BIO344 – Special Topics: Cancer Biology
Fall 2016

Meeting Times and Locations:
Classroom: Monday, Wednesday, Friday 8:00am – 8:50am in NHS - Rm. 305
Laboratory: Thursday 1:30pm – 4:20pm in NHS - Rm. 225

Contact Information:
Professor: Laura Burrack
Office Location: NHS - Rm. 221A Phone: x7325
Email: lburrack@gustavus.edu (Email is the preferred way to reach me. I try to respond to emails within 24 hours.)
Drop-in office hours: Mondays 2:30 – 3:30pm, Wednesdays 10:30am – noon, and Thursdays 10:30am – noon.
I am here to help you understand the material and be successful in the class (and beyond). I welcome talking with students outside of class and meeting in person is often the best way to communicate, especially for questions about the material. Feel free to come to me with specific questions about the class or with general questions about science or your future. You can drop by my office hours or e-mail to set up an appointment.

Course Materials:
- Textbook (required): *The Biology of Cancer*, 2nd Edition, by Robert A. Weinberg
- Additional readings from the primary and secondary literature will be provided
- Course website:
    - Please regularly check our class website for documents such as additional readings and assignments. http://moodle.gac.edu. Lecture PowerPoint files and homework assignments will be available on Moodle in the page titled "2016 f-bio-344-001." Use your email username and password to log in.
    - If there is a problem with a *particular document*, please contact me. If you're having trouble getting Moodle to work *in general*, you should contact Gustavus Technology Services (GTS).
    - Course announcements will be made in class and via email. It is your responsibility to check your @gustavus.edu email regularly.
- Lab manual – will be provided as sections on Moodle and in class
- You must purchase a bound notebook or a three ring-binder to use as a lab notebook.

Course Description:
Cancer is a broad class of diseases with significant human health impacts. This course will explore a selection of the mechanisms by which genetic changes permit uncontrolled cell growth in cancerous cells. We will examine how altered cell-cell interactions and physiology permit cancer cells to metastasize to multiple tissues. Additionally, we will discuss immunological defenses and modern treatment approaches that limit cancer cells' growth and spread. The course will emphasize reading and analyzing landmark and recent primary research papers. The laboratory portion of the class will include experiments such as characterizing the response of cells to commonly used chemotherapy drugs. Students will have the opportunity to learn a variety of techniques such as mammalian cell culture as well as work in small groups to design an experiment and carry out this experiment in lab.

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Course Learning Objectives:
After this class, you will be able to:

- Describe molecular alterations in cancer cells and understand how these alterations contribute to tumorigenesis and metastasis
- Understand cancer and the development of chemotherapy resistance as evolutionary processes
- Read, evaluate and discuss primary literature on various areas of cancer biology.
- Critically examine our current understanding of cancer biology and evaluate strategies to improve patient treatment.
- Apply knowledge about cell growth and division mechanisms to design and execute an independent project studying perturbation of the cell cycle with chemotherapy drugs using mammalian tissue culture cells.
- Communicate scientific results in various formats including poster presentation and writing for a general audience.

For a larger picture view of how BIO344 fits into the larger curriculum in the biology department and the college as a whole, please see: "BIO344: Learning Outcomes" posted on Moodle.

Weekly Summary Sheets:
A summary sheet will be handed out at the end of each week. The summary sheet is meant to highlight readings, assignments and laboratory details for the following week. Please note that the readings given for a particular day are to be completed in advance of the lecture for that day. A typical weekly summary sheet will contain:

1. Details on reading assignments for the upcoming week
2. Indication of upcoming assignments and exams
3. Laboratory activities for the week

Assessment:

Exams (3x50 points)	150 points
Response papers (5x15 points, lowest score of 6 dropped)	75 points
Clinical trials assignment	50 points
Class participation and paper discussion leading	25 points
Independent project proposals	25 points
Independent project project poster	50 points
Lab notebooks	25 points
Lab participation and citizenship	25 points
	Total = 425 points

Grading Scale:

93-100%	A	77-79%	C+
90-92%	A-	73-76%	C
87-89%	B+	70-72%	C-
83-86%	B	65-69%	D+
80-82%	B-	60-64%	D
		Below 60%	F

Final grades will be based on the percentage scale provided above and not on a "curve". Thus, you will not be competing with your fellow students for a pre-determined allocation of grades. You can calculate your current grade at any time during the semester.

