**INSTRUCTORS:**

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\*Often in the lab, so contact by email instead of office phone

**TEACHING ASSISTANTS:**  Madeline Gray and Yusuf Uddin

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**COURSE HOURS/LOCATION:** MWF 10:10-11:00 am Weber SST III

**OFFICE HOURS:** No regular office hours are scheduled, but students are STRONGLY ENCOURAGED to meet with the TA and instructors when needed by arranging a time via e-mail.

**COURSE DESCRIPTION AND LEARNING OBJECTIVES:** Modern cell biology is a unifying discipline that describes the structure and function of cells in all their genetic, biochemical, developmental, physiological and pathophysiological aspects. This course will introduce students to the dynamic relationships between cell structure and the biochemical processes that are necessary for cell growth, differentiation, survival and death with an emphasis on eukaryotic cells. The format of the course will consist of **in-class discussion of topics related to the material in the book chapters** and, toward the end of the course, **analysis of assigned research articles,** with each student preparing a WRITTEN SYNOPSIS/CRITIQUE of one research paper. Preparation for each lecture will require 1-2 hours of reading, taking notes, and answering pre-class questions, although some students may need to commit more time. By the end of this course, students will be able to:

1. Articulate structure-function relationships at multiple levels, from individual biomolecules to macromolecular assemblies and cellular subsystems, and how they determine the behavior of cells, tissues and organs.
2. Explain common techniques in modern cell biology and interpret the data they generate.
3. Draw connections between cellular processes and how they are altered in pathological conditions such as cancer.
4. Critically analyze primary literature in the field of molecular cell biology.

**TEXTBOOK:** H. Lodish et al. 2016. *Molecular Cell Biology, 8th Ed.* W.H Freeman and Company. Optional reading (on reserve in the library): Gillen, C. M., 2007. *Reading Primary Literature*, Pearson/Benjamin Cummings Pub. (ISBN-13: 978-08053-4599-5).

**Learning Catalytics:** In-class participation and homework assignments will be administered via Learning Catalytics. Students must purchase an individual subscription ($12 per semester) at: <https://learningcatalytics.com/student_sign_up> - if you are enrolled in other courses that also use Learning Catalytics in Fall 2018, just one subscription will serve multiple courses for the semester.

**OTHER SOURCES:** The website for the textbook; Biomedical search tools: PubMed (and Google Scholar) http://www.ncbi.nlm.nih.gov/pubmed/. Online journals via the Georgia Tech library: <https://gatech-primo.hosted.exlibrisgroup.com/primo-explore/citationlinker?vid=01GALI_GIT&lang=en_US>

Link to useful online cell biology resource: http://www.cellbio.com

**IMPORTANT GEORGIA TECH DATES**

Mon Aug 20 CLASSES BEGIN

Mon Sep 3 OFFICIAL SCHOOL HOLIDAY

Mon-Tues Oct 8-9 FALL RECESS

Wed-Fri Nov 21-23 THANKSGIVING BREAK

Wed-Thu Dec 5-6 READING PERIOD (ends 2:40 pm Dec 6)

**COURSE EXAM DATES - All exams are in Weber SST III**

Mon Sep 10 EXAM 1

Fri Oct 5 EXAM 2

Mon Oct 29 EXAM 3

Mon Nov 19 EXAM 4

Wed Dec 12 FINAL EXAM (CUMULATIVE); 8:00am - 10:50am

**EVALUATION CRITERIA:**

**Lecture exams**: **50% of the final grade**. There will be FOUR closed-book exams during the semester. Each will consist of multiple-choice and short answer questions. Your lowest score will be dropped, so each of the remaining exams is worth 20% of the final grade.

***Missed exams***: If you are participating in an Institute-approved activity (scientific conference, sports event, etc.) that causes you to miss an exam, the instructors will try to schedule for you to take it at an alternative time (usually the day before the scheduled exam date), but you must arrange when at least two weeks before the scheduled exam date. If you miss an exam due to another documented reason (e.g., illness, family emergency, etc. that has been reported to the Dean of Students), the instructors will either arrange a makeup exam (which is rare because the original exams take many hours to prepare) or another mechanism to assess your knowledge of this portion of the course (for example, to use your score on the equivalent section of the final exam as the score for the missed exam). You might elect to use the missed exam as your dropped score.

