Course Outline

BEES6741: Astrobiology: Life in the Universe

School of Biological, Earth and Environmental Sciences

Faculty of Science

Term 3, 2021

1. Staff

Position	Name	Email
Course Convener	Associate Professor Carol Oliver	carol.oliver@unsw.edu.au
Marker	Dr Tara Djokic	t.djokic@unsw.edu.au

2. Course information

Units of credit: 6

Teaching times and locations: **Fully online**

2.1 Course summary

Welcome to BEES6741 Astrobiology: Life in the Universe – a fully online course

Astrobiology encompasses the search for our origins on Earth against the backdrop of the vastness of space, how life co-evolved with our planet, and what our future on Earth might be in cosmic perspective terms. It tackles the profound question of whether we are alone in the universe and what the answer – either way - would mean to us. Astrobiology is interdisciplinary, bridging across astronomy, microbiology, geology, geochemistry, paleobiology, and planetary geology. It also includes ethical and philosophical questions such as planetary protection and whether we should send messages into space on behalf of all humanity in the infinitesimally small chance of being heard by other intelligent civilisations.

To grasp the immensity of the subject, the course centres on the origin of life on Earth and the search for a second origin of life within our own solar system to better understand whether we may or may not be alone in the universe. The most likely and accessible place to find that second origin of life is Mars – the most Earth-like planet and the one most likely to be visited and ultimately inhabited by humans in the foreseeable future. Students virtually explore a Mars analogue related to the origin of life on Earth (the Pilbara in Western Australia) in preparation to explore a potentially similar environment on Mars – Jezero Crater – with guidance for the latter in a virtual class with NASA Mars Deputy Program Scientist Dr Adrian Brown.

The course concludes with an overview of how what we learn about Mars as a habitable world informs our search for life elsewhere in the universe. This is a third level (third year) course also open to postgraduates.

2.2 Course aims

This course aims to develop skills in interdisciplinary thinking, following in the footsteps of astrobiologists in their quest to figure out our place in the universe. The focus is on how

students use their increasing knowledge of astrobiology learned naturally through thinking about the problems and challenges in astrobiology. As such, there are no quizzes because no rote learning is required or tested, but each module concludes with a summary of what students should have gained from the module for you to self-check on progress. In addition, Assignment 1 Part A is due in Week 2 with marks back in Week 3 to help students ensure they are on track at an early stage of the course.

2.3 Learning in a fully online course

BEES 6741 is fully online and mostly asynchronous. This means you can study the weekly modules flexibly. However, it is strongly recommended you study the module in the week it is released to avoid falling behind in the course.

There are three 30-minute synchronous virtual class discussions. The dates and times are specified in the course table below. The sessions, focused on assessment help, are intended for direct interaction with me and the rest of the class. These are recorded, but participation is encouraged so students can ask questions that occur during the discussion. Other virtual classes will be held weekly or fortnightly depending on demand.

One-on-one tutorials with me are available on request throughout the course – and you are strongly encouraged to take advantage of this opportunity (multiple times if you wish).

2.4 How to be successful in this course

Now: Treat this course as you would a face-to-face course. Review the course outline carefully and ask me any questions you may have. Create a schedule for the reading of the modules, the additional reading to increase your depth of understanding, and time to undertake assessments. Read assessments and rubrics – studies indicate up to 80% of students do not perform this simple function and lose marks by not addressing the assessment and rubrics. But equally, some part of the assessment or rubrics may not make sense to you. If you find you are not completely confident with the assessment and rubrics, or the content of the week's module, book a one-on-one tutorial with me so we can discuss.

Daily: Read any announcements posted in the course.

Weekly: Complete the current week's module, including readings. Take notes when reading course materials or watching videos as you would in a face-to-face course. Studies show that writing notes by hand helps you to learn and reflect and ultimately to do better on assessments, so consider whether this would be helpful to you. Reading online and watching the videos without note-taking is a less effective learning strategy. Lack of note-taking may result in assessments taking longer to undertake. You are strongly encouraged to begin assessments at least in the previous week before the assessment is due.

Anytime: Connect with me, Carol, your instructor if you have any questions in advance of due dates. I am here to help, and I really like to see my students do well.

2.5 Course learning outcomes (CLO)

On completion of the course the successful student will be able to:

- CLO 1: Critically analyse and evaluate multiple lines of evidence in relation to the search for life in the universe. Students will be able to form a coherent argument on the strengths and weakness of the available evidence.
- CLO 2: Synthesise the evidence from a Virtual Field Trip to reconstruct the geological sequence of events 3.48 billion years ago that led to the formation of microbial mats called stromatolites – the earliest, most convincing evidence of life on Earth.
- CLO 3: Apply lessons learned in the Virtual Field Trip to investigate Jezero Crater on Mars, and to consider the implications for the search for life elsewhere in the universe.
- CLO 4: Demonstrate the ability to search for, evaluate, and select appropriate primary and secondary literature relating to Mars and the search for life elsewhere in the universe.

