

# The Searches for Life on Mars in Fact and Fiction

Otherwise known as Planetary Science 342  
Semester: Fall 2020

## Description, Course Objectives:

This course will cover both the scientific searches for life on Mars, and the way those searches have been translated into science fiction. Life on Mars is likely to be a scientific "hot topic" for the rest of your life. After this class, you should have a good understanding of what planetary scientists think about the chances of life on Mars, why they think that, and how current and future spacecraft missions plan to address that. In addition, since life on Mars has been the subject of some classic science fiction for more than 100 years, with no signs of letting up, you should understand how that science fiction relates to science. For the class, you will need to demonstrate your ability to connect works of science fiction about Mars to other Mars science fiction and to the understanding of Mars, and life on Mars, at the time the work was produced. My real goal is that as the current debate resolves itself, and as spacecraft explore Mars during the next few decades, you'll understand what's going on and which claims are important, and that as you read or watch science fiction dealing with Mars, you'll appreciate how it relates to past and present science and sci-fi.

## Specific Course Learning Outcomes:

By the end of this course, you will be able to

- Explain how scientific knowledge and public opinion about Mars, and life on Mars, have changed over the last 150 years
- Describe the current goals of Martian exploration as it relates to life
- Identify key unanswered scientific questions relating to life on Mars and the measurements needed to answer them
- Identify recurring themes in Martian fiction
- Describe how those themes relate to knowledge of Mars at the time the works were created

## Instructor and Contact Information:

Prof. Tim Swindle

[tswindle@lpl.arizona.edu](mailto:tswindle@lpl.arizona.edu) (best way to get in touch with me)

Office: Kuiper Space Sciences 323

Phone: 621-4128

Office hours:

Official: 10:30-11 a.m. and 12-12:30 p.m. (i.e., before and after class), on the days we have class.

Unofficial: I'm usually available 9-5:30 every day, and we can make an appointment (e-mail is the best way to do that).

## Schedule:

We will meet MWF 11 to 11:50 a.m. We will start and end the semester meeting via Zoom. In between, we will frequently, though not always, meet in person in Kuiper 330, although Zoom will always be available as an option for attendance. More details are given below about our use of Zoom. In terms of which days will be in-person and which will be remote, this will be decided, with input from the class, on a week-by-week basis and posted on D2L.

In addition to class time and the normal time for reading and class preparation, students will be required to spend one evening viewing Mars through a telescope on Mt. Lemmon, although this will also be done via Zoom. The list below gives topics in something close to the order in which we will discuss them. However, some topics will take much longer than others, and we may change the order slightly to better fit schedules or take advantage of things in the news. I will always announce the upcoming schedule (live vs. Zoom) in class, and send email, but they'll always be on D2L.

*Order of topics:*

- 1 Introduction
- 2 Percival Lowell and the canals of Mars  
(and why are there so many telescopes in Arizona)
- 3 1<sup>st</sup> generation Mars fiction
  - War of the Worlds - book, radio play & part of rock opera
  - “The Black Amazon of Mars” novella
- 4 Mars the planet and its potential for supporting life
  - Introduction to spacecraft exploration of Mars (including instrumentation and orbital considerations)
  - Short story – “Discovering Life”
  - The landscape and the climate
  - Meteorites from Mars
- 5 Origin of life on Earth and implications for Mars (Is all life based on carbon?)
- 6 Other 1<sup>st</sup> generation Mars fiction – Martian Chronicles
- 7 Generation 1a – Face on Mars (Why wouldn't scientists believe it?)
- 8 Life on Mars at present
  - Viking biology
  - Methane on Mars
- 9 Life on Mars in the past – Climate history
  - Evidence for water
    - Mars Odyssey GRS
    - Phoenix Mars Lander
    - HiRISE evidence (we will schedule a tour of the HiRISE operations center on campus)
  - Was Mars warmer and wetter in the past?
  - Clay/sulfates transition
  - Meteorite ALH84001
    - Panspermia
  - Mars Exploration Rovers Spirit & Opportunity
  - Mars Science Laboratory Curiosity
- 10 2<sup>nd</sup> generation Mars fiction
  - Books
    - Mars Underground (including discussion with author Hartmann)
  - Movies
  - Short story – “Arthur Sternbach Brings the Curveball to Mars”
  - Rovers in fiction and other pop culture
- 11 Current and future spacecraft missions
  - Curiosity (again)
  - ExoMars
  - MAVEN
  - InSight
  - Mars 2020 and sample return
  - Other nations' spacecraft