If you have a more prolonged illness (or several) that cause you to miss more than one exam, you should contact the Dean of Students office to certify the illness(es) and the Dean will inform us that some sort of accommodation would be appropriate.

IF YOU HAVE A COLD or OTHER MINOR, POTENTIALLY COMMUNICATIBLE ILLNESS DURING AN EXAM OR OTHER CLASS WHEN ATTENDANCE IS REQUIRED: Please let the teachers know so they can try to find a way for you to participate far enough away from other students to minimize its spread. If you are seriously ill, do not come to class.

**Final exam**: **30% of the final grade**. THE FINAL EXAM is an integrative overview of all of the cell biology concepts covered in the course (not just the chapters since exam 4, but also the earlier material). The final exam cannot be dropped.

**Paper critique: 10% of the final grade.** This is the grade on your critique of the research paper.

**Participation and in-class exercises: 10% of the final grade.** There will be homework assignments and in-class exercises using Learning Catalytics, which will help you understand the lecture concepts and prepare for exams.

Near the end of the semester, if >75% of the class performs the on-line course critique, everyone in the class will receive 1 point; if >85% reply, everyone will earn 2 extra credit points.

**CALCULATION OF FINAL GRADE:**

Your average for the course is calculated as follows:

Mean of the scores on 3 of the 4 lecture exams (having dropped the lowest lecture exam score) = 50%

Score on the final exam = 30%

Paper critique score = 10%

Participation score = 10%

The letter grade is assigned by the scale: A= >90; B= >80, C= >70, D= >60, F= <60. Grades are not “curved,” but fractions are rounded to the nearest whole number (e.g., 79.6 -> 80). Comment about not curving the grades: the instructors examine the class responses to each question of each exam and if we discover that performance was lower than expected on a given question due to deficiencies in the design of the question, we adjust the points immediately and inform the class when the exam grades are posted. **If you disagree with the points that have been awarded to you on an exam**, you should report this to the TA within a week after you have received the grade to determine if the error was merely a miscalculation. If you disagree with the number of points that have been awarded by the TA, you should contact the instructor who prepared the question within two weeks (thus, you have one week to check with the TA first, then another week to consult the professor, if you deem necessary). You are welcome to do this; however, you should examine your answers carefully first. TAs sometimes give more points for an answer than the instructor would, so **review of your answers by the instructor might reduce your grade rather than increase it,** if your argument for why your grade should be higher is not strong.

**Research paper analysis (10% of the final grade)**

This activity gives students experience in reading and discussing primary, peer-reviewed research papers in molecular and cell biology to familiarize them with how research in this area is conducted and reported. Two papers will be discussed in depth during the semester, and each student will responsible for the aspects of the papers that are discussed in class (there will be a few questions on the exams from this material) and preparing a WRITTEN report on ONE of the papers. Early in the semester, the instructors will create a sign-up site on T-square where students can express their preference for the paper that they will analyze for this report (each will have enough sign-up slots for approximately 1/2 of the class, so if you have a strong preference for which paper you use for your written report, sign up early).

General instructions for the written report: The written report will be a 2-page summary of the paper including an analysis/critique of some aspect of the paper. In general, the first half of the report will be similar to the abstract of the paper but with additional background information, more specifics about the experiments that were done, and key results. The second half of the paper will discuss some aspect of the paper that the student considers to need improvement (for examples: Was one of the methods used incorrectly? Did the authors misinterpret the data in a figure or table? Did the authors overlook an important paper already in the literature that would have affected their conclusions?), or if the work is judged to be solid, a discussion of how the findings might be built on by follow-up experiments. These students are expected to provide documentation for their comments on all aspects of the paper (background, key methods, discussion of the results, etc.) by citing pertinent papers from the scientific literature (and putting these in a bibliography with at least 5-6 references from the peer-reviewed research literature). The grading rubric that is used by the instructors will be posted on T-square so students should take care to include information in all of the categories that are scored. The report must be turned in at the beginning of the class that it is due; if late, the score will be reduced per day it is late.

