

The Biology and Engineering of Superheroes

Bioengineering 88S | University of California, Los Angeles | Spring 2018

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Class Time: 4pm Mondays @ Boelter 5420
Office Hours: TBD, by appointment

Course Description

Through the ages and across the world, ordinary human beings have always searched for ways to surpass normal human limits. To scratch this itch, we invented superheroes – fictional, bigger-than-life characters with exceptional abilities and powers. From Hercules to Superman, superheroes have served as role models to those who endure against seemingly impossible challenges.

However, vast scientific achievements have been made since the conception of today's most popular superheroes. The contributions made by modern-day scientists, physicists, and engineers have given us greater understanding of the world around us and helped us bridge the gap between reality and fantasy.

This course will dive deeper into the scientific gap between normal human beings and superheroes. Together, we will learn what it biologically means to be ordinary, evaluate the feasibility of superpowers, and explore if new technology can gift ordinary humans with superhuman abilities.

Course Objectives

The objectives for this course are:

- To learn about and understand relevant and applicable physics and human biology concepts
- To use physics and biology concepts to evaluate how realistic superpowers are
- To explore efforts in innovative research that may make superpowers achievable
- To think critically and ethically regarding controversial topics affecting bioengineering

Class Policies

No Prior Knowledge Needed

This course is designed to accommodate students of all majors; no prior knowledge of biology, physics, or engineering is necessary to be successful in the class.

Late Work & Make Up Policy

Late assignments will be docked 10% for every day that it is late. However, in case of an emergency, please contact me so we can make arrangements!

Contact Policy

All emails should include “BE 88S” in the subject line. Please give me 24-48 hours to respond to your email. Emails received after 5pm on Friday may or may not be responded to until Monday.

Plagiarism

Please do not plagiarize: it is against school policy and is detrimental to the learning of yourself and your peers. See UCLA's paragraph on academic integrity for clarification:

<http://www.deanofstudents.ucla.edu/Academic-Integrity>.

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Grading

This course is a 1-unit, P/NP seminar. A passing score in this course is 72% final grade.

Reflections (3)	30%
Participation (15% In-Class Participation, 15% Attendance)	30%
Final Project (15% Reflection Paper, 25% Presentation)	40%

Assignments

Assigned Readings

All assigned readings are required and will be posted on CCLE.

Reflections

The purpose of the reflection assignments is to evaluate the student's understanding of the subject. Students are expected to write one-page double-spaced papers reflecting on the assigned readings and class discussions. In the reflection assignments, students will make connections with outside readings, current events, or personal experiences. Reflections are submitted online via CCLE and due by 11:55pm Fridays on weeks that they are due.

Participation

Students are expected to come to class each week having read the assigned reading for that week. Participation is graded on two components.

- **In-Class Participation**: In-class participation will be graded based on level of engagement in and contributions to discussions during class time. Students should show that they have read and thought about the reading material. As we will discuss in our class, technology helps facilitate quick access to information. However, if I see students who abuse this privilege and are using technology such as phones and/or laptops inappropriately, I will have to ask students to refrain from using technology in class and bring in paper copies of readings instead.
- **Attendance**: Students will also be given opportunities to provide feedback and suggestions in the form of weekly course evaluations at the end of each lecture. Attendance will be taken using these course evaluations. Two or more unexcused absences may result in a grade of **No Pass**, so please let me know if you are having any issues so we can make arrangements.

Final Project

In the final project, students will choose a superpower by Week 7 and scientifically dissect it, as we have done in class in the previous weeks. Students will work in pairs for the final project, which is composed of two parts.

- **Reflection Paper**: Students will submit a three page double spaced reflection paper on the final project and/or course in general. Students will need to *submit separate reflection papers*.
- **Presentation**: A 3-minute presentation will be made for each superpower. A rubric will be provided later in the quarter that will detail the expectations of the presentation.