- Planetary protection
- 12 Life on Mars in the future – terraforming
- 13 Martian moons
  - Theories of origin
  - Potential for exploration
  - Mentions in fiction

**Required reading:**

- H. G. Wells, “War of the Worlds,” 1898
- Ray Bradbury, “Martian Chronicles,” 1950
- Leigh Brackett, “Black Amazon of Mars,” 1951
- Kim Stanley Robinson, “Discovering Life” and “Arthur Sternbach Brings the Curveball to Mars”, from a collection of short stories called “The Martians,” published in 2000
- One other novel about life on Mars (or living on Mars) written since 1991
- One other novel about life on Mars (or living on Mars) of the student’s choice
- Various short science articles about searches for life on Mars

**Required viewing:**

- One movie (selected by the class) in class
- One other movie about life on Mars (or living on Mars) of the student’s choice

**Readings:**

You’ll be expected to read four novels that deal with life on Mars or the exploration of Mars, and write a “book review” about each of them. One is the first great work of Mars fiction, “War of the Worlds” by H. G. Wells, written in the 1890s. Another is “Martian Chronicles” by Ray Bradbury. Both are available as e-books, and “War of the Worlds” is available free online at Project Gutenberg (<http://www.gutenberg.org/ebooks/36>). The other two are any novels involving life on Mars or living on Mars, at least one of them published since 1991 (a list of possibilities will be given with the assignment – anything on the list is OK, many others also are, but check with the instructor for those). For extra credit, you can read a fifth (again, of your choice).

The “book reviews” of the required books might better be called essays inspired by the books – you need to write something relating to life on Mars and the way the book approaches it. Your essays should reflect the things we discuss in class, but you don’t have to agree with the instructor to get a good grade. It’s not a book report, so you don’t have to tell the story of the book (since we’ll discuss many of these books in class). More details will be in the assignments.

There will also be short stories from two other authors, Leigh Brackett and Kim Stanley Robinson, and some short scientific papers, which will be assigned reading in advance of specific class discussions. From Brackett, it will be “Black Amazon of Mars”, a novella that is also available through Project Gutenberg (<http://www.gutenberg.org/ebooks/32664>). From Robinson, it will be two stories from “The Martians”, which is available as an e-book. The stories are “Discovering Life” and “Arthur Sternbach Brings the Curveball to Mars.” There will much shorter “book reviews” of these. There will be in-class assignments about many or all of the books and short stories.

You will need to watch one movie about life on Mars or living on Mars. You’ll then be required to write a short review of the movie, explaining how it fits in.

You will also be expected to do some reading to generate a paper on some aspect of the actual searches for life on Mars (the largest single component of your grade). In the first few weeks of class, you should choose a topic. Many of the topics that we discuss in class would be fine (although you probably would want to limit your paper to something smaller than the topic titles on the previous page). There are other possible topics as well – you will need to clear your topic with the instructor. Your information sources should be a combination of the original scientific papers and articles from science-oriented magazines or websites.

### Other requirements:

*Telescope viewing:* Normally, you would spend an evening, or even the whole night, at the Mt. Lemmon Sky Center observing Mars (among other things) through a high-quality telescope, and sketch what you see. This year, we will still have an evening of viewing through a telescope atop Mt. Lemmon, but it will be done via the Web. Unfortunately, you will not get the ambiance of night on the mountain-top, but you won't have to sleep in the dorms up there, and you won't have to drive the Mt. Lemmon highway. Incidentally, the course fee that normally goes into supporting the activities on Mt. Lemmon is being used this year to enable the remote viewing.

You will be observing Mars under conditions similar to those experienced by the astronomers of the late 19<sup>th</sup> and early 20<sup>th</sup> Centuries, and you can compare your sketches to what some of those astronomers (Percival Lowell, in particular) sketched. You will need to compare the appearance with the spacecraft photos that you are used to seeing and the images obtained with modern technology. If your artistic ability is no better than mine, you will need to spend more words describing the appearance than if you can produce a drawing that faithfully represents what you see.