In-class discussion of the research papers: The research papers will be discussed in class discussion in the following manner: a) the instructors will distribute a list of the major issues/questions about the paper that they want the class to notice and discuss; b) there will be a 15-minute overview of the main points in the paper to orient everyone to it; c) approximately 15 min will be allocated for students to use the understanding that they have gotten about the paper from this overview plus the paper itself to arrive at answers for the major issues/questions provided by the instructors; and d) the last 15 min of the class will be used for discussion of these issues/questions. After this discussion, the students will hand in the bottom section of the list distributed by the instructor as a record of participation (see below for participation grading).

Student volunteers for the oral overview of the paper: The overview of the paper at the beginning of the class discussion is usually more interesting when given by a small team of students who volunteer to do this. One advantage for students who participate in the in-class overview is that they do not need to submit a 2-page written review; however, the preparation usually takes the same effort (and sometimes more—although students who invest this time usually report that it was worth it). If you are interested in doing this, we recommend that you form your team (4 to 5 students, max) and contact the instructors stating that you would like to give the overview as soon as possible after the papers are posted. If more than one team volunteers, we will correspond with the team leaders (i.e., the person(s) who initiate the contact with us) to try to ascertain who might do the better job, since this presentation is important for the entire class. In the event of a tie, the group will be selected randomly. If there are no volunteers for a particular paper, the instructors will introduce the paper.

The team that prepares the overview for presentation in class should consult with the instructor about how they plan to do it. The presentation is usually via PowerPoint. The first slide of the ppt presentation should give the name of the paper (title, authors, journal, etc.), and the names of all of the students in the group. It should also have a statement that: “The preparers of this presentation agree that it can be posted on t-square for use by other students in the class only. None of the material may be reproduced or used for other purposes because it may be covered under copyrights from the original sources.” Next, there should be 2 to 3 slides summarizing the background for this paper and its hypothesis, 2-3 slides explaining key methods; 4-5 slides showing key data; 1-2 slides summarizing the conclusions; 1-2 slides stating some concerns and directions for future work; and a bibliography of at least 5 research papers used in analysis of this paper and the points you have raised (additional references to web sites and other information sources can be added, but the bibliography must contain 5 references from research journals). Be careful to include only the most essential points in each slide since the entire presentation must be made in 15 minutes. A copy of the grading template is posed on T-square so students will know what is considered to be most important for them to cover. A single grade will be assigned for the entire group, so the group should prepare and rehearse it early (in the rare event that a member of a group is having difficulty with his/her portion of the presentation, and the others need to help). The instructors hope the teams will consult them during the preparation of the overview, and show them a draft of the Powerpoint presentation. The instructors are willing to make suggestions for improvement of the presentation, but to ensure that they have time to do so, you need to contact them well in advance of the presentation date.

**THE HONOR CODE AT GEORGIA TECH**: All students are required to adhere to the Georgia

Tech Academic Honor Code (www.honor.gatech.edu). This includes, but is not limited to, the following issues that pertain to the oral and written critiques, mnemonic tools, and exams for this class:

1. **Plagiarism** is not allowed. Plagiarizing is defined by Webster’s as “to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source.”

In simpler terms: When you use any phases, sentences, etc. verbatim from another source, they must be identified by quotation marks and citation of the source. In scientific writing, it is generally preferable to

rephrase information from other sources and cite the source rather than use the same text, even when you offset the text with quotation marks. When you show diagrams, models and other materials that are not your own, the sources must also be identified.

In science, it is assumed that most of what you write or say has come from another source, even if you are

assembling the information into a hypothesis or conclusion that is uniquely your own. Therefore, you are

expected to acknowledge those sources. These rules apply both to published information and information that you might receive from another student, website, previous class report, etc.

Plagiarization will be dealt with according to the GT Academic Honor Code.

