cushing (Sherlock Holmes)? If I try that new dish at the restaurant, will I like it? Will the Red Sox win the World Series this year (of course they will!)? Cell biology is a wonderful outlet to pursue that innate desire in us to learn, to discover new knowledge, and satisfy our passion for curiosity, in particular relating to life and nature. The drive of a cell biologist to understand life expresses that drive to be fully human, to create, to be the first, to see life as beautiful, to live!

2. Show you the healing power of biology—cell biology as a means to bring healing to the world by curing human illness. Healing illness is a means to grow, learn, and ease the suffering of others and brings great joy and meaning to our lives. Cell biology also has enormous potential to bring healing to the world via improvements in agriculture, energy production (green fuels), and environmental remediation (to name a few areas). In this class, we will discuss how cell biology can be used to heal disease and how advancements in cell biology can be "translated" into real-life applications (translational research).

HOW WE WILL ACHIEVE THESE AIMS AND SUBAIMS:
1. Readings from the textbook. Each week you will be assigned no more than 36 pages of reading from the textbook (4-5 hr). These readings will provide you with a good working knowledge in cell biology as well as provide essential foundations for our discussions in class and sections.

To succeed in the class and get the most out of the class, it is important that you come to class prepared with all the readings done before hand. If you do the readings for each lecture before the lecture, I guarantee you will do much better than if you don't. The first half of each lecture we will go over material in the readings but we will not go over in lecture everything in the readings you need to know. You will be required to be familiar with material in the readings that we do not cover in class. This might be different from what you are used if you are used to having the instructor explain everything in the text to you that he/she wants you to know. There are several good reasons for this. First, I cannot help you build essential analytical skills if I take time to explain everything in the text. Second, learning how to understand things without having them formally explained to you is an essential skill you will need in the future. I can almost guarantee that you will never end up in a job in which you will be handed material to read and then your supervisor spend hours explaining it all to you. Rather, you will be given material and be expected to glean the relevant information from it and ask questions of those things you don't understand. Third, my goal is to help you learn how to take command of your learning, something you will have to do when you leave UCSD. Fourth, this will also hopefully prompt you to work in study groups, which I strongly recommend and endorse.

So what happens when you read something you can't figure out? Here's the good news. First, I will begin every lecture asking you if there is anything in the reading you didn't understand and then spend time (up to ~20 minutes) on topics from the text YOU want to discuss. If you've done the reading ahead of time, then you will know what areas you need help in, ask for that help, and get it! Second, you can come talk to the TAs or myself during our many office hours. Third, you can get help from your peers. I encourage you to work in groups. I have definitive proof from my years of teaching that a group of people can learn something together that none of the individuals were able to at first understand on their own. Fourth, there are tremendous number of resources on the web you can tune into that can provide other ways of explaining something that may resonate better with you.

And here's the great news. In your readings, you can focus on learning the material without worrying about memorizing because all the exams and assignments in this class are open book! I want to challenge the notion that all learning is memorization or even that memorization is the most important skill in learning. The fact that you have made it to this class proves you have excellent skills in memorization (based on success in high school and previous classes). Now is the time to learn analytical skills that will enrich your life and provide a true foundation for personal success. As you will discover later, cramming and memorizing material for a test is not often a useful skill for life success.

Note the readings this year are trimmed down significantly from last year. If you find you are spending either more or less than 4-5 hours per week reading, please let me or the TA's know so we can calibrate readings assignments better.

2. Reading primary scientific literature. Cell biology is based on primary scientific literature, and everything in the textbook is derived from it. Therefore, reading primary literature ("papers") is essential for moving on to the next level of comprehension—understanding how we know what we know and how scientists problem solve. This literature will provide you with concrete examples of the scientific method in action—how an observation leads to a hypothesis, which leads to experiments, which leads to a new observation etc… Important aspects of this enterprise include:

a. learning to make an observation. This might seem trivial, but it is not. One of the keys to success in life is knowing what information is relevant, and what is not. Think about a sports team. Great teams are those that, using the information available to them, find the very best players. Everyone has access to the same information, but only a few are able to truly make good use of it. We are inundated with information and need to know how to take all that information and extract what is useful for our purposes. This is, in essence, what scientists do when they make an observation.

b. then asking "good" questions that lead to productive answers. Once you have identified important information, you need to be able to ask a good question so that you can get more information. For example, a patient comes in with a set of symptoms. You decide which are important and then ask more questions to try to hone in on the correct diagnosis. Asking the right question can be a matter of life and death. It is also important to realize that it is often (but not always) most useful to ask questions for which you have the means of answering. This is especially true in science.

c. once you have extracted relevant observations and asked good questions, you then need to figure out how to proceed. In science that means setting up and executing a relevant experiment to answer that question. This involves setting up

appropriate controls and then learning how to interpret the data in order to draw relevant and factual conclusions. This then because a new observation that can leads to the cycle stating anew.