3. Graduate attributes developed in this course

Faculty of Science Graduate Attributes	**Level of Focus** 0 = No Focus 1 = Minimal 2 = Minor 3 = Major	**Related Tasks & Assessment**
1. Research, inquiry, and analytical thinking abilities.	3	Interactive Virtual Field Trip investigative project with problem solving assessment. The final assessment involves a critical analysis of data to form a strategy for detecting past life on Mars if it was ever present. The skills can be transferred and applied to the workplace
2. Capability and motivation for intellectual development.	3	Students are encouraged to explore their capability for lifelong learning, motivated by the interesting question: Are we alone in the universe? Rote learning is strongly discouraged in the course. Students are encouraged to explore each concept in terms of how the learning fits into their worldview or changes it. Prompting lifelong learning may lead to a wider choice of careers over a working life.

3. Ethical, social, and professional understanding.	1	Ethical questions are addressed in terms of the exploration of Mars as a pristine planet. Have we already introduced microbes from Earth by landing on Mars? And what would we do if we discovered Mars has evolved life and that microbesstill exist on Mars. Should we still send human explorers in the future? An understanding of ethical considerations may be able to be transferred and applied in the workplace.
4. Communication.	3	Interactions with other students in virtual classes and communicating with at least one other student for part of the second assessment. Communication is regularly at the top of the list of graduate attributes sought by employers.
5. Teamwork, collaborative, and management skills.	3	Create and present a three-minute video with at least one other student. This is to elicit the sequence of events – from the evidence – that must have occurred in the Pilbara 3.48 billion years ago to encourage microbial life to flourish. Teamwork and collaborative skills are desirable graduate attributes in the workplace.
6. Information literacy.	3	Search for and use primary and secondary literature to support arguments relating to available evidence in astrobiology. Understand confirmation bias in using internet search engines. Information literacy is critical in workplace decision-making.

4. Strategies, rationale, and approaches to learning

Students engage with strategies aimed at integrating new astrobiology knowledge into prior science learning to deepen and broaden that knowledge with a unique interdisciplinary approach. Students are provided with opportunities to research and write about astrobiology to consolidate and integrate that new knowledge.

The assessments are interrelated, one building on the other. They are formative and summative. Assessment 1 (Parts A and B) teaches the student to analyse and evaluate new and sometimes complex information. Assessment 2 (Parts A and B) is designed for active and social learning, as well as learning by doing. Assessment 3 provides students with the opportunity to engage with the world's leading space agency, NASA, to develop and consolidate their mastery of this course.

Comparisons between early life on Earth and the possibility of past or present life on Mars will allow students to reflect on variation, and to discuss the probabilities of life on Mars and beyond, drawing on both past and new knowledge. From the outset, it will be made clear to students why the concepts in astrobiology are useful to past, present, and future learning by understanding what an interdisciplinary approach to research means and how drawing on, and integrating, expertise from different disciplines could be applied to their intended careers, whatever they may be.

Student to student and student to staff dialogue will be encouraged to drive active learning, co-operative learning, synthesis of diverse perspectives, and the social construction of knowledge via the forum and Teams discussions.

5. Lessons, assessments, and time input required for course

Lessons: The core content is delivered via short electronic books containing text, images and videos aimed at student understanding of the interdisciplinary nature of key concepts in astrobiology.

Three assessments: These are aimed at helping students build confidence in their understanding of astrobiology. They are based around interactive and dynamic learning including an interactive Virtual Field Trip to where we find the earliest most convincing evidence of life on Earth 3.48 billion years ago. The three assessments are: **A1 (Parts A and B) = 25%; A2 (Parts A and B) = 30%; A3 = 45% (in place of a final exam).**

Note: Assessments 1, 2 and 3 MUST be completed to pass the course. This is a course requirement.

Time input into the course: The hours for a six Units of Credit at UNSW is 150 hours for the whole course. One third is course content, one-third self-directed research to deepen your understanding and study, and one-third for assessments. You should tackle this fully online course with regular interactions with the course content, completing the week's module in the week it is presented.

