



Course Outline



BEES2741

Introduction to Astrobiology: Life in the Universe

School of Biological, Earth
and Environmental Sciences

Faculty of Science

Term 2, 2021

1. Staff

Position	Name	Email
Course Convener and instructor	Associate Professor 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 BEES2741 Introduction to Astrobiology

Astrobiology is the study of origins, evolution, distribution, and future of life in the universe. UNSW has the only astrobiology research centre in the southern hemisphere - the Australian Centre for Astrobiology in the School of Biological, Earth and Environmental Sciences.

Astrobiology is still a relatively young science, driven by one of the most profound questions we can ask of ourselves: "Are we alone in the universe?" To begin to answer this question we need to start with the only sample of life we know of - life on Earth - and pose another question: "What is life?" This question leads to other, more intriguing questions that relate to the idea that if we have trouble with a definition of life on Earth, how will we fare with defining life beyond the thin biosphere that envelopes the planet.

This course is an introduction to astrobiology. Throughout the course, life is the theme from the origin of life on Earth, to the ideas that we have about life elsewhere within the solar system and to extrasolar systems in the universe beyond. The course also provides students with a good foundation on which to

consider going onto our third level science elective course, BEES6741 Astrobiology: Life in the Universe in Term 3, in which students study early life on Earth and apply it to the search for life on Mars, in particular Jezero Crater where the newest NASA rover mission, Perseverance landed in February 2021.

Course aims

Students are introduced to the multidisciplinary and interdisciplinary subject of astrobiology. The course also aims to develop skills in interdisciplinary thinking and research and to inspire students through the study of the origin of life, the possibility of life elsewhere in the universe and space exploration in general.

Course learning outcomes

At the completion of this course, successful students will be able to:

1. Describe, analyse and evaluate the role of an interdisciplinary approach to discoveries in the search for life elsewhere in the solar system.
2. Search for appropriate primary literature and critically review topics in astrobiology
3. Investigate and combine the elements of the evolution of life and our planet and interpret the potential that other planets and moons in our solar system have for past or present life.
4. Recognise the nature of the construct of the phylogenetic Tree of Life and use this model to demonstrate the relatedness of all life on Earth.
5. Explain that truth in science is the best model that we have, and that uncertainty about our natural world is at the heart of astrobiology and all other science.

2.2. How to be successful in this online course

NOW: Time management in an online course means regular interactions with the content. 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. It is strongly recommended that you do not go a whole week without connecting with the course. Note there is no final exam and therefore no rote learning. Instead, you'll use the content to learn and think about our place in the universe and consider whether there may be other intelligent civilisations in the cosmos. If not, are we alone in the universe, and what does that mean if we are?

DAILY: Read any announcements posted in the course. You will get a summary each day

DAILY: Read and respond to any course email messages. Course messages will go to your student e-mail account.

ON A WEEKLY BASIS: plan to spend 3-4 hours a week completing the modules plus time for additional reading and reflection and the three assignments.

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 without taking is not an effective learning strategy. A better one is to mind-map the concepts for each module to make sure you understand the relationships.

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. If you stick to the rubric you only have to do what is in the rubric and no more.

ON A WEEKLY BASIS: Connect with me, Carol Oliver at carol.oliver@unsw.edu.au if you have any questions in advance of due dates. I am here to help, and I really like to see students do well !! :)

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	All aspects of this course are focused on the ability to reflect on the content, to think analytically, and to integrate information to achieve learning. The course therefore contains no rote learning and no final exam.
2. Capability and motivation for intellectual development.	3	Learning in the course is designed to drive motivation for intellectual development to create capability and capacity for lifelong learning.
3. Ethical, social and professional understanding.	2	Searching for life in the universe is a societal as well as a science question. For example, is life bound to rise to intelligence, or is life on Earth the result of chance? Is it ethical to land on pristine planets with spacecraft that cannot be completely Earth microbe-free?
4. Communication.	3	Students are encouraged to share their reflections on the content of the course with other students through the forum.
5. Teamwork, collaborative and management skills.	3	Students partner with other students to produce a three-minute video on the search for life on other worlds in the solar system.
6. Information literacy.	3	Search for and make extensive use of primary literature.

