

BIO 40S: Advances in Cancer Biology Research and Cancer Treatments

SUMMER 2024

**STLC Rm 115
Tu/Th 10:30 – 11:50 AM**

Teaching Team

Instructor: Dr. David Armenta (he/him/his) | darmenta@stanford.edu | Office hours Wednesdays 11:00 – 12:00 PM, 2nd Floor of Sweet Hall or by appointment!

Teaching Assistant: Angel Rivera (she/her/hers) | a1rivera@stanford.edu | Office hours Tuesdays 1:00 – 2:00 PM, at the tables outside Blend Eatery or by appointment! <3

Office Hours

Please come see the teaching team at one of our regularly scheduled times (or make an appointment) to chat about the class, ask questions, or just say hi! If you want to speak with either of us privately, just let us know in advance and we can make an appointment. David's office hours will be in conference rooms on the second floor of Sweet Hall. Angel's office hours will be at the tables outside of Blend Eatery.

Course Description

Cancer is a ubiquitous global challenge—most families will be affected by it at some point in their lives. However, recent advancements in cancer treatment and prevention offer hope. In this course, we will delve into the fascinating world of cancer biology to explore groundbreaking research and treatment options.

Diving deep into the inner workings of cancer cells, we will discover the potential of revolutionizing treatments such as CAR T immunotherapy, a cutting-edge technique that genetically modifies a patient's own immune cells to recognize and attack cancer cells. We'll also explore the crucial role of the cellular environment around tumors and learn how targeting this microenvironment can improve the effectiveness of existing therapies. We'll examine the unique nutrient requirements of cancer cells and how this knowledge can be used to selectively kill cancer cells while sparing healthy ones. And we'll discuss the power of biomarkers in developing tailored therapies that can significantly improve cancer patients' quality of life.

Each class will consist of a mini-lecture and in-class learning activities. Students will be divided into groups and each group will be assigned a recent development in cancer therapy. The class will build towards a group Student-Led Lesson (SLL) and final group project consisting of a podcast-style audio report on the development in cancer therapy. By the end of this course, students will have gained a solid understanding of advances in cancer therapy and how they affect the future of cancer treatment.

Learning Goals

In this course, students will:

- Be able to explain what makes cancer cells different from healthy cells
- Understand how and why traditional cancer treatments work, and where they can be improved upon
- Develop an understanding for the rationale underlying new/future cancer therapies
- Improve their comprehension of scientific literature
- Be able to create and defend ideas in discussion groups

Course Expectations and Attendance Policy

1. This course is designed to help you understand recent developments in cancer research and cancer therapy
2. For this to be successful, we expect you to **come to class prepared**. This means reading all the materials, watching the videos, and completing the written assignments BEFORE class. It also means **participating** in class. There are many ways to participate actively in class, and I ask that you please refrain from using electronics in class for purposes other than those directly relevant to the current situation in class. It is distracting to you and your peers to use electronics for other purposes during class.
3. This goal is only possible **if you are in attendance**. We expect you to attend every section, unless you are unwell. However, we will allow a 2 absence “pass”—no questions asked—which can be made up with alternative work (usually writing/speaking). Please **email Angel** no later than 24 hours after the absence she will offer you a make-up assignment for your participation points.
 - a. Arriving > 5 minutes late will result in you losing your participation for the day and arriving very late for the class (more than 10 minutes) will count as an absence.
4. A note on word counts: Usually, assignments will have a word count—either a single number (e.g. 500 words), or a range (e.g. 750 - 1,000 words). Writing within a word count is an important skill to develop (and writing concisely and efficiently to fit within the word count while still meeting the prompt requirements is especially important). Thus, I ask that you please adhere to the word counts. If a single number is given, please stick to +/- 10% of that number (e.g. if we ask for 500 words, you should write between 450 and 550); if a range is given, please stay within the range. Not adhering to the word count as detailed above will result in docked points.

5. Participation in the creation of the final project is required for successful completion of this course.

Course Structure

1. Most of the material preparation assignments can be accessed through this syllabus, either as links or PDFs.
2. Announcements will be made through the Canvas site.
3. Homework should be submitted via Canvas Assignments.

Late Submissions

It is imperative to complete and submit assignments **on time**. Barring extenuating circumstances, late assignments will not be accepted for credit. Please reach out to us as soon as possible if extenuating circumstances arise.

Required Texts

All course preparation materials will be available through this syllabus.

Assignments

Each week, students will be assigned a short problem set based on the important concepts of the week.

Beginning Week 4, groups will have the opportunity to teach their classmates about their assigned aspect of frontier cancer therapies in a 35-40 minute SLL (Student-Led Lesson).

To help guide you all, **the teaching team will workshop your SLL with your group outside of class time** the week before your SLL assigned date. After our workshop together, you will have one week to edit your SLL before submission. Groups **MUST** email David and Angel their SLL lesson plan (and any associated slides) no later than 24 hours before their scheduled tutorial, and also email us finished lesson plans (and any associated slides) no later than 24 hours before their scheduled SLL (see SLL prompt on Canvas for full details).

Grading

Grading Item Category	Total Points	Category Description
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Attendance & Participation	15	Attend and participate in class (1 pt per session)
Weekly Assignments	24	Complete and submit 8 Weekly Assignments to Canvas (3 pts each)
Tutorial	8	Attendance and participation/preparation for 2 required tutorials: SLL tutorial and peer review script feedback (4 pts each)
Student-Led Lesson (SLL)	24	<ol style="list-style-type: none"> 1. Lesson Plan (6 pts) 2. Individual Discussion (6 pts) 3. Team Discussion (6 pts) 4. Reflection (6 pts)
Final Project	29	<ol style="list-style-type: none"> 1. Outline (7 pts) 2. Script Version 1 (7 pts) 3. Final Audio (8 pts) 4. Reflection (7 pts)
Total	100	

Final grades will be assigned according to the below scale.