One thing to note in all this is that there is tremendous amount of learned intuition that goes into each of these steps. It is our goal for you to develop that intuition so as to apply these extremely powerful set of tools to many aspects of your life.

You will be expose to primary literature in three venues. 1) We will talk about examples from primary literature in class, usually by me pulling out one or two figures or sections from a paper and discussing it in the second half of class. 2) Primary literature assignments will be an integral part of your Sections, both in discussion of assigned papers and in Challenge Sets that incorporate primary literature. In these, you will be able to work in groups on your own to tackle primary literature and develop these skills. In addition to learning vital analytical life skills, you will also develop the tools for tackling your final paper and exam for this class.

In addition, there are several key techniques used over and over again cell biology that will form a core of our discussions. They are (along with my nickname):
1. location, location, location: localization of proteins in cells; 2. pulling out the spark plug/supersize me: genetic-type experiments of seeing what happens when a protein is perturbed (turned off or on very highly); 3. BFF (best friends forever): finding out if two proteins or molecules directly interact with each other in a cell; 4. test-tube baby: taking cellular components out of the context of a cell and in some idealized, highly controlled environment for detailed tests; 5. others, as they come up

3. Interactive class room sessions that involve the use of iclickers, in-class group discussions and challenge-solving sessions, and "Emergency Expert Panel Sessions (EEPS)" in which you (alone and in small groups) will be given a challenging question or scenario and work your way through to a solution (usually indicated by clicker voting). iclickers will be used in class for several different purposes. I will use them to help assess comprehension of the readings and of explanations, showing which areas might need some more attention. I will use them to stimulate challenge-solving sessions in which you will work individually and in small groups during class to solve (hopefully fun) problems relevant to our discussions. They also may play a role in your grade for the class, if you so choose (see below).

4. Lectures that interweave within them four current "hot" areas of research that will expose you to wide-ranging, important, and fundamental aspects of cell biology and where there is still much we do not understand and where there are important implications for health and life. These topics are:

1. How does the body respond to insulin?
2. How do cells of the immune system move to the site of an infection and how do they polarize themselves to be able to directionally fight invading pathogen?
3. How do we taste?
4. How do cells replicate and how do defects in this process lead to cancer?

These four areas will serve as foci for discussing (1) membrane channels, protein targeting, organelle identity, the endoplasmic reticulum, the secretory pathway,

regulated secretion, and endocytosis; (2) the cytoskeleton (actin, microtubule, motors), cell motility, and cell polarity; (3) G-protein coupled receptors and signal transduction; (4) cell cycle control, mitogen signaling, and cancer.

What you can expect in lectures: In general, the first half of each lecture will cover material from the textbook. The second half will cover techniques, analytical methods and challenges, and discussion of readings from the primary literature. These readings will usually be provided at least two days in advance, indicating as well which sections/figures we will discuss. Lecture notes are not posted (although any slides not from the textbook shown in class will be posted). Lectures are podcast. Please note I view podcasting as a privilege and not as a requirement.

5. Three Challenge sets that you will do throughout the quarter and that will be discussed and graded in your Sections. These will usually incorporate primary literature (papers) and specific questions about the application of the scientific method, data, and interpretation of the data in those papers. The problems in these will not be unlike those found on the exams. You can discuss these in small groups but need to write up your answers on your own.

Guidelines for working in groups: I encourage you to work together in groups on your challenge sets and readings (textbook and for sections) within the following guidelines:

Groups should ideally be 2-3 students; keep the groups small so that everyone in the group has an opportunity to participate and get feedback.

For Challenge Sets, even if you discuss it in a group, you are expected to write up your own answers by yourself. By putting your pencil to the paper, you are making sure that you interact with the material and take the final steps towards completing the assignment. Finishing is an important skill for success in life. Do not copy anyone else's assignments. Duplicate assignments will be treated as a breach of academic integrity.

Your final paper is to be worked on entirely by yourself.

6. Sections: Sections are mandatory for this class. In Sections, you will go over papers (put up on the web by 4 pm the Thursday of the week before they are due) that are relevant to the class, that will reinforce and strengthen you analytical skills, and that may end up on the final exam. In addition, it is during sections that you hand in your Challenge Sets and during section that they are graded (you will each grade each other's Challenge Sets using a well-defined set of criteria).