For more information, visit: https://teaching.unsw.edu.au/sites/default/files/upload-files/unsw-graduate-attributes_0.pdf

3. Strategies and approaches to learning

3.1 Learning and teaching strategies, rationale and activities

The overall strategy is to build on the desire to know the answer to the question "Are we alone in the universe?". A technology-enabled fully online approach is used, utilising teaching strategies aimed at integrating new knowledge into prior science

learning. This approach will enable students to deepen and broaden knowledge using the unique interdisciplinary approach of astrobiology.

The three assessments build one on the other. From the outset, it will be made clear to students why the concepts in astrobiology necessarily require an interdisciplinary approach, and how this might be applied. Interrelated assessments provide a coherent story for the student to work through. It is formative (learning) as well as a summative (marking) approach to encourage reflective and active student-centered learning constructively aligned to course outcomes. In short, the assessments are designed to be meaningful and useful in the underlying soft skills such as critical thinking and collaboration.

Supporting materials: This is both a science elective and a general education course. Therefore, there is no assumption of prior knowledge of astrobiology. Students at any point in their university career can take this course. All that is needed is an interest in science in the context of searching for life elsewhere in the universe.

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. There are four non-mandatory video classes – an introductory one and the remaining three focused on help for each of the three assessments.

Three assignments (assessed) – These assessments are aimed at helping students build confidence in their comprehension of the challenges in astrobiology in its key goals of the study the origin of life on Earth, the search of life in the universe, and the implications for future life on Earth.

THERE IS NO FINAL EXAM. The course is **fully online**. Your total course marks out of 100% will be based on:

- Three assignments (90% combined) **A1 = 20%; A2 = 25%; A3 = 45%**
- Virtual Lab = **10% (a substitute short answer response be substituted in 2021)**

6. Course schedule and structure

Week	Topics	
<p>Week 1</p> <p>To do this week:</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Put up a paragraph about yourself on the “who else is in this class” forum to find video assignment partners 	<p>Is life common in the universe?</p> <p>An introduction to the course; an overview of astrobiology; the Big Bang to the formation of planetary systems; the chemistry of life resident in the Periodic Table; is life common in the universe, or could life be limited to Earth or our solar system? The Drake Equation.</p>	<p>Finding partners for video assignment</p> <p>Introduce yourself to the class with a paragraph on “who else is in this class?” This is a good way to find another you might like to team with online for the videoassignment in Week 5. There is no compulsion to work with a partner, but it is recommended. Whatever you choose your mark will not be affected.</p> <p>FIRST NON-MANDATORY VIDEO CLASS 4PM FRIDAY JUNE 4: Meet and greet (30 MINS ONLY)</p>
<p>Week 2</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Read the assignment 1 and rubric and make notes on requirements 	<p>Origin of life and water on Earth</p> <p>Formation of the solar system; creation of the moon; early and late bombardment; history of zircon crystals; hot springs in the ocean; hot springs on the land; the origin of water on Earth, its special properties, and relevance to searching for life elsewhere in the universe</p>	<p>Assignment 1:</p> <p>Students read the Week 2 content and write an essay giving the strengths and weaknesses of the following three sources of water: It came from comets; it came from asteroids and meteorites; it was always in the mantle of the Earth and rose after the early bombardment. Worth 20% of the course marks and due in Week 3, Friday 7pm. Spend at least 30 minutes reading the assignment and rubric and make notes on what is required.</p> <p>SECOND NON-MANDATORY VIDEO CLASS FRIDAY 11 June One hour on help with Assignment 1.</p>

<p>Week 3</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Submit Assignment 1 	<p>The Tree of Life, early life on Earth and extremophiles</p> <p>The phylogenetic Tree of Life, the Last Universal Common Ancestor (LUCA), role of energy in life systems, role of lateral gene transfer in evolution, extremophiles, microbiology of microbial mats, and Shark Bay stromatolites. Early life on Earth and detecting biosignatures on Earth and elsewhere in the solar system</p>	<p>1. Assignment 1 due on Friday this week at 7pm.</p> <p>Make sure you have read the assignment and the rubric and that you have rechecked your assignment when complete.</p> <p>Submit your assignment to Turnitin</p> <p>2. Short essay assignment OR Virtual Lab completion. This is worth 10% of the course mark. Open now for completion at the end of Week 5.</p>
<p>Week 4</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content 	<p>Life elsewhere in the solar system?</p> <p>Could there be life elsewhere in the solar system? Could life exist in the clouds of Venus or in the depths of slushy ice seas found on Europa, a moon of Jupiter, or Enceladus, a moon of Saturn? Or could life exist in an entirely different chemistry on Titan, the only other planet or moon in the solar system with a thick atmosphere life that found on Earth? (Note: Mars will be considered in Week 8 as a case on its own)</p>	<p>Assignment 2</p> <p>Students investigate the potential hot springs of Europa, an icy moon of Jupiter, producing a three-minute video (plus or minus 15 seconds). Students may partner or produce their own video using PowerPoint, with a voiceover and then exported to video for upload to YouTube.</p> <p>Videos must be uploaded to YouTube as UNLISTED – do not use the public or private settings.</p> <p>The assignment is worth 25% of the course marks and is due on Friday in Week 7 at 7pm. A one paragraph description with student names and numbers uploaded to Turnitin with the link to the video.</p> <p>Next week’s module will be released with this week’s module.</p>