*Writing a short story:* Since a lot of this course is about Mars-oriented science fiction, some students want to try their hand at writing a piece of science fiction. If you want to do that, you can write a short story, instead of a book review on a fifth book, for extra credit.

### Other policies (many related to COVID-19):

- This class is scheduled to be taught in the **Flex In-Person** modality.
- **In-person or remote?** We will be meeting remotely until the University notifies us that in-person meetings may commence. We will also be meeting remotely after Thanksgiving. Class participation will be a portion of your grade, but we will have options for participation if you are attending via Zoom, whether you attend during the regularly scheduled time or at some other time. However, the discussion will be better if we can have real-time conversation, so I would encourage you to attend at the regularly-scheduled time if possible. There will be at least three different types of class periods, ones that are entirely driven by class discussion, ones that are mostly lecture with options for questions, and ones that include some lecture or in-class discussion, but also some small-group discussions. We will evaluate which of these work best with which formats. Each week, you will get an email (and the message will be posted on D2L) no later than 5 p.m. Friday describing the meeting plan for the next week.
- **Physical distancing and face coverings are required in our classroom:** During our in-person class meetings, we will respect CDC guidelines, including restricted seating to increase physical distancing and appropriately-worn face coverings. Per UArizona's [Administrative Directive](#), face coverings that cover the nose, mouth, and chin are required to be worn in all learning spaces at the University of Arizona (e.g., in classrooms, laboratories and studios). Any student who violates this directive will be asked to immediately leave the learning space, and will be allowed to return only when they are wearing a face covering. Subsequent episodes of noncompliance will result in a Student Code of Conduct complaint being filed with the Dean of Students Office, which may result in sanctions being applied. The student will not be able to return to the learning space until the matter is resolved.
  - The [Disability Resource Center](#) is available to explore [face coverings and accessibility considerations](#) if you believe that your disability or medical condition precludes you from utilizing any face covering or mask option. DRC will explore the range of potential options as well as remote course offerings. Should DRC determine an accommodation to this directive is reasonable, DRC will communicate this accommodation with your instructor.

- **Classroom attendance:**
  - Attendance will not be taken, but class participation is a part of the grade (and attendance is a part of that). Note, however, that class participation **does not** have to in-person, and it does not have to be at the scheduled class time, although that is preferred. To receive class participation points from a day's class which you attend asynchronously, you have to complete it before the time of the next class, and email your answers to the prompts that appear (there will be no more than one or two per class period, and sometimes none) to the instructor via D2L. The exception is, of course, if you are ill. In that case, please contact the instructor.
  - Attendance **is** required at the scheduled class time on days of exams, although absences will be excused in cases that are pre-approved by the UA Dean of Students or for holidays or special events observed by an organized religion for those students who show affiliation with that particular religion.
  - The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>. The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>. Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>
  - If you feel sick, or may have been in contact with someone who is infectious with COVID-19, stay home. Except for seeking medical care, avoid contact with others and do not travel.
  - [Campus Health](#) is testing for COVID-19. Please call (520) 621-9202 before you visit in person.
  - Visit the [UARizona COVID-19](#) page for regular updates.
  
- **Academic advising:** If you have questions about your academic progress this semester, or your chosen degree program, please note that advisors at the [Advising Resource Center](#) can guide you toward university resources to help you succeed.
  
- **Life challenges:** If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The [Dean of Students Office](#) can be reached at 520-621-2057 or [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu).
  
- **Physical and mental-health challenges:** If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520-621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.
  
- **Exams:** There will be two exams in this class, a mid-term, scheduled for Oct. 12, and a Final Exam, scheduled for 10:30 on Dec. 14. The exams will be open-book. The Final will definitely be taken on D2L. I would prefer that we do the mid-term the same way, but if we are having in-person meetings, we will discuss other options.
  