2. Students are encouraged to collaborate in some aspects of the preparation of oral and written critiques, such as the early stages where you are achieving an understanding of the assigned papers; however, the final critiques must be written by each student alone.

3. Unless specifically identified as group work; quizzes, tests, take–home-tests, homework, etc. are to be

completed alone.

4. For Quizzes/Tests: Cheating off of another person’s test or quiz is unethical and unacceptable.

Cheating off of anyone else’s work is a direct violation of the GT Academic Honor Code, and will be dealt with accordingly.

5. Because the exams for this course change every semester, students may use old tests as study tools.

For any questions involving these or any other Academic Honor Code issues, please consult the professors, teaching assistant, or www.honor.gatech.edu.

**Office of Disability Services**

Some students also benefit from assistance from the Georgia Tech disability services office, and if you think they can be helpful, we encourage you to contact them (http://disabilityservices.gatech.edu/).

Sometimes students have difficulty taking an exam when uncomfortably crowded between other

students, so if that happens to you, feel free to move to another seat in the room (there are usually several at the front), and we’ve occasionally had students take the exam nearby, such as in the hallway.

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| **Class #** | **DAY** | **DATE** | **Chap** | **LECTURE TOPIC** | **Lecturer** |
| 1 | MON | 20-Aug | 1 | Intro to Cells and Cell Biology | JC + AM |
| 2 | WED | 22-Aug | 2 | Chemical Foundations | AM |
| 3 | FRI | 24-Aug | 3 | Protein Structure and Function | AM |
| 4 | MON | 27-Aug | 4 | Culturing and Visualizing Cells | AM |
| 5 | WED | 29-Aug | 5 | Fundamental Molecular Genetic Mechanisms | JC |
| 6 | FRI | 31-Aug | 6 | Molecular Genetic Techniques 1 | JC |
|  | MON | 3-Sep |  | OFFICIAL SCHOOL HOLIDAY |  |
| 7 | WED | 5-Sep | 6 | Molecular Genetic Techniques 2 | JC |
| 8 | FRI | 7-Sept | 7 | Biomembranes | JC |
| 9 | MON | 10-Sep |  | Exam 1 (Chapters 1-7) | JC + AM |
| 10 | WED | 12-Sep | 8 | Genes, Genomes, Chromosomes | JC |
| 11 | FRI | 14-Sep | 9 | Transcriptional Control of Gene Expression | JC |
| 12 | MON | 17-Sep | 9 | Transcriptional Control of Gene Expression | JC |
| 13 | WED | 19-Sep | 10 | Post-transcriptional Gene Control | JC |
| 14 | FRI | 21-Sep | 10 | Post-transcriptional Gene Control | JC |
| 15 | MON | 24-Sep | 11 | Transport of ions & small molecules | JC |
| 16 | WED | 26-Sep | 12 | Cell energetics | JC |
| 17 | FRI | 28-Sep | 13 | Moving Proteins into Membranes and Organelles | JC |
| 18 | MON | 1-Oct | 14 | Vesicular Traffic, Secretion, and Endocytosis | AM |
| 19 | WED | 3-Oct | 14 | Vesicular Traffic, Secretion, and Endocytosis | AM |
| 20 | FRI | 5-Oct |  | Exam 2 (Chapters 8-14) | JC + AM |
|  | MON | 8-Oct |  | FALL RECESS |  |
| 21 | WED | 10-Oct | 15 | Signaling Transduction and G-Protein-Receptors | AM |
| 22 | FRI | 12-Oct | 16 | Signaling pathways | AM |
| 23 | MON | 15-Oct | 16 | Signaling pathways | AM |
| 24 | WED | 17-Oct | 17 | Cell Organization: Microfilaments | AM |
| 25 | FRI | 19-Oct | 18 | Cell Organization: Microtubules and IF | AM |
| 26 | MON | 22-Oct | 18 | Cell Organization: Microtubules and IF | AM |
| 27 | WED | 24-Oct | 19 | Eukaryotic Cell Cycle | JC |
| 28 | FRI | 26-Oct | 19 | Eukaryotic Cell Cycle | JC |
| 29 | Mon | 29-Oct |  | Exam 3 (Chapters 15-19) | AM + JC |
| 30 | WED | 31-Oct | 20 | Integrating Cells into Tissues | JC |
| 31 | FRI | 2-Nov | 20 | Integrating Cells into Tissues | JC |
| 32 | MON | 5-Nov | 21 | Stem Cells, Cell Asymmetry & Cell Death | JC |
| 33 | WED | 7-Nov | 21 | Stem Cells, Cell Asymmetry & Cell Death | JC |
| 34 | FRI | 9-Nov | 21 | Research Paper Exercise 1 | JC |
| 35 | MON | 12-Nov | 22 | Nerve Cells | AM |
| 36 | WED | 14-Nov | 22/23 | Nerve Cells (cont)/Immune Cells | AM |
| 37 | FRI | 16-Nov | 23 | Immune Cells | AM |
| 38 | MON | 19-Nov |  | EXAM 4 (Chapters 20-23) | AM + JC |
|  | WED | 21-Nov |  | Pre-Thanksgiving Recess |  |
|  | FRI | 23-Nov |  | OFFICIAL SCHOOL HOLIDAY |  |
| 39 | MON | 26-Nov | 24 | Cancer | AM |
| 40 | WED | 28-Nov |  | Research Paper Exercise 2 | AM |
| 41 | FRI | 30-Nov | 24 | Cancer | AM |
| 42 | MON | 3-Dec |  | Course Wrap-up | JC + AM |
|  | WED | 12-Dec |  | FINAL EXAM 8:00 AM - 10:50 AM | AM+JCAMAM+JC |
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**Suggestions for studying**: Here are suggestions from three sources about how best to learn the material