You need to enroll in one section and go to that section (to keep the sizes reasonable and so that we can get to know you better and get you connected with a TA). To enroll in a section, go to https://sections.ucsd.edu/. Enter BICD110. There is a limit of 30 students per section. Enrollment starts at 5 pm today and ends 5 pm next Friday (first come first serve basis).

Sections are:
A01 - Monday 2:00 PM - 2:50 PM U413
A02 - Monday 3:00 PM - 3:50 PM U413
A03 - Monday 4:00 PM - 4:50 PM U413
A04 - Tuesday 1:00 PM - 1:50 PM WLH 2208
A05 - Tuesday 2:00 PM - 2:50 PM WLH 2208
A06 - Wednesday 5:00 PM - 5:50 PM YORK 3000A

A07 - Thursday 8:00 AM - 8:50 AM CENTR 201
A08 - Friday 3:00 PM - 3:50 PM HSS 1305
A09 - Friday 4:00 PM - 4:50 PM HSS 1305

MATERIALS FOR THE CLASS

Textbook (required): Molecular Biology of the Cell, 5th Edition (2008), Alberts et al. The fourth edition will not work. Note, since the final exam is open book, it is very important that you have a copy of the book. I also encourage you to bring it to class as many students find this very helpful (including taking notes in it). If you cannot afford a copy of the book, we have several copies on reserve in the Biomed Library. For the final exam, we will try to bring as many copies as we have to class for your use but we cannot guarantee you will get a copy to use. The responsibility of having a copy for the final ultimately rests with you.

Problems book (optional): Molecular Biology of the Cell 5th Edition "The Problems Book". This book provides many excellent practice for problem solving in cell biology as well as answers to the questions at the end of each chapter from the textbook. Also on reserve in the Biomed Library.

iClickers: Required. Available from the bookstore.

Access to a computer and printer is required for downloading assignments and supplementary materials.

HOW YOU (THE STUDENTS) AND WE (THE TEACHERS) WILL BE EVALUATED IN THIS CLASS

Our goal is to provide you with excellent opportunities to succeed. To help you achieve the aims of this class and to help evaluate your performance throughout the quarter, the class will have regular assignments. Formal evaluation of your progress (for your benefit and ours) will come from the following:

1. Exams:

A. Practice exams 1 and 2: There will be two take-home (open book) cumulative exams that will emphasize problem-solving skills and will be of the same format as the final. They will be handed out on two Thursdays at the end of lecture (10/15 and 11/19). They are due the following Monday by 12 noon outside my office. Practical Exams handed in after this time will not be graded. These Practice Exams will have mostly short answer and problem solving formats. They will be graded by the TAs just like regular exams. These practices exams are aimed to challenge you to think in new ways and to develop and hone your problem solving abilities. They will also (hopefully) provide you with "aha" moments— the joy of discovery, of finding solutions and uncovering new insights. You are to work on these individually and not in groups so that you can test your own ability to work on the material and to help you prepare for the final exam.

Although graded, these Practice Exams will not count towards your final grade and instead are stress-free opportunities for you to practice for the final exam. By grading these exams, we will provide you with direct feedback of what we are looking for on the final exam. By not having them count, they will provide you with opportunities to

learn the requisite skills without having to worry about what grade you will achieve on them and without fear of making mistakes (which are a necessary part of learning!). They will also provide us with valuable feedback as to how we are doing in stimulating your learning and how you are doing at that point of the course

Although the only exam in this course that matters for your final grade is the final exam, the percent of your grade in the class dependent on the final exam can be the same as it typically is for this class under many teachers, 50%. Our goal is to give you opportunities to learn, make mistakes (safely), and succeed. The two Practice Exams are just that.

B. Final exam to be held on Thursday, 12/10/09, 8:00 am – 10:59 am: 50%-70% of your final grade (depending on how you choose to use clickers and Challenge Sets). The exam will be cumulative (covering the entire class) and will be in the same format as the Practice Exams (so you will have ample opportunity to practice). The exam will be open textbook and open notes so you will not have to spend your time and energy memorizing facts from the text. No electronic media (cell phones, computers, calculators, etc..) will be allowed. The final will be graded on a standard scale (<u>not on a curve</u>) so that everyone has the opportunity to achieve a high grade and so that the final exam does not become a competition, which I believe is detrimental to the learning process.
To help achieve fairness (*e.g.*, in the event the final exam turns out to be more difficult than anticipated), 100% on final exam will be normalized to the average of the top 5 grades in the class. There is no regrading of the final exam except in the case where incorrect addition of points in the exam resulted in an incorrect score.