- **Equipment and software requirements:** For this class you will need daily access to the following hardware: laptop or web-enabled device with webcam and microphone; regular access to reliable internet signal; ability to download and run Adobe Acrobat Reader and a web browser that will support Zoom. Notes will be posted in PowerPoint format, but if you do not have access to that, talk to the instructor, and most of the content can be converted to PDF.

- **Remain flexible:** If pandemic conditions warrant, the University may require that we return to remote operations. If that is the case, we will notify you by D2L Announcement and email that we are moving to remote operations. In any case, you will receive a notification each Friday of the plans for the next week.
- **Class Recordings:**
  - **Class will be recorded, including the discussion.** For lecture recordings, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with UArizona values and educational policies are subject to suspension or civil action.
  - **When we are having class remotely, please use the same name in Zoom every time.** If, for privacy reasons, you prefer not to have first and last name, or even prefer to just have a nickname, that is fine, but it is your responsibility to have the appropriate name on the screen. Let the instructor know via email if you're using a nickname that doesn't obviously connect with the name on the course roll.

**Accessibility and Accommodations:** At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268 or [drc-info@email.arizona.edu](mailto:drc-info@email.arizona.edu)) to explore reasonable accommodation.

**Classroom behavior:** Use of cell phones, laptops, or other electronics during an in-person class is prohibited except as it specifically relates to the class (e.g., web searches related to an in-class discussion). I reserve the right to answer any cell phone that rings.

**Code of Academic Integrity (Plagiarism):** Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

Papers will be checked against an online database. If there are any questions about what constitutes plagiarism, ask. Also, the University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>. In general, the penalty for the first instance of plagiarism is loss of credit on that assignment plus loss of one grade for the semester. For the second, a failing grade for the course will be given.

**Notification of Objectionable Materials:** This course will contain material of a mature nature, which may include explicit language, depictions of nudity, sexual situations, and/or violence. The instructor will provide advance notice when such materials will be used. Students are not automatically excused from interacting with such materials, but they are encouraged to speak with the instructor to voice concerns and to provide feedback.

The UA **Threatening Behavior by Students** Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

**UA Nondiscrimination and Anti-harassment Policy:** The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human->

[resources/nondiscrimination-and-anti-harassment-policy](#)

**Confidentiality of Student Records:**

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

**Syllabus Subject to Change:** Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

**Grading:**

2% - Personal interview, class participation – If you talk to me for at least 10 minutes at least once before the mid-term exam, you get half of this 2% (it doesn't depend on what you say to me), if you attend class regularly and express an opinion at least occasionally, you get the other half.

38% - Average of four book reviews, movie review

10% - Various short assignments, including in-class activities and reviews of short stories

10% - Telescope night

15% - Paper on the real searches for life on Mars

10% - Mid-Term Exam

15% - Final Exam

5% - Extra credit review or short story

Other than in-class work, all assignments are due at 11:59 p.m. on the day that they are due, normally on D2L. There is a 10% late penalty for each Monday, Wednesday or Friday they are late. In other words, if you turn it in late, but before the next day we might have had class (whether or not we actually have class that day), your grade will be multiplied by 90%, if you turn it in before the next one, we'll multiply by 80%, etc., with the maximum penalty 60%. One thing that means is that any assignment turned in before the final exam is worth at least 40% of the grade it would have received if it had been turned in on time.

Final grade scale

>90% - A

80-90% - B

65-80% - C

50-65% - D

<50% - E

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

**Important dates:**

Note that due dates are subject to change, in the following sense: I reserve the right to move due dates later, but will not move them up. Work can always be turned in before the due date. The dates for the exams and the evening of observing are fixed.

Sept. 9 – Review of “War of the Worlds” due

Sept. 21 – Observing (remote) using Mt. Lemmon telescope – block out the evening

Sept. 23 – Short review of “Black Amazon of Mars” due

Sept. 28 – Observing writeup due

Oct. 5 – Review of “Martian Chronicles” due

Oct. 12 – Mid-term exam

Oct. 26 – Review of “Mars Underground” due

Nov. 2 – 2<sup>nd</sup> review of “Mars Underground” due

Nov. 9 – Movie review due

Nov. 16 – 4<sup>th</sup> book review due

Dec. 4 – Paper on the real searches for life on Mars due

Dec. 14, 10:30 a.m. – Final exam