



USC University of Southern California

GESM-150: Putting the Science in Science Fiction (50472)

Units: 4

Term – Day – Time: Spring 2023 – Tuesday/Thursday – 9:30-10:50 AM

Location: VPD 107

Instructor: Aaron Wirthwein

Office: SHS-369

Office Hours: Tuesday 4:00-5:00 PM or by appointment

Contact Info: wirthwei@usc.edu

Teaching Assistant: Not yet assigned

Office: TBA

Office Hours: TBA

Contact Info: TBA

Course Description

Too often we hear scientific principles being espoused to refute or contradict the claims and fantasies entertained in famous works of science fiction. In this course we approach the “art of the possible” from the perspective of a physical scientist. We will attempt to understand and explain many topics featured in the genre of science fiction such as interstellar travel, teleportation, artificial intelligence, time travel, and more. To understand these topics, we will introduce theories, concepts, and formulas that may be daunting in stricter academic settings. There is a lot we can say about the science behind the stories and technologies of imagined futures, and the perspective we adopt by taking them seriously is filled with lessons about our own reality. This course is designed for the non-science or science major alike and assumes little-to-no background in science or mathematics at the university level. Students with a STEM background will find a unique application of their knowledge and skills towards understanding the science and technologies of the imagined worlds we will investigate. The central goal of this course is to understand the well-grounded scientific principles of today and how they inform science fiction, but we will also explore the broader context and implications of these works as they apply to our own lives and possible futures.

Learning Objectives

By the end of this course, students will be able to:

1. Think like a scientist. Students will learn and practice the scientific method. We will construct models of physical systems and test those models using empirical evidence.
2. Conduct a survey of peer-reviewed scientific literature. Students will learn how data is generated, presented, and interpreted.
3. Conduct a scientific analysis of famous works of science fiction. Students will dissect the essential components of each imagined phenomenon or technology and attempt to explain them using well-grounded scientific principles of today.
4. Utilize basic algebraic and quantitative reasoning in the application of scientific principles.
5. Think critically about contemporary issues in science and technology using the works of science fiction.

Communication

Announcements, illustrative material, grades, etc. will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

Students are expected to be proficient in using Blackboard. Students will require a hand calculator (e.g., on smartphone or personal computer) to do some of the laboratory and examination exercises.

Required Materials

Assigned readings, movies, and television shows.

We will engage with work from many of the great names in science fiction, including Jules Verne, Isaac Asimov, Arthur C. Clarke, Stanley Kubrick (tentative list) to name a few. See the schedule below for a comprehensive list.

Grading Breakdown

Laboratory assignments: Students must register separately for laboratory sections, which meet for approximately 2 hours once every other week. The labs will provide students with hands-on experience as they explore basic physical principles. Students will learn how to design an experimental apparatus and make quantitative measurements. Students will learn how to handle experimental uncertainties and present their numerical results in terms of confidence intervals. Laboratory sessions will begin during the week of January 16th. Lab exercises can be downloaded from Blackboard. The Teaching Assistant will grade all lab work; the instructor will intervene only in the case of conflicts.

Homework assignments: Approximately 7 assignments will be posted to Blackboard over the course of the semester. The due date for the assignment will be clearly posted and no late submissions will be allowed without instructor approval. The cumulative homework score, up to 15 grade points, will be computed for each student after dropping the student's lowest score. The primary purpose of the homework assignments is to guide you through active participation

with the course material on a personal level, and although discussing the homework with your peers is allowed (and encouraged), each student will submit their own assignment.

Examinations: The three examinations will evaluate student comprehension of the lecture and textbook material:

- Midterm Exam 1 will be given during class on Thursday, February 17th. It will cover only material up to the exam date.
- Midterm Exam 2 will be given during class on Thursday, March 23rd. It will cover only the material since midterm 1.
- Final Exam will be 8:00-10:00 AM on Tuesday, May 9th. It will be a *comprehensive examination*, covering all lectures and reading assignments throughout the term. The location will be announced during class.

If you want to do well on the exams, I encourage you to attend class, take notes, read the assigned materials, and review the lectures.

Missed examinations: *If you have to miss an examination because of illness or an academic conflict, you must inform the instructor by email in advance, and provide documentation.* Make-ups of examinations will, in general, NOT be permitted except for extraordinary circumstances (e.g., documentable conflicts with other USC-related commitments). In the case of a missed midterm, where a reasonable excuse exists, the midterm may be waived with a score assigned that reflects the average of your work done on the other two exams.

