

Cancer Biology and Biotechnology (Biol 4015 & 7015) Fall, 2014

Course description: The purpose of this course is to introduce graduate and upper level undergraduate students to the major concepts of cancer biology as well as to state-of-the-art technologies that are being applied to the understanding of cancer and cancer risk, the early detection of tumors, cancer treatment, and monitoring of treatment efficacy (and recurrence). Although these topics will be covered in depth, the course is designed for a multidisciplinary audience encompassing basic scientists, engineers and others in the Georgia Tech community.

Instructor(s): Al Merrill, Biology (al.merrill@biology.gatech.edu)
Eva Lee, Industrial and Systems Engineering, Director, Center for Operations Research in Medicine and HealthCare (evakylee@isye.gatech.edu)
with faculty from the Colleges of Sciences and Engineering at Georgia Tech as well as special invited lecturers from Emory and elsewhere.

Teaching assistant: Po-Yi Ho (bio4015ta@gmx.com)

Time and location: Thursdays, Classroom: 5:05 to 7:55 pm; Howey (Physics) L3
(sometimes 7:05 to 7:55 pm will be dedicated to small group meetings)

Optional textbook: No textbook covers all the information in this course, but if you want a general overview of cancer biology, two recent (and good) books on cancer biology are: *Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, 3rd Edition* by Lauren Pecorino (Oxford University Press, 2012) and *The Biology of Cancer, 2nd Edition* by Robert A. Weinberg (Garland Science, 2013). The Pecorino book is a general (and relatively inexpensive) overview, whereas, the Weinberg book is more in-depth (the tables of contents for these books are given at the end of this syllabus). The Tech library has been requested to put a copy of each on reserve. All of the information that you will be required to know will be presented in class or assigned research papers. The course will also refer to the relatively recent document prepared by Georgia Tech entitled "Innovations in Cancer Biology, Detection and Treatment" which can be downloaded from T-Square or the web site:

<http://gtresearchnews.gatech.edu/wp-content/uploads/2011/06/Georgia-Tech-CancerPublication-2011.pdf>

Grading:	Exams (Mid-term exam, 30%; Final exam, 30%)	60%
	Team research project (Festival presentation and final poster, 20%; Individual written report, 20%)	40%

Final grades will be assigned by the scale: 90% and greater (A); 80-89% (B); 70-79% (C); 60-69% (D); Less than 60% (F)

Course format: Classes will be comprised of introductory lecture(s), discussion of research literature, and team projects.

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Date	Topic(s)	Faculty
Aug. 21 (1)	5 pm An overview of cancer 6:30 pm Meeting to organize small groups	A. Merrill, PhD (GT Biol)
Aug. 28 (2)	5 pm Cell signaling and cancer biology 6:30 pm Small group meetings to discuss their papers/topic	A. Merrill, PhD (GT Biol)
Sept. 4 (3)	5 pm Tumor detection methods 6 pm Special topic discussion: Mechanics and Malignancy: How forces contribute to tumor growth and metastasis 6:30 pm Small group meetings to discuss their papers/topic	A. Merrill, PhD (GT Biol) Michelle Dawson, PhD (GT ChBE)
Sept. 9	Teams send CBT team & topic form to TA	
Sept. 11 (4)	5 pm Cancer genetics and epigenetics 6:30 pm Small group meetings to discuss papers/topic	Paula Vertino, PhD (Emory Radiation Oncology & Winship Cancer Institute)
Sept. 18 (5)	5 pm Special topic discussion: Microfluidic and imaging technologies for cancer biology 5:45 pm Flash talks covering papers selected	Hang Lu, PhD (GT ChBE)
Sept. 25 (6)	5 pm Tumor virology (brief discussion of the MD/PhD career path, and other service) 6 pm Special topic discussion: Nanomedicine 6:30 pm Flash talks covering papers selected	Margaret K. Offermann, MD, PhD (Emory, ACS, FASEB) Mostafa El-Sayed, PhD (GT Chemistry)
Oct. 2 (7)	5 pm Prostate cancer 6:15 pm Flash talks covering papers selected	Omer Kucuk, MD (Emory Hematology & Medical Oncology)
Oct. 9 (8)	5 pm Computational methods in cancer informatics, early intervention, diagnosis, and treatment 6 pm Flash talks for projects with Biocomputing components	Eva Lee, PhD (GT ISyE)
Oct. 16 (9)	5 pm Mid-term exam 6:15 Special topic discussion: Nanoprobe and nanodevice design, characterization and applications to cancer 7 to 8 pm Flash talks for other projects	Po-Yi Ho (biology) Gang Bao, PhD (GT BME)
Oct. 23 (10)	5 pm Special topic discussion: image RNAs in cancer cells 5:45 pm Special topic discussion: Quantum dots for bioimaging and biodiagnostics 6:30 to 8 pm Flash talks for other projects	Phil Santangelo, PhD (GT BME) Brad Kairdolf, PhD (Emory GT BME)
Oct. 30 (11)	5 pm Breast cancer and nanomaterials for cancer therapy 6:30 to 8 pm Flash talks for other projects	Julie Champion, PhD (GT ChBE)
Nov. 6 (12)	5 pm Basic and clinical aspects of ovarian cancer 6:30 pm exchange poster drafts and discuss	John McDonald, PhD (GT Biology; Ovarian Cancer Institute)
Nov. 12	Nearly final drafts of the posters due (e-mail to TA)	
Nov. 13 (13)	5 to 7 pm Final preparations for Festival (review of posters, etc.)	Al Merrill, PhD (GT Biol)
Nov. 20 (14)	5 to 7 pm Georgia Tech Festival of Research Ideas in Cancer Biology and Technology, IBB Atrium	Entire class
Nov. 27	No class Thanksgiving holiday	
Dec. 2 4	Revised posters due by e-mail to TA Individual written reports due in class	
Dec. 4 (15)	5 pm Review of principles and approaches covered	A. Merrill (GT Biol)
Dec. 11	5 pm Final exam (all lectures & information presented on student posters)	