6. Course schedule and structure

Week number	Topics	Due dates and virtual class dates
Week 1 Introduction to Astrobiology	• What is astrobiology? • Understanding the processes of nature of science • Where are we in the universe? • Follow the water • Habitability • From the Pilbara to Mars • Role of the moon • Rise to intelligence	**Virtual class 1 (30 minutes) Thursday Week 1 at 9.30 am**
Week 2 Co-evolution of life and the planet	• Introduction to co-evolution • Early evolution of Earth and Mars • Planetary drivers • Plate tectonics introduction • Great Oxidation Event • First eukaryotes • Events in the 'boring billion' • Snowball Earth • Cambrian Explosion	**Reflection Part A Assessment 1:** Watch an 8-minute clip of a lecture on Mars. Summary of up to 300 words. (5% of course marks) DUE FRIDAY WEEK 2 AT 7PM.
Week 3 Early life on Earth	• Shark Bay stromatolites • Pilbara ancient stromatolites • Microfossils and pseudo microfossils • Chemical biosignatures • Biomarkers • The four stages in which the Pilbara Dresser Formation stromatolites arose and died 3.48 billion years ago	**Essay Part B Assessment 1:** 1,000 – 1,200 words excluding references on co-evolution as a possible framework for the search for life on Mars. Reading for assessment: Cabrol (2018), Astrobiology DUE FRIDAY WEEK 3 AT 7PM
Week 4 Preparing for Virtual Field Trip	• Undertaking virtual fieldwork • Field trip preparation • Field notebook preparation • Orienting yourself in the Virtual Field Trip • Field trip VR and 3-D imagery	**Virtual class 2 (30 minutes) Thursday Week 4 at 9.30am** **Begin Virtual Field Trip exploration**
Week 5 Origin of life	• Ocean-based hot springs • Land-based hot springs	**Undertake Virtual Field Trip for Assessment 2 (Parts A)**

on Earth	• Life in the extreme environments • Ancient hot springs on Mars	It is essential that you work with your partner on Assessment 2B in a timely way. Failure to do so on this assessment could lead to loss of marks. Partners can choose to provide an essay of up to 1,000 words with images and references in place of a video. Assessment 2 Part A due Friday this week at 7pm
Week 6 Flexibility Week	**No assessments or new material this week**	
Week 7 Searching for life on Mars	• Comparing Earth and Mars • Past water on Mars • Climate change on Mars • Perchlorates and the Vikings • Carbonates, phyllosilicates, and clays on Mars • Habitability of Mars • Martian methane: geology or biology?	**Assessment 2B video interpretation:** You should work with another student to interpret the VFT experience in a 3-minute video. DUE FRIDAY WEEK 7 AT 7PM
Week 8 Exploring Jezero Crater	• Site selection • Relationship of the crater to the Pilbara VFT • Arriving on Mars • Instruments on Perseverance • Assumptions about Jezero Crater • Findings to date • The science mission	**Virtual class 3 (30 minutes) Thursday Week 8 at 9.30 am** Note that is class is subject to date and time change to meet the needs of NASA during an active Mars mission.
Week 9 Taking the lab and hammer to Mars	• History of Mars exploration • Sojourner • The landers • The twin Mars Exploration rovers • Car-size Curiosity rover • Exomars • First flight on another planet • China's rover on Mars	

	• UAE achieves orbit around Mars	
Week 10 Jezero to the stars	• How scientists develop a search strategy • Considering Earth analogues • Searching primary and secondary literature on Jezero Crater • Implications of finding a second genesis of life • Implications for searching for life elsewhere in the universe	**Essay assessment 3 (2,000 to 2,500 words excluding references):** Using the instruments onboard Perseverance, students suggest where and how the rover might find evidence of past life on Mars and consider the implications for looking for life elsewhere in the solar system and beyond. DUE SUNDAY AT THE END OF WEEK 10 AT 7PM

7. Referencing and academic integrity

Referencing is a way of acknowledging the sources of information that you use to research your assessments. You must provide a reference whenever you quote or paraphrase someone else's words, ideas, or research. Not referencing in these circumstances is called plagiarism. If you are not certain of what plagiarism is then go to this UNSW link <https://student.unsw.edu.au/plagiarism>.

This course uses APA referencing style. Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing> and for APA style, here <https://student.unsw.edu.au/apa>.

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: Honesty, trust, fairness, respect, responsibility, and courage. At UNSW, this means that your work must be your own, and this includes all forms of cheating. UNSW takes academic integrity very seriously, and there are serious consequences if your work is found to be not your own, including using the work of others without referencing.

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

8. Special consideration

You should not undertake an assessment if you are not fit to do so. This may extend beyond issues relating to your physical and mental health. This includes issues around the current pandemic. If you are uncertain about whether you qualify, the best tack is to apply for Special Consideration through your MyUNSW without hesitation. More information on Special Consideration can be found here: <https://student.unsw.edu.au/special-consideration>.

Equitable Learning Plan students must present their plan to me in Week 1. This is to enable

me to fully support your needs.

Students facing learning difficulties (whether temporary or permanent) should approach Equitable Learning Services to discuss whether an Equitable Learning Plan would be helpful. The link is here < https://student.unsw.edu.au/els/register>

9. Gaining a sense of learning community

A sense of learning community is important in learning. In an online course, your active involvement in the virtual classes and with the group assessment 2B will help you feel this sense of community You are also strongly encouraged to engage with me in relation to the course content through the virtual classes, one-on-one tutorials, and e-mail.

I generally aim to respond to your enquiries with 12 hours and often much sooner. Please feel free to follow up if you do not get a response in that timeframe.

All correspondence will be via your UNSW student account. You can contact me at carol.oliver@unsw.edu.au. I am very happy to answer any questions, or provide advice, about the course via my email address.