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Further explanation of assessment categories:

Exams: There will be 3 exams covering specific content related to the concepts, techniques and application of Cancer Biology. Each exam will build on content and techniques as we move throughout the semester, but will focus on material covered more recently.

Response papers: There will be 6 written response paper assignments pertaining to the primary research journal articles. Each paper assignment will be worth up to 15 points and will be due at the beginning of class on the day of the discussion (marked as JC #1-6 below).

Clinical trials assignment: To explore future possibilities for cancer treatments, one course assignment is a report on a current clinical trial for a novel anti-cancer treatment. This assignment is worth 50 points and should be both scientifically accurate and written for a general audience. Options for formatting include a magazine article, blog post, etc. Creativity in the format is encouraged.
Important dates: 11/9 Clinical trial selection and format choice due
11/30 Draft of clinical trials assignment due (optional – feedback returned by 12/7)
12/14 Final clinical trials assignment due

Paper presentation/discussion leading and class discussion: Participation in class discussions and activities is essential. I am not simply counting the number of times each student speaks, but rather participation is meant to reflect preparation and active engagement with the material. I will try to structure discussions so that each member of the class has an opportunity to participate in a way that works for them. I will give you feedback partway through the semester. In addition to my own observations, you will be tracking your own participation via a Moodle feedback survey each week.

During the semester, each student will work in a small group to provide background information and lead the discussion of a primary literature article (JC #1-#6 on schedule below). The background information presentation will be given the class period before we discuss the paper to help put the paper into context and provide background information on major techniques used. Students will then be responsible for helping to lead the class discussion of the paper. The group will meet with me ~1 week before the JC date on the syllabus.

Independent project proposals: For your independent project, you will complete a proposal for your project. This proposal has two parts (both due Friday 10/21 by noon):
1) Background and Rationale (15 points) To be completed individually.
2) Experimental Plan and Materials Needed (10 points) To be completed with your lab group.

Independent project poster: Lab projects will focus on chemotherapy drug responses in mammalian tissue culture cells. For several weeks, you will be working in small groups on an independent project of your own design, Based on these projects, we will have a class poster session on Thursday December 8th. Evaluation will be based both on the poster and on your individual presentation during the poster session.

Lab notebooks: Several times throughout the semester, I will check lab notebooks without warning. Lab notebooks are an essential record of your research and in this class will serve as your "lab reports". Make sure you are following the format and suggestions found in the lab manual handout given out on the first day of lab.

Lab participation and citizenship: This category will include lab effort, such as coming in outside of scheduled time when necessary and being prepared and focused during lab time, sharing plans and results informally during lab meetings, and lab citizenship, such as keeping your bench organized and clean, being courteous and helpful toward your peers, having a positive attitude, keeping pipette tip boxes filled, etc. I will give you feedback on partway through the semester, after you have spent some time in lab.

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Attendance Policy:
Attendance and participation in class is required. Please notify me *at least* one week in advance if you anticipate a scheduled absence (such as an approved athletic event, a graduate school interview, or celebration of a religious holiday) or as soon as possible in case of illness. Absences for medical or other emergencies may be considered excused at my discretion if they are verified by documentation. For all pre-arranged absences, any classwork due during the time of the absence must be turned in by the scheduled due date. Unexcused absences in lecture or in lab will have consequences for class and lab participation grades. Unexcused absence for exam dates will result in a score of 0 on the exam. Tardiness to class or to lab will also negatively impact participation points.

Late Policy:
Late assignments will be penalized 20% of the possible points per day. If an assignment is due at the beginning of class and you are late for class, your assignment will be considered late. Computer problems do not constitute a legitimate excuse for late work. Each student will be allowed one 48 hour extension per semester for any reason – use it wisely! To use this extension, you must contact me via email at least 12 hours before the assignment is due.