Team research paper analysis and presentation at the Festival of Research Ideas in Cancer Biology and Technology

The goal of this portion of the course is to give you a chance to work on a challenging problem in the area of cancer biology and technology. During the first week of class, the instructors will have you divide into teams of approximately 5 members per team, and over the next two weeks you will pick a research paper that addresses some facet of cancer that involves technology.

The team will fill in the “CBT team & topic” form (download template from T-square) and send it to the TA by Sept. 9. We will go over these during part of the Sept. 11 class to try to refine the selections, if necessary.

For the next several weeks, you will analyze the paper and think about how its technology can be improved or applied. You are responsible for exploring the published research literature to broaden your understanding of the technology you have selected, and encouraged to discuss your ideas with the instructors and any persons at Tech, Emory or other institutions who might be of assistance.

The TEAM deliverables are:

a) Two in-class progress reports on the technology and your thoughts about how to improve/apply it. These will be given as “flash talks”—one to give a brief outline of the paper/project selected, the other to explain how the group plans to extend the work. Flash talks are Powerpoint presentations with just the essentials summarized in 5 slides in 5 minutes followed by 5 minutes of discussion with the instructors and class about how it might be improved. Thus, the first flash talk will cover (in one slide each): What is the need? What is done now? How does this paper propose to meet the need? What evidence is there that it works? What do the authors (and/or you) suggest should be done next?. The second flash talk will give only a very abbreviated background on the need and current technology (one slide), one summarizing what this paper has done, then three slides explaining how your group proposes to extend the work.

Depending on how many teams there are, scheduling these talks in the time allowed might be difficult. If there are too many groups; we might divide into smaller groups that present the information and critique each other rather than present this to the entire class.

b) A poster that describes the technology and your proposal about how to improve or apply it (the format for this will be discussed in class). Drafts of all posters must be ready for review in class on November 6. They do not need to be printed in full size for this class, but can be brought to class on a USB drive or printed a size that can be read easily (such as 11 x 14”).

c) Presentation of the poster at the Festival of Research Ideas in Cancer Biology and Technology on November 20

d) Revision of the poster in response to suggestions at the Festival

e) Submission of the revised poster (electronically) to the TA before class on Dec. 2 (so we can review them and post them on T-square for everyone to have access to the information).

EACH individual member of the team is also responsible for sending a one-to-two page summary of the technology and its improvement/application (in his/her own words—this must be written by YOU and not cut-and-paste from the team’s report) (this is due to the TA before class on Dec. 4). More details about what must be included in this summary will be posted on T-square. The purpose of this separate summary is to ensure that all team members work closely enough with the project that they can clearly describe its content, and it is also an opportunity for each team member to explain their role in preparing the final poster and any particular ideas that they might want to express that didn’t appear in the final version.