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Course Outline

DATE	TOPICS AND READINGS
Week 1 [4/2]	Introduction and Motivation In this lecture, we will discuss the structure of the class, student expectations for learning, and experience an abridged version of future lectures.
Week 2 [4/9]	Superman Superman not only has to fight the forces of evil but also has to fight the forces of physics! During this week, we will calculate just how strong Superman really is. • Reading: "The Solar Cell Efficiency of Superman" by University of Leicester (2 pgs)
Week 3 [4/16]	Wonder Woman Are Wonder Woman's bullet deflection skills real? We'll put her bracelets to the test. • Due: [4/20] Reflection 1 • Reading: How the Creator of Wonder Woman Also Invented the Lie Detector by Rachel Swaby (4 pgs)
Week 4 [4/23]	Spiderman Just how strong are spiderwebs? Using fundamental centripetal acceleration equations, we will find out if Spiderman can actually swing from building to building. • Reading: "Spinning a new version of silk" by David L. Chandler (4 pgs)
Week 5 [4/30]	X-Men Genetic mutations are largely responsible for the diversity of life present on Earth. We will explore how mutations occur and ways researchers are exploiting them to advance science. • Due: [5/4] Reflection 2 • Reading: "Genome Editing with CRISPR-Cas9" (5 mins)
Week 6 [5/7]	Deadpool Today, stem cell research is a large focus of study in the field of regenerative medicine. During this lecture, we will discuss what stem cells are and the controversies surrounding the topic. • Reading: "What are Stem Cells?" by The MNT Editorial Team (9 pgs)
Week 7 [5/14]	Jean Grey While we aren't fully there yet, engineers are working hard to develop telepathic capabilities. This week, we'll learn about current and future research of brain-computer interfaces. • Due: [5/18] Reflection 3 • Due: [5/18] Final Project Proposals • Reading: "Neuralink and the Brain's Magical Future (Part 3)" by Tim Urban (30 pgs)
Week 8 [5/21]	Student Choice In this lecture, we will work together to explore and expand upon a superpower or superhero of the students' choosing. • Reading: TBD – Depends on superpower chosen
Week 9 [5/28]	Memorial Day
Week 10 [6/4]	Final Presentations Apply what you learned during the quarter to dissect your own superpower! • Due: [6/8] Final Reflection

* Please note that this syllabus is flexible and subject to change throughout the quarter. Students are encouraged to make suggestions for change through the weekly course evaluations. Any changes in the syllabus will be addressed in email and during lecture.

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Campus Resources

Attending and/or adjusting to college in a large campus can be difficult. If there are any issues that may affect your performance in this class, please let me know early on so we can make arrangements to help you succeed. Take advantage of...

Center for Accessible Education (CAE)

CAE is able to provide adequate accommodation for students with suspected and/or documented disabilities. Accommodation requests can be made at their office A255 Murphy Hall or over the phone 310-825-1501.

Counseling and Psychological Services (CAPS)

This is a multidisciplinary student mental health center for the UCLA campus. CAPS offers an array of free services, including individual counseling. If you suspect you are experiencing mental health problems or just need to talk, you can make an appointment at John Wooden Center West (facing Drake Stadium, second floor), over the phone 310-825-0768, or their website counseling.ucla.edu.

Campus Assault Resources & Education (CARE)

This is a confidential resource to seek support around sexual violence, including sexual assault, intimate partner violence, and stalking. The CARE Office seeks to create a safe and comfortable space for students to heal, and they also offer a CARE Advocate to support students in reporting, connecting to resources, and/or receiving accommodations. They offer the Yoga as Healing program, as well as alternative healing programs that happen every week.

Undergraduate Writing Center (UWC)

The Writing Center is staffed by peer learning facilitators (PLFs) and offers UCLA undergraduates one-on-one sessions at any stage in the writing process. Make an appointment by visiting www.wp.ucla.edu and clicking "Student Writing Center/Make and Appointment." For questions, call (310) 206-1320, email wcenter@ucla.edu, or just drop in.

Bruin Resource Center (BRC)

This resource center offers a connection to resources for all students, focused on building resilience, student development, and supporting wellbeing. The BRC offers resource referral, personalized support, personal/professional development, and a strong support network for students. Additionally, it houses the Undocumented Student Center (SAC B52), the Transfer Student Center (KH 128), the Veteran Resource Center (KH 128), Bruin Guardian Scholars, Students with Dependents, the Collegiate Recovery Program, the GRIT Coaching Program, and the Intergroup Relations Program. You can find the center at 220 Westwood Plaza B44, Students Activities Center, by phone at 310-825-3945 or via email at brc@saonet.ucla.edu.

LGBT Campus Resource Center (LGBTCRC)

This resource center provides a range of education and advocacy services supporting intersectional identity development. It fosters unity; wellness; and an open, safe, inclusive environment for lesbian, gay, bisexual, intersex, transgender, queer, asexual, questioning, and same-gender-loving students, their families, and the entire campus community. You can find the center at 220 Westwood Plaza B36, Students Activities Center, (310) 206-3628, or via email at lgbt@ucla.edu.