Questions about your exams or assignments:
I am happy to discuss your exams and assignments, but make sure you consult keys, your notes, etc. as appropriate to make sure our discussions can focus on your understanding and improving performance in the future. If you have a concern about your grade, please wait 24 hours before submitting your re-assessment request. If you request a re-assessment of any question, write a rationale for why you believe I should re-consider your answer, and include your original exam, quiz or homework assignment with the request. Reassessment requests must be submitted in writing and within 1 week of receipt of the grade. I will respond to you within 48 hours. I reserve the right to re-grade your entire assignment.

Technology:
I expect that cell phones will not be used in class. Research has shown that for many individuals the processing and synthesis necessary to take notes on paper improves recall of concepts on tests compared to typed notes (Mueller and Oppenheimer 2013 - http://pss.sagepub.com/content/25/6/1159.abstract). I would encourage you to try to take notes by hand. However, not all students have the same needs, so if you prefer to use a laptop - that is fine, but please speak with me first. If you use a laptop to take notes, do not use it for purposes unrelated to class; it is rude to me and even more importantly, distracting to your peers. I will ask you to put away your computer for the class period if you are doing other types of work or are playing on it.

Reference Desk Assistance:
The library's Reference Desk provides one-on-one guidance to help you with your research. The reference librarians will help you find information on a topic, develop search strategies for papers and projects, search library catalogs and databases, and provide assistance at every step. Drop-ins and appointments are both welcome. Visit https://gustavus.edu/library/reference_question.php for hours, location, and more information.

Group Work and Academic Honesty:
As science is a collaborative process, it is my hope that you will discuss your readings, assignments, and laboratory work with each other. However, it is expected that all group members will participate in laboratory work and that graded work should be the unique product of the individual turning it in unless otherwise specified. You have agreed to abide by the academic honesty policy and you will sign this honor code on all assignments: "On my honor, I pledge that I have not given, received, or tolerated others' use of unauthorized aid in completing this work." Cheating on exams, parasitizing group members and plagiarism never will be tolerated. Plagiarism is defined as using the ideas and/or words of another and representing them as your own *and includes pasting material from web sites*. If you are dishonest in your work, I will discuss it with you and the Dean, and you will earn a 0 for the

assignment. Students fail the course if they repeat it a second time. “It is plagiarism if you use an author’s key phrase or sentence structure in a way that implies they are your own, even if you cite the source. Instead, enclose the original wording in quotations and cite the source. Better yet, put the whole passage in your own words.”[1] Excessive quotations (>2) and reliance on websites are not acceptable. To cite a source, use a technique that you are comfortable with (footnotes, parenthetical citations, etc). I am not picky about your citation method, but ask that you are thorough, honest and consistent. Full descriptions of the Academic Honesty Policy and the Honor Code can be found in the Academic Catalog (online at www.gustavus.edu/general_catalog/current/acainfo).

1. McMillan, V.1998. *Writing Papers in the Biological Sciences*. Bedford Books, New York. Pgs. 44-46.

Accessibility (Resources for Students with Disabilities and ELL):
I am committed to ensuring that all students fully participate. We will work together to ensure this class is as accessible and inclusive as possible. Gustavus Adolphus College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or you think you may have a disability of any nature) and, as a result, need reasonable academic accommodation to participate in class, take tests or benefit from the College’s services, then you should speak with the Disability Services staff, for a confidential discussion of your needs and appropriate plans. Course requirements cannot be waived, but reasonable accommodations may be provided based on disability documentation and course outcomes. Accommodations cannot be made retroactively; therefore, to maximize your academic success at Gustavus, please contact Disability Services as early as possible. Disability Services (www.gustavus.edu/advising/disability) is located in the Academic Support Center. Disability Services Coordinator, Kelly Karstad, (kkarstad@gustavus.edu or x7138), can provide further information.