A+	98–100 points
A	94–97 points
A–	90–93 points
B+	87–89 points
B	83–86 points
B–	80–82 points
C+	77–79 points
C	73–76 points
C–	70–72 points
D+	67–69 points
D	63–66 points
D–	60–62 points
F	0–59 points

The Honor Code

The Stanford Honor Code was composed by students in 1921 (updated in 2023), and expresses the university's expectations for academic integrity. Please read it [here](#). Together with the [Fundamental Standard](#), these documents lay out the rights and responsibilities of Stanford students, in particular with regard to their academic behavior. Some key points:

- Students cannot submit the same written work for different classes.
- Plagiarism (copying passages from other people’s work without attribution) is forbidden.
- Having someone else complete an assignment for you is forbidden.
- The use of or consultation with [generative AI](#) will be treated analogously to assistance from another person.

Classroom Behavior

I consider the classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, abilities, and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

Please attend to all university policy and classroom etiquette procedures. Those not heeding the policies will be asked to leave the classroom immediately to maintain the learning environment. Students failing to respect classroom norms and behavior may suffer a reduction in their final class grade through a withdrawal of attendance and participation points.

Stanford recognizes the inherent dignity of all individuals and promotes respect for all people. Hostility toward other students will not be tolerated. Free speech does not permit harassment, intimidation, threats, or other behaviors that impede the learning of other students or the work of faculty and staff. Please refer to the [Stanford Policies and Guidance](#).

Preferred Pronouns

I will gladly honor your request to address you by your chosen name and/or gender pronouns. Please advise me of this preference early in the quarter so that I may make appropriate notes on my records.

Access and Accommodations

I hope to make my class accessible to everyone. If you have an Academic Accommodation Letter, please share it with me at the earliest possible opportunity so I can work with you and OAE to identify and overcome any barriers to access and inclusion that might come up in this course.

Course Readings

Subject to change—please heed this live version instead of a downloaded copy

Week 1: Why is cancer so hard to cure?

- Watch: [Why is it So Hard to Cure Cancer?](#) – TED
- Watch: [The Reason Why Cancer is so Hard to Beat](#). Kurzgesagt – In a Nutshell

- Read: [Why is Cancer So Hard to Cure?](#) – Sydney Morning Herald
- Read: [New approaches and procedures for cancer treatment: Current perspectives](#) – Debela et al.

Week 2: How do traditional cancer therapies work?

- Read until section titled “Recent advancements and next-generation therapeutic approaches”, plus “Conclusions and Future Directions”: [Cancer chemotherapy and beyond: Current status, drug candidates, associated risks and progress in targeted therapeutics](#) – Anand et al.
- Read: [Radiation Therapy to Treat Cancer](#) – NCI
- Read: “[How is Surgery used in Cancer Treatment?](#)” and “[What are the Different Types of Surgery Used in Cancer Treatment?](#)” – Stanford Health Care

Week 3: What features do cancer cells tend to have?

- Read: The original [Hallmarks of Cancer review](#) (2000, Hanahan & Weinberg)
- Read: The [updated Hallmarks of Cancer review](#) (2011, Hanahan & Weinberg)
- Read: At least until “Unlocking Phenotypic Plasticity”, plus Figure 6, in the [newest Hallmarks of Cancer review](#) (2022, Hanahan)

Week 4: How can the immune system help fight cancer?

- Read: [CAR T Cells: Engineering Patients’ Immune Cells to Treat Their Cancers](#) — American Cancer Society
- Read: [A guide to cancer immunotherapy: from T cell basic science to clinical practice](#) — Waldman et al.

Week 5: How do the nutrient requirements of cancers present unique vulnerabilities?

- Read: [Targeting Nutrient Dependency in Cancer Treatment](#) – Fan et al.
- Read: The following sections of [Nutrient metabolism and cancer in the in vivo context: a metabolic game of give and take](#):
 - o Introduction
 - o Therapeutic window of dietary interventions
 - o Implications of gut microbiome in the diet-cancer interaction, including Figure 1
- Read: [Starving Cancer Cells Could Help Treat Glioblastoma](#) – Scientific American

****Final Project Outline due Sunday at 11:59 PM****

Week 6: How can tailored therapies help treat cancers?

- Read: [Targeted Therapy for Cancer](#) – National Cancer Institute
- Read: [Precision Oncology: Who, How, What, When, and When Not?](#) – Schwartzberg et al.
- Read: [Rational combinations of targeted cancer therapies: background, advances and challenges](#) – Jin et al.

****Final Project Script due Sunday at 11:59 PM****

Week 7: What features of the tumor microenvironment may be exploited for cancer therapies?

- Read: the following section of [Nutrient metabolism and cancer in the in vivo context: a metabolic game of give and take](#)
 - Do oncogenic mutations and tissue origin drive specific nutrient dependencies during tumor initiation? (including Figure 2)
- Read: [Tumor Microenvironment as a Therapeutic Target in Cancer](#) – Xiao & Yu

****Final Project Audio due Sunday at 11:59 PM****

Week 8: Podcast screenings and recap

- No assigned readings

****Final Project Reflection due Wednesday at 11:59 PM****