Course Outline

BEES6741: Astrobiology: Life in the Universe

School of Biological, Earth and Environmental Sciences

Faculty of Science

Term 3, 2020

1. Staff

Position	Name	Email
Course Convener	Dr Carol Oliver	carol.oliver@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 is a research discipline aimed at understanding how life arose and co-evolved with Earth, whether there might be life elsewhere in the universe and what our future on Earth might be. Astrobiology encompasses the search for our origins on Earth in the backdrop of the vastness of space and the quest to know how we fit into the universe.

Astrobiology tackles these profound questions by bridging across research disciplines such as astronomy, astrophysics, microbiology, geology, geobiology, geochemistry, chemistry, biology, palaeobiology, and planetary science.

This course takes students on a journey from understanding our own origins to the efforts to detect microbial life on Mars – past and/or present. Mars is the most Earth-like planet in our solar system, and the one most likely to be visited by humans in the foreseeable future. The course concludes with an overview of how what we learn about Mars as a habitable world helps to inform our search for life elsewhere in the universe. This is a third level (third year) course.

2.2 Course aims

This course aims to develop skills in interdisciplinary thinking that enables students to follow the footsteps of experienced astrobiologists and to understand the true nature of science.

2.3 Course learning outcomes

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

1. Critically analyse and evaluate different theories on the same problem. They will be able to combine elements to form a coherent argument on the strengths and weaknesses of those

theories.

2. Synthesise 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.

3. Apply lessons learning in the Virtual Field Trip to investigating Gale Crater on Mars, and to consider the implications for the search for life elsewhere in the universe.

4. Construct a short primary literature review, demonstrating they are able to search for and select appropriate primary literature and critically review, and evaluate, and with the ability to recognise the significance of the publications they select.

3. How to be successful in this online course

NOW: Treat this course as you would a face-to-face course. Review the course outline carefully and create a work and assignment schedule in relation to your other courses to stay on track. Don't go a whole week without connecting with the course – students who do this generally get low marks or sometimes fail.

DAILY: Read any announcements posted in the course.

DAILY: Read and respond to any course email messages, within 24 hours.

ON A WEEKLY BASIS: plan to spend approximately 10 hours a week completing coursework requirements, including readings. Take notes when reading course materials or watching videos (it will help you practice better note-taking skills). Research shows that writing notes by hand helps you to reflect more easily on the materials and do better on assignments. Reading online only and watching the videos has been shown in research to be less effective in learning strategies. You are also strongly encouraged to begin assignments at least one week in advance. Print and keep referring to the assignment and rubric – students commonly do not do this, so waste time and marks going off-topic.

ON A WEEKLY BASIS: 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 !! :)

4. 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. Developing a research question about the search for life on Mars

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.
3. Ethical, social and professional understanding.	1	Ethical questions are addressed in terms of the exploration of 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 microbes still exist on Mars. Should we still send human explorers in the future?
4. Communication.	3	Interactions with other students on the course online and in interactions with the course staff via email, Zoom, Teams and - where possible for the student - in face-to-face interactions.
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.
6. Information literacy.	3	Search for and use primary literature to support scientific arguments (digital literacy).

5. Strategies, rationale and approaches to learning

Are we alone in the universe? It is perhaps the most profound question we can ask of ourselves

The overall strategy is to build on this desire to know the answer to the question to understand how science is done. We will undertake strategies aimed at integrating new knowledge into prior science learning to deepen and broaden that knowledge with a unique interdisciplinary approach. We will achieve this by providing opportunities to research and write about astrobiology, relate the new learning to their past science learning and apply to debates on the hot topics of the day.

The assignments are interrelated, one building on the other. They are formative and summative. Assignment 2 is designed for active, social learning, as well as learning by doing.

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 encourage active learning, co-operative learning, synthesis of diverse perspectives, and social construction of knowledge via the forum.

What you should know: Students taking this course come from across the science disciplines. Students should have at least 48 Units of Credit in science to take this course (equivalent to one year of university science). Primer content is provided to support the comprehension of the lessons and assessments across the sciences. However, students without at least one course in microbiology or geology are strongly encouraged to consider BEES2741 Introduction to Astrobiology: Life in the Universe before taking this 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 assignments (assessed) – These assignments 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.

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 and study, and one-third for assessments. You should tackle this fully online course with regular interactions with the course, completing the week's content in the week it is presented.

THERE IS NO FINAL EXAM. The course is **fully online**.

Your total course marks out of 100% will be based on:

- Three assignments **A1 = 25%; A2 = 30%; A3 = 45%**

Note: Assignments 1, 2 and 3 MUST be completed to pass the course because there is no final exam. This is a course requirement.