Support for English learners and multilingual students is available through the Academic Support Center’s Multilingual Learner Tutor (https://gustavus.edu/advising/). The MLL tutor can meet individually with students for tutoring in writing, consulting about academic tasks, and helping students connect with the College’s support systems. When requested, the MLL tutor can consult with faculty regarding effective classroom strategies for English learners and multilingual students. If requested, the MLL tutor can provide students with a letter to a professor that explains and supports appropriate academic arrangements (e.g., additional time on tests, additional revisions for papers). Professors make decisions based on those recommendations at their own discretion. In addition, English learners and multilingual students can seek help from peer tutors in the Writing Center (https://gustavus.edu/writingcenter/). Questions can be directed to Dean Julie Bartley (jbartley@gustavus.edu or x7541) or Dean Micah Maatman (mmaatman@gustavus.edu or x7541).

Title IX
Title IX is federal legislation that makes clear that violence and harassment based on sex or gender are civil rights violations. Gustavus Adolphus College takes incidents of sexual misconduct and sexual harassment seriously. For examples and more details, please see www.gustavus.edu/deanofstudents/policies/gustieguide/sexualassault.php#misconduct. Sexual Harassment is any behavior of a sexual nature that is unwelcome, offensive or fails to respect the rights and dignity of another person whether of the same or opposite sex. (Please see: www.gustavus.edu/facultybook/allcollegepolicies/#Anchor-Sexua-60443.) Not all college employees are mandatory reporters. However, all faculty are legally mandatory reporters and must make a formal report to the Dean of Students Office within twenty-four hours. The college will respect the confidentiality of the victim and alleged offender(s) as much as possible consistent with the College’s legal obligations. Students also always have a choice as to whether to participate in an investigation or not. The only exception to this reporting responsibility for Gustavus employees is that conversations with SART/CADA, Chaplains, Counseling Center staff, and professional health care staff may be kept strictly confidential. SART/CADA can be reached 24 hours a day at 507-933-6868. If you have any questions, contact the Title IX Coordinator (Julie Kline, Director of Human Resources, at 507-933-6075) or one of the deputy coordinators (https://gustavus.edu/titleix/titleix.php).

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Tentative Class Schedule and Readings (Subject to change if necessary)

Date	Discussion Topic	Reading from textbook (or Moodle)
W Sep 7	Cancer: Past and Present	
F Sep 9	Types of cancer and common causes	BOC 2.1-2.4, 2.8-2.11
M Sep 12	Overview of hallmarks of cancer	(Hanahan and Weinberg, 2011)
W Sep 14	Viral causes of cancer	BOC 3.1-3.7
F Sep 16	Introduction to oncogenes, JC #1 Intro	BOC 3.8-3.12
M Sep 19	Viral oncogenes (JC #1)	(Goodwin *et al.*, 2000)
W Sep 21	Cellular Oncogenes	BOC 4.1-4.6
F Sep 23	Growth factors and receptors	BOC 5.1-5.6, 5.10
M Sep 26	Signaling pathway interactions	BOC 6.1-6.6
W Sep 28	No Class - Nobel Conference	
F Sep 30	Tumor suppressor genes	BOC 7.2-7.9
M Oct 3	Tumor suppressor genes: pRb, JC #2 Intro	BOC 8.1-8.6, 8.12
W Oct 5	pRb (JC #2)	(Collins *et al.* 2012)
F Oct 7	p53	BOC 9.2-9.10
M Oct 10	Exam 1	
W Oct 12	Avoidance of Apoptosis	BOC 9.13-9.16
F Oct 14	Cell Immortalization, JC #3 Intro	BOC 10.2-10.8
M Oct 17	Telomeres (JC #3)	(Hahn *et al.* 1999)
W Oct 19	Multi-step tumorigenesis	BOC 11.1-11.5
F Oct 21	Evolutionary models of cancer cells	BOC 11.6-11.12
M Oct 24	No Class – Fall Break	
W Oct 26	Tumor-promoting factors	BOC 11.13-11.17
F Oct 28	Genome instability, JC #4 Intro	BOC 12.8-12.12
M Oct 31	Chromosome instability (JC #4)	(Crasta *et al.*, 2012, Hatch and Hetzer 2015)
W Nov 2	miRNAs in cancer	BOC 1.10, (Adams *et al.*, 2014)