I realize you may have many finals. Please look at your finals' week schedule now. If the timing of this final conflicts with other finals, then you might want to take this (or the other class) during a different quarter (cell biology is offered every quarter). Writing a fair exam that tests problem solving abilities and the skills we are looking to develop in class takes a lot of effort. Therefore there are no make-up finals and no early finals. Due to the constraints of so large a class and our ability to write and grade the final, to get credit for the final exam you must take it at the scheduled time except under extraordinary documented circumstances (*e.g.*, documented illness that requires hospitalization), and I must be notified of that extraordinary circumstance prior to the final. Makeup finals may be an oral presentation to the instructor.

I again want to emphasize, even though only one exam "counts" for your grade in this class, **that one exam counts no more for your total grade as for any other cell biology class**, if you so choose!

2. Discussion paper on a piece of primary literature due on the final week of class. **30% of your grade**. The format of these papers and what will be expected from the students will be made explicitly clear when the papers are assigned on Nov 10. <u>You are to work on these individually</u> and are expected to do your own thinking and writing. They are due in class on Dec 1 (3 weeks later) and will be graded according the handout that will accompany them (similar to discussions of three primary literature paper assignments leading up to this). To get full credit for your work your must hand your assignment in on time. If you hand them in late, there will be several unavoidable consequences. One is, we may not be able to find time to grade it (which would result

in a zero) because we have scheduled time to grade these and cannot let the grading go into finals week. The second is your peers will (justly) complain to us that it is unfair that someone got to hand their paper in late when they handed theirs in on time. The third is your education and serenity will probably suffer since you will be piling on your workload before finals week. If, for whatever reason, you cannot meet this deadline please let your section TA and me know before the due date by email.

These discussion papers (see above) will be graded on a standard (not on a curve). That standard will be clearly delineated in a handout to accompany the discussion paper on the day it is assigned. There is no regrading of the discussion paper.

3. Clickers, optionally 10% of your grade: Throughout each lecture, I will present small, multiple-choice questions that will challenge your thinking and comprehension of material just presented and that provide opportunities for problem solving on a smaller scale, individually and in groups. These questions will also provide important and immediate feedback to me as to how the learning process is progressing. To make this form of feedback and learning work, I need every member of the class to purchase and bring with them a clicker. In addition, I will usually begin each class with a clicker question relevant to the readings for that day.

By answering 75% of the clicker questions (right or wrong, it doesn't matter), you will receive 10% of your grade as an A (100%). Clickers will be individually registered according to instructions given on the second class. Below this level of participation, you will receive no credit and instead that 10% of your grade will be switched to the final. The idea is encourage active in-class learning—showing up, thinking about the problems, and participating in problem solving. This approach is also true to science itself, which is a dynamic and participatory process, not an isolated one. I am making this optional because I do not believe in "forcing" attendance. Needless to say, use your own clicker only (see Section on Academic Integrity).

You need to register your iclicker. To do that, go to:
http://www.iclicker.com/registration/

4. Challenge Set, optionally 10% of your grade: There are three challenge sets due in Section, graded in section, and discussed in section. For each Challenge Set, you will receive either an "S" (satisfactory), "U" (unsatisfactory), or "N" (not done). The questions on these challenge sets will mirror those in the exams. Unlike the practice exams, however, these can count. If you receive an "S" on 2/3 Challenge Sets, then you will receive and "A" for 10% of your grade. If not, then that 10% will be assigned to your final. These are to be handed in to your section and will be graded in your section that same day. In general, to get and "S" you must receive a 75% or greater on your Challenge Set.

Thus, if you both do clickers and receive at least two "S" on Challenge Sets, then you will have 20% of your grade already as an "A" and your final will be worth 50% of your grade. In this way, you are empowered to make a difference in your grade.

Instructor/instruction evaluations: Periodically, students will be asked to fill out evaluations on index cards at the end of class to help us evaluate the effectiveness of instruction and the instructor.

Grades
Course grades will be assigned as follows:
A: 85-100%; B: 75-85%; C: 60-75%; D: 45-60%.