6. Course schedule and structure

Week number	Topics	What is due
Week 1 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Undertake reflection on Mars video	**Introduction to Astrobiology** • Where are we in the universe? • Follow the water • Habitability • From the Pilbara to Mars • Role of the moon • Rise to Intelligence • Introduction to primary literature	Reading: The University of California Berkeley website on the understanding of the nature of science: https://undsci.berkeley.edu/article/0_0_0/howscienceworks_01
Week 2 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**Co-evolution of life and the planet** • Introduction to co-evolution and relationship to the development and death of Mars in the same timeframe • Geology primer (systems, isotopes and basic rock types: the stories rocks tell) • Planetary drivers overview • Early geological changes • Plate tectonics • Great Oxidation Event • First eukaryotes • Events in the 'boring billion' • Snowball Earth • Cambrian Explosion	**Reflection Part A Assignment 1:** Watch a 4-minute clip of a lecture on Mars. Up to 300 words. Submit to Turnitin by Friday, 7pm Week 2. This reflection is worth 5% of course mark and part of assignment 1. **Reading:** Co-evolution of life and the environment on Mars – Cabrol, 2018, Astrobiology

Week 3 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**Biosignatures and biogenicity** • Living stromatolites: Shark Bay Western Australia • Strelley Pool chert stromatolites: Pilbara • Dresser formation stromatolites: Pilbara • Microfossils and pseudo microfossils • Chemical biosignatures • Biomarkers	**Assignment 1 Part B is due on Friday at 7pm, Week 3** Assignment 1 is a 1,000-word essay, excluding references and media, on an astrobiology topic (changes with each year's presentation). It is aimed at providing students with the opportunity for critical analysis and the use of primary literature. Assignment 1 is worth 25% of the course marks. It includes 5% for the Week 2 Part A reflection.
Week 4 Module **To do this week:** • Read the e-book; take notes • Watch the videos and take notes • Reflect on the e-book content	**Virtual Field Trip work preparation** • Why undertake field work? • Field trip preparation • Virtual Field Trip guide to orienting yourself in the VFT • Field notebook preparation • Video tutorial: Using the VFT software • Field trip VR and 3-D imagery	**Paper to read** • Land-based hot springs, Djokic et al.
Week 5 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**Land-based and deep ocean hot springs** • Extremophiles • Modern day hot springs • Ancient land-based hot springs • Home Plate hot springs on Mars	Prepare for Virtual Field Trip assignment due in Week 7.
Week 6	**Flexible week – no new coursework or assessments**	

Week 7 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**Mars** • Comparing Earth and Mars on the inside • Epochs of Mars compared with Earth • Water on Mars • Martian poles: the first evidence of water ice • What happened to the atmosphere on Mars? • Climate change on Mars • Perchlorates and the Vikings story • Carbonates, phyllosilicates and clays primer • Habitability of Mars • Methane: geology or biology? • Ancient hot springs on Mars	**Assignment 2 is due on Friday at 7pm at the end of this week, Week 7.** Students undertake a Virtual Field Trip experience to the site of the earliest convincing evidence of life on Earth in the Pilbara in Western Australia. Students keep a field notebook that they then image and transfer to Word and convert to a PDF to submit for Part A. Student name, number and title of notebook should be in the header for Turnitin to accept it. Students then work in pairs to review jointly their total collection to work out the sequence of events that must have occurred at the Dresser formation, which they interpret in a 3-minute video for Part B. Picture samples collected in the VFT may be used for the video, which should be uploaded to YouTube as an UNLISTED video, with the link emailed to carol.oliver@unsw.edu.au **Part A** is worth 10% of the course marks, and **Part B** 20%. Maximum upload for Part A is 40mb
Week 8 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**Jezero Crater** • Site selection • Relationship to VFT assignment • Arriving on Mars • Instruments on Perseverance • Assumptions about Jezero Crater • The science mission	

Week 9 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**How do scientists develop a research strategy in searching for life on Mars?** • Research approaches to exploring Mars • Considering Earth analogues • How to create a mini-literature review	
Week 10 Module **To do this week:** • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content	**Revision and reflection** (released with Week 9)	**Assignment 3 is due on Sunday at 7pm at the end of this week, Week 10** Students use the learning from assignments 1 and 2 to define and refine a simple, but original, research question related to the search for life on Mars at Jezero Crater. They then suggest a simple experiment that could test that research question. Students must use primary literature in formulating their question. The essay length can be 2,000-2,500 words (excluding references). **Please help me by filling out the MyExperience survey.** **Your feedback matters to me. Thank you!**

7. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you paraphrase someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism. This course uses APA referencing style.

Further information about referencing styles can be located at: https://student.unsw.edu.au/referencing

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 others' ideas should be appropriately acknowledged. If you don't follow these rules, any plagiarism will be detected in your work and penalised. The acceptable amount of plagiarism is zero.

Further information about academic integrity and plagiarism can be located at: https://student.unsw.edu.au/plagiarism

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. Engage with me!

You are strongly encouraged to engage with me in relation to the course content and the assignments.

I generally aim to respond to your enquiries with 12 hours and often much sooner, so 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 also request a one-on-one virtual or phone meeting with me at a time convenient for you and for me by e-mailing me at carol.oliver@unsw.edu.au

I am very happy to answer any questions or provide advice via my email address.