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F Nov 4	Cell-cell interactions	BOC 13.1-13.5
M Nov 7	Angiogenesis	BOC 13.6-13.10
W Nov 9	Tumor cell metabolism	(Cairns *et al.* 2011)
F Nov 11	Re-examination of hallmarks of cancer	(Hanahan and Weinberg, 2011)
M Nov 14	Exam 2	
W Nov 16	Cancer invasion and metastasis	BOC 14.1-14.4
F Nov 18	Metastasis, cont. JC #5 Intro	BOC 14.5-14.7, 14.12, 14.15
M Nov 21	Metastasis, cont. (JC #5)	(Yang *et al.*, 2004)
W Nov 23	No Class – Thanksgiving	
F Nov 25	No Class – Thanksgiving	
M Nov 28	Immunology introduction and overview	BOC 15.1-15.6
W Nov 30	Tumor immunology	BOC 15.7-15.13
F Dec 2	Immunotherapy applications	BOC 15.16-15.21
M Dec 5	No class – posters due for printing by noon to lburrack@gustavus.edu	
W Dec 7	Chemotherapy, JC #6 Intro	BOC 16.1-16.5
F Dec 9	Targeted chemotherapies, JC #6	(Oltersdorf *et al.*, 2005)
M Dec 12	Drug resistance	BOC 16.11-16.13
W Dec 14	Current advances in treatment	BOC 16.18
M Dec 19 3:30-5:30pm	Exam 3 (during final exam period)	

Detailed reading information (readings will be posted on Moodle):

Adams, B.D., *et al.* (2014) Aberrant Regulation and Function of MicroRNAs in Cancer. Curr Biol *24*, R762-R776.
Cairns, R.A., *et al.* (2011). Regulation of cancer cell metabolism. Nat Rev Cancer 11, 85-95.
Collins, M.J., *et al.* (2012). Loss of Rb Cooperates with Ras to Drive Oncogenic Growth in Mammalian Cells. Curr Biol *22,* 1765-1773.
Crasta, K., *et al.* (2012). DNA breaks and chromosome pulverization from errors in mitosis. Nature *482,* 53-58.
Goodwin, E.C., *et al.* (2000). Rapid induction of senescence in human cervical carcinoma cells. Proc Natl Acad Sci U S A *97*, 10978-10983.
Hanahan, D., and Weinberg, R.A. (2011). Hallmarks of cancer: the next generation. Cell *144*, 646-674.
Hahn, W.C., *et al.* (1999). Inhibition of telomerase limits the growth of human cancer cells. Nat Med *5*, 1164-1170.
Hatch, E.M. and Herzer, M.W. (2015). Quick guide: Chromothripsis. Curr Biol *25*, R391-408
Oltersdorf, T., *et al.* (2005). An inhibitor of Bcl-2 family proteins induces regression of solid tumours. Nature *435*, 677-681.
Yang, J., *et al.* (2004). Twist, a master regulator of morphogenesis, plays an essential role in tumor metastasis. Cell *117*, 927-939.

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Tentative Lab Schedule (Subject to change if necessary)
Lab date Lab activities (Thursday 1:30-4:20pm)

Sept. 8th – Introduction to mammalian tissue culture and immortalized cells, lab safety
Each student will sign up for a time for tissue culture demonstration and receiving cells on Thursday (Sept. 8th), Friday (Sept. 9th) or Monday (Sept. 12th)

Sept 15th – Quantifying cell growth/mitotic progression

Sept 22nd – Microscopy and cell viability assays

Sept 29th – Anti-mitotic chemotherapy drugs

Oct 6th – Data analysis/Intro to bioinformatics

Oct 13th – Lab meeting/Bioinformatics/Project planning

Oct 20th – Project planning (cont.)

Oct 27th – Independent project week 1

Nov 3rd – Lab meeting/Independent project week 2

Nov 10th – Independent project week 3

Nov 17th – Independent project week 4

Nov 24th – No Lab (Thanksgiving)

Dec 1st – Independent project data analysis and poster preparation

Dec 8th – Independent project poster session

Important Lab Assignment due dates:

Friday October 21st – Project proposals due by noon to lburrack@gustavus.edu

Monday December 5th – Posters due for printing by noon to lburrack@gustavus.edu

Thursday December 8th – In class presentations of posters