in this course.

**I. General principles/approaches:**

a) Take notes by hand. Rewrite your notes, preferably no later than the evening of the class day. Do not

just recopy your notes, but rather both condense and extend them where appropriate, paraphrasing them so that you make the meaning your own.

b) Develop relationships with other class members and form study groups if you can, so you can

convert the information from a passive mode into an active mode, as you discuss it with others.

c) Work “what if” scenarios and practice problems: study the text and lecture information, then ask

yourself (and/or study team members) questions about it to ensure you really know it. If there are mathematical relationships, think of practice problems using them.

d) Enter the tester’s mind by asking yourself (or team members) what are the most important things in

each section, keeping in mind both that you need to know the concepts involved and the appropriate vocabulary to describe the process. You can take the exams from previous semesters to see if your level of questioning is similar to the instructors, but do not study the exams because most of the questions are made fresh every semester.

e) Set attainable study/learning goals so the time you allocate to studying this course is used most

effectively. For examples: If you learn best from the notes with supplementation from the textbook, do not read the textbook first and end up using all your study time getting halfway through the chapter and having none left to review the notes. If you start your review by recopying the diagrams in the notes from memory, do not get bogged down in trying to exactly recapitulate the artwork when a simpler sketch will describe the main ideas adequately.

**II. Learning suggestions from Dr. Al Merrill** (who was the lead instructor for this course for many years):

As you study the material, ask yourself:

1) What fundamental cell biology question is this addressing? For example: How do proteins

get from their site(s) of synthesis to their ultimate destination(s) in cells?

2) Then, imagine that you have been asked this question by someone you know, and you are

answering it for them….

3) …and they keep asking you for clarification--”Okay, but how does that work?” “How does

the cell turn that on and off?” “What happens after that?” “ What use is that?”

4) Repeat this exercise until you think you have been able to explain how the process works

using the appropriate terms that apply to the steps you have had to explain. You will retain this vocabulary of new terms and concepts longer than if you try to memorize them as items on a page.

**III. Comments/suggestions from previous students who have done very well on the exams:**

>I have learned … to focus heavily on the lecture slides, and to completely understand every word and

mechanism discussed in these slides. As I go through the lecture slides, I look at the corresponding book

material, focusing only on the picture captions for diagrams discussed in class and the text descriptions of the complex mechanisms. Thus, I refer to the book more as a secondary reference to clear up material that I find confusing from lecture. I find the section summaries in the textbook to be very helpful for understanding big concepts as well. I also look through all the old practice exams and make sure to not only understand what the correct answer is and why, but also why the other answer choices are wrong. I have found these methods of studying to help me on past exams, and I hope they can be of some assistance to other students.