When teams present their works-in-progress, they will fulfill item “a” above. When undergraduate students listen to these presentations, they will earn credit toward their participation grade; graduate students

will be randomly assigned to provide written suggestions for improving the projects and the draft posters, and these will be part of their in-class participation. Participation in the festival will also count toward the participation grade.

The Georgia Tech Festival of Research Ideas in Cancer Biology and Technology. This will be held in the atrium of the Petit Institute of Bioengineering and Biosciences from 4 to 7 PM on November 20. This will be publicized to the cancer research community essentially as follows:

Goal: You are invited to attend the third Festival of Research Ideas in Cancer Biology and Technology at Georgia Tech. The purpose of this event is to provide an open and stimulating forum for exploration of new ideas for basic and translational research in cancer biology and technology. Ideas for how new technologies can be applied to cancer as well as findings from ongoing research at Georgia Tech, the Winship Cancer Center at Emory University, and local institutions will be presented in the Atrium of the Petit Institute for Bioengineering and Biosciences. Contact al.merrill@biology.gatech.edu for more information, including if you are a cancer researcher and would like to display a poster on your work.

Thus, your posters will be viewed not only by your student colleagues but also by professional cancer researchers (and likewise, you will see posters from some of their work). Any useful suggestions/comments that you receive should be used to revise your poster and its suggestions for improvement/application of the technology before you submit an electronic copy of the revised poster to the TA. The final version should be sent both as a Powerpoint slide and as a pdf file.

Grading for this portion of the course: All members of a project group will receive the same grade for the report (worth 25% of your final grade) **plus an individual grade (worth 20%) for the one-page summary.**

NOTE: If there is any difficulty with respect to a member of the group who is not fulfilling their share of the responsibilities for the team project, contact Dr. Merrill as soon as possible. Conversely, if anyone decides they are not comfortable in a group, they should change within the first few weeks.* At the end of the semester, you will need to declare what has been your role in preparing the poster and presenting it at the Festival), so it is in the best interest of everyone if non-participation by any member of the team is identified and solved as soon as possible.

*In exceptional circumstances, it might be possible for a student to prepare a report alone.

Additional information (required by 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, quizzes, 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 phrases, 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.

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

Plagiarizing 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.

For team oral presentations, students may collaborate in all aspects of the work, indeed, it is expected that all will contribute equally to the final product and that they will share the single grade that is awarded for the ppt presentation. Students may use copyrighted figures, etc. from publications in the ppt presentation (if appropriate citations are given) because the ppt will only be posted on the access restricted WebCt website. However, if the team uses multiple copies of any copyrighted items (such as the pdf file of a copyrighted article), each student must download their own copy from the Georgia Tech library website rather than for one student to distribute the pdf.

In the event the assigned paper has been used by a previous class, students are not allowed to use any of the ppt slides in whole or part that were prepared by the other class.

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.

Table of Contents for optional textbooks: this might be helpful to you in deciding which textbook to consult if you need supplemental reading.

**Molecular Biology of Cancer. Mechanisms, Targets, and Therapeutics, Third Edition
Lauren Pecorino (Oxford Press)**

1. Introduction
2. DNA and Stability: Mutations versus Repair
3. Regulation of Gene Expression
4. Growth Factor Signaling and Oncogenes
5. The Cell Cycle
6. Growth Inhibition and Tumor Suppressor Genes
7. Apoptosis
8. Stem Cells and Differentiation
9. Metastasis
10. Infections and Inflammation
11. Nutrients, Hormones, and Gene Interactions
12. The Cancer Industry: Drug Development and Clinical Trial Design
13. Cancer in the Future: Focus on Diagnostics and Immunotherapy

The Biology of Cancer, 2nd Edition

Robert A. Weinberg (Garland Science)

1. The Biology and Genetics of Cells and Organisms
2. The Nature of Cancer
3. Tumor Viruses
4. Cellular Oncogenes
5. Growth Factors, Receptors, and Cancer
6. Cytoplasmic Signaling Circuitry Programs Many of the Traits of Cancer
7. Tumor Suppressor Genes
8. pRb and Control of the Cell Cycle Clock
9. p53 and Apoptosis: Master Guardian and Executioner
10. Eternal Life: Cell Immortalization and Tumorigenesis
11. Multi-step Tumorigenesis
12. Maintenance of Genomic Integrity and the Development of Cancer
13. Dialogue Replaces Monologue: Heterotypic Interactions and the Biology of Angiogenesis
14. Moving Out: Invasion and Metastasis
15. Crowd Control: Tumor Immunology and Immunotherapy
16. The Rational Treatment of Cancer