Academic Integrity: Academic dishonesty undermines the hard work of all the students in the class who are engaged in the learning process and who are taking responsibility for their learning. It is also incompatible with the practice of science and search for the truth. I will not tolerate it. Out of respect and appreciation for your own efforts, you should not tolerate cheating among your colleagues either, and I encourage you to talk with any of the BICD110 staff if you learn of any incidents of academic dishonesty. If I suspect dishonesty, I will meet with you to discuss my concerns, and I will report the incident to the Biology Undergraduate Affairs office and to your college Dean. The following is an excerpt from the UCSD General Catalog on Academic Dishonesty: "Each student is responsible for knowing and abiding by UCSD's policies on Academic Dishonesty and on Student Conduct. Any student violating UCSD's Academic Dishonesty or UCSD's Student Conduct policies will earn an 'F' in the course and will be reported to their college Dean for administrative processing. Committing acts that violate Student Conduct policies that result in course disruption are cause for suspension or dismissal from UCSD." Use of two or more clickers in the class (ie clicking in for someone else) will be treated as a violation Student Conduct Policies.

If you follow these steps, you can have high confidence in succeeding in this class:

1. spend the 8 hours outside of class time expected for a 4 unit class. Read the textbook before class (~4 hr) and prepare for sections (readings, Challenge Sets) (~4 hr)
2. ask questions whenever something in not clear, either before/during/after class, during my office hours (please come!), during TA office hours, in sections.
3. attend lecture; participate in clicker questions and class discussions
4. attend your section
5. do all the assignments—do the Challenge Sets. Whether you get "S" or not, you will learn a lot in the process. Read the papers for Section discussions. Take the Practice Exams. They will challenge and stimulate your learning and give you excellent practice for the final.
6. talk with me and/or your TA's about any difficulties you are having with assignments, with understanding the material, with reading primary literature, with problem solving techniques. Let us know as soon as you are able how we can help you learn.
7. work in groups as indicated

CLASS ETIQUETTE

1. The best place for learning is up front in the active learning zone.
2. Come on time. If you come late, please sit in the back so as to not disturb others.
3. Be present in the class. That means all cell phones off, please. No texting, no phone calls. It is disruptive to other students and to your instructor.

Cell Biology BICD110 Class and Section Schedule, Fall 2009

Week/Topic (total reading pages)	**Tues lecture and readings (#pages)**	**Thur lecture and readings (#pages)**	**Assignment-- available on webct by 4 pm Thursday/section topics**
1/Diabetes- intracellular compartments and traffic (9)	N/A	9/24 Introduction; Diabetes and glucose transport 651-659 (9)	Paper posted
2/ Diabetes- intracellular compartments and traffic (35)	9/29 Compartments; signal sequence; into the ER 695-702; 723-736; omit 731 (21)	10/1 Vesicle transport 749-764; omit 755-756 (14)	Challenge set 1 handed out (due in Section week 3) /Paper discussion
3/ Diabetes- intracellular compartments and traffic (31)	10/6 ER-Golgi; Endocytosis 766-773; 787-798 (20)	10/8 Exocytosis 799-809 (11); Guest lecturer no office hours	Paper posted/ CS1 graded.
4/Immune cells- cytoskeleton (36)	10/13 Actin and tubulin; monomer dynamics 965-980; 987-988 (18)	10/15 Actin and tubulin; regulation of filaments ; 992-1010; omit 1005 (18)	Practice exam 1 handed out 10/15 in class (due 9 am Monday 10/19)/Paper discussion
5/Immune cells- cytoskeleton (28)	10/20 Motors 1010-1025 (16)	10/22 Cell motility and polarity 1036-1047 (12)	None/Discussion of PE1
6/Taste- G protein coupled receptors (36)	10/27 Signaling basics 879-887; 895-903 (18)	10/29 GPCRs 904-921 (18)	Challenge set 2 (due in Section week 7)/Open discussion in section
7/Taste- G protein coupled receptors (0)	11/3 GPCRs and taste no textbook readings	11/5 Special lecture (TBD)	Paper posted/CS2 graded
8/Cancer- cell cycle (30)	11/10 Cell cycle I 1053-1070 (18) Discussion papers posted; due 12/1 in class	11/12 Mitosis 1071-1080; 1087-1088 (12)	Challenge set 3 (due in Section week 9)/Paper discussion
9/Cancer-cell cycle (24)	11/17 Receptor tyrosine kinases 921-930; 932-935 (14)	11/19 Control of cell division 1101-1110 (10)	Practice Exam 2 handed out 11/19 in class; due 9 am Monday 11/23)/CS3 graded
10/Cancer- the disease (19)	11/24 Cancer, the disease 1205-1223 (19)	11/26 No class; no office hours	None/Open discussion in section
11/Cancer- the disease (30)	12/1 Cancer, molecular and cellular processes 1230-1239; 1241-1250 (20); Discussion papers due	12/3 Cancer, cures 1256-1265 (10)	None/Open discussion in section