>I hear people say Biology is all about memorization, but I completely disagree. In fact, I can't

memorize anything I don't understand. I believe they should do the same, i.e. understand all the concepts beforeresorting to memory.

>It's always helpful for me to read the book, before or after class. It helps keep what you're learning on

track and in a way put it all in better context. [this is only true, however, if you can read fast enough to keep up with the class; otherwise, it can make you get behind]

>A studying technique that's been VITAL for me: Here's how I studied for the last test. I went to the

Molecular Science and Engr. Bldg, picked an empty classroom and started lecturing!! Granted I sounded crazy for being alone in there and talking to myself for hours, but it was an extremely beneficial experience for me. (1) It prevented me from getting bored as opposed to when sitting and studying on some desk. (2) It allowed me to realize how much I do or don't know about a concept and act accordingly. (3) If you really convince yourself that you're in a real classroom, it would allow you to think like a teacher, elaborate on concepts, and be better prepared for the test.

>To do well … in Cell Bio in general, after studying I'd take the old tests posted on T-square and make

sure I know how to answer the questions, not remember the answers.

>My advice to other students would be to look over the parts of the book that were covered in the

powerpoints, especially if they don't understand the pictures/figures. I also tend to jot down a few notes when reading over sections of the book just to make sure that I understand the concept.

>The method that I have found most helpful when studying … has been to teach the material to another

person, while using the slides and my notes as prompts. Obviously, it's best to have studied some before doing this, so that it's not just reading off the slides. I find this to be more interesting than staring at the pages for hours and involving another person adds motivation and focus, since it is embarrassing to fumble with the information in front of someone else. Additionally, being asked questions by a motivated listener really helps me pick out which areas I need to work on. For me, this is the best method, particularly because I am interested in becoming a professor, but it can be time consuming. Generally, I would recommend small study groups, since it is easier to ask questions and be involved. Removing the answers from the old exams before looking at them and waiting until after studying to attempt the old exams are also helpful because it is easier to identify what has been effectively learned and which topics need to be reviewed.

These suggestions are provided as “food for thought” and we hope you have, or are successful in

developing, method(s) that work well for you. Feel free to discuss this with the instructors if you are having difficulty learning the material and doing well on the exams.

Stress management: We find that some students have difficulty with stress while taking this course,

with a lot of factors coming into play: it covers a lot of material; the students who take it come from a variety of backgrounds; many of the students have a heavy load of other courses and outside activities that compete for their time; and—being a 3000-level course--the format is more “open-ended” than most (or all) of the courses that the students have taken previously. By “open-ended” we mean that the goal of the course is not just to survey the major concepts and processes in cells at a molecular and cellular levels, but also to prepare students for future developments in the field by discussing recent research publications and broader implications of the subject. The first way to control stress about the course is to keep up-to-date with the course material, being careful to prioritize your time in dealing with it. Most students find the class ppt and notes to be the best place to start, then use the textbook to further explain topics that you do not understand from the notes, as well as to read about topics that were not covered but interest you. If, however, you are the type of student that learns best from the textbook, feel free to use your preferred method to learn the material, but notice which topics are emphasized by the instructors (by what they covered in class--you do not need to learn everything in the textbook, so do not let it scare you). We think you will find it useful to study with others; however, this doesn’t work for everyone, and you can be just as successful at learning the material by teaching it to an “imaginary friend” as long as she/he is able to ask questions about it to ensure you know what you are talking about! See the section above about study methods, if you think it might also help. The Counseling Center is committed to helping Georgia Tech students manage their stress so that they can succeed. They have a variety of brochures and programs devoted to this important skill of stress management. You can get them by going by the counseling center to pick up a brochure or you can download it from their web site, which also has videos on stress and strategies for dealing with stress:

http://www.counseling.gatech.edu/plugins/content/index.php?id=32