Final report and presentation: Beginning the first week of classes, students will make progress on an individual project of their choosing that must have relevance to a contemporary issue in science and technology (personal, societal, or environmental) or a topic of purely scientific interest. Students will meet regularly with the instructor to discuss their progress. The students must submit a written report and give an oral presentation. Requirements and grading rubrics for the final report will be posted to Blackboard.

Maximum Scoring for Each Grade Element

Student grades are based on the cumulative score of 100 grade points summed over five graded elements: laboratory work, homework assignments, two mid-term exams, and a final exam. The maximum number of points that can be earned for each element is given in the following table:

Graded Element	% of Grade
Laboratory Assignments	15
Homework	15
Midterm Exam 1	15
Midterm Exam 2	15
Final Exam	20
Final Report + Presentation	20
Total	100

Although the lab component counts for only 15% of the final grade, students must pass the laboratory component to receive a passing grade in the class.

Disability Services

Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed; please be sure the letter is delivered to the instructor as early in the semester as possible. DSP is open Monday-Friday, 8:30-5:00. The office is in Student Union 301 and the phone number is (213) 740-0776.

Grading Scale

Each student will receive a final grade based on their cumulative score.

- A: 90-100%
- B: 80-89%
- C: 70-79%
- D: 60-69%

Assignment Submission

All assignments will be posted on Blackboard, and all completed assignments will be submitted via Blackboard.

Communication Policy

To communicate with the instructor outside of class or office hours, email the instructor from your USC email account. In the subject line, indicate the course number and your full name. Simple questions will be answered by email, but for more complex discussions students may be instructed to visit office hours.

Sharing of course materials outside of the learning environment

USC policy prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

Residential and Hybrid Streaming Model Courses

The latest COVID-19 testing and health protocol requirements for on campus courses can be found on the [USC COVID-19 resource center website](#).

Course Schedule: A Weekly Breakdown			
	Lecture & Discussion Topics	Readings/Watch List	Laboratory
Week 1	Philosophy of science, the scientific method, reading fiction scientifically	<i>Short Introduction to Philosophy of Science</i>	No lab first week
Week 2	Space exploration I Rocket science, Orbital Mechanics	<i>From the Earth to the Moon</i> , Jules Verne	Basic Aspects of Physics
Week 3	Space Exploration II Life in deep space, interplanetary travel	<i>2001: A Space Odyssey</i> , Stanley Kubrick	No lab
Week 4	Space Exploration III Extra-terrestrial survival, Terraforming	<i>Project Hail Mary</i> , Andy Weir	Conservation Laws and Rocket Physics
Week 5	Einstein's Theory of Relativity I Time dilation, length contraction, twin paradox	<i>Time for the Stars</i> , Robert Heinlein	No lab
Week 6	Einstein's Theory of Relativity II General relativity, Gravitational time dilation	<i>Dragon's Egg</i> , Robert L. Forward	Relativistic Time Dilation and Muon Decay
Week 7	Einstein's Theory of Relativity II General relativity, wormholes	<i>Interstellar (2014)</i> , Christopher Nolan <i>Dark Matter</i> , Blake Crouch	No lab
Week 8	Time travel	<i>Blink, Dr. Who</i>	Gravitational Time Dilation and GPS
Week 9	Teleportation	<i>Star Trek</i>	No lab
Week 10	Genetic engineering	<i>Leviathan</i> , Scott Westerfeld <i>Frankenstein</i> , Mary Shelly	No lab

Course Schedule: A Weekly Breakdown			
	Lecture & Discussion Topics	Readings/Watch List	Laboratory
Week 11	Extraterrestrial Intelligence Science of language and communication technologies The story of Jocelyn Bell Burnell: What about the Little Green Women!?	<i>Contact</i> , Carl Sagan	Spectroscopy
Week 12	Artificial Intelligence in Machines	<i>I, Robot</i> Asimov	No lab
Week 13	Artificial Intelligence in Humans Neuroscience and cerebral “hijacking”	<i>Playtest</i> , Black Mirror	Solar Cells
Week 14	Advanced Energy Systems Solar energy, nuclear energy, matter-antimatter, zero-point energy Discussion of Madame Curie	<i>Let There be Light</i> , Robert Heinlein <i>Atomic Anna</i> , Rachel Barenbaum <i>Radiactive</i> , Marjane Satrapi	No lab
Week 15	Science and the human condition Discussion of sci-fi as an outlet for expressing fears of unintended consequences from scientific progress	<i>Childhood’s End</i> , Arthur C. Clarke	No lab
FINAL	FINAL EXAMINATION		

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally

unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.