<p>Week 5</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Submit Assignment 2 on Friday of this week at 7pm 	<p>What makes a planet habitable?</p> <p>An introduction and overview of the formation of the Earth and its co-evolution with the emergence of life on Earth.</p> <p>From island chains and no oxygen to oceanic crust, plate tectonics, the rise of oxygen, the rise of complexity and to intelligence. Earth's planetary systems.</p>	<p>THIRD NON-MANDATORY VIDEO CLASS – ONE HOUR – ON ASSIGNMENT 2. Friday July 2 at 4pm.</p>
<p>Week 6</p>	<p>Flexible week no coursework</p>	
<p>Week 7</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Read and take notes on the requirements for Assignment 3 and associated marking rubric 	<p>Why did Mars die so early?</p> <p>Mars got going as a habitable planet before Earth, but it died early on. What have we learned about Mars and what are the implications for life on Earth? Did life arise on Mars? Is life still present today? Will humans go to Mars?</p>	<p>Assignment 2 is due on Friday this week at 7pm</p> <p>Assignment 3</p> <p>Students describe the research to date on Mars in a 1,500-word essay (excluding references). They utilise the search for life on Mars to consider the search for life elsewhere in the universe.</p> <p>Additional evidence is drawn in from supplying at least five primary references referred to in their essay. APA-style must be used for referencing. Any form of APA style is acceptable, providing it is</p>

		<p>consistent through all of the references, Secondary references may be used but each secondary reference requires a one-line defense of why the source can be considered reliable (e.g. NASA). Course content may be referenced.</p> <p>The assignment is worth 45% of the course mark and is due SUNDAY 7pm of Week 9.</p>
<p>Week 8</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • 	<p>Is there life elsewhere in the universe?</p> <p>The discovery of exoplanets; how they are discovered, how many have been discovered; how many are habitable; the Kepler mission; sniffing the atmospheres of distant world for evidence of life – James Webb Space Telescope.</p>	<p>FINAL NON-MANDATORY VIDEO CLASS ON FRIDAY JULY 23 at 4PM, one hour on assignment 3.</p>
<p>Week 9</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content • Assignment 3 due on SUNDAY this week at 7pm 	<p>Technosignatures: Will ET be biology or technology?</p> <p>The Search for Extra-Terrestrial Intelligence (SETI) – searching for intelligence elsewhere in the universe. Radio and optical search strategies; Breakthrough Listen; and Breakthrough Starshot</p>	<p>Assignment 3 is due on SUNDAY at 7pm</p> <p>Apply for special consideration now. Extensions must be pre-arranged, bar exceptional last-minute instances</p>

<p>Week 10</p> <ul style="list-style-type: none"> • Read the e-book and take notes • Watch the videos and take notes • Reflect on the e-book content 	<p>Revision and hot news week</p> <p>THIS WEEK WILL BE RELEASED WITH WEEK 9</p>	<p>You are advised to undertake this module with the week 9 module to revise and reflect on the content of the course to help you with Assignment 3</p> <p>Please help me by filling out the MyExperience survey.</p> <p>Your feedback matters to me. Thank you!</p>
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Assessment criteria and standards

These will appear on the assignment instructions

UNSW grading system: <https://student.unsw.edu.au/grades>

UNSW assessment policy: <https://student.unsw.edu.au/assessment>

Submission of assessment tasks and special consideration

Late submission of assignments will result in 10% penalty per day (including weekends).

If for any reason you are unable to submit an assignment on time be sure to contact the course staff and make the necessary special consideration steps. Instructions can be found at: <https://student.unsw.edu.au/special-consideration>. We understand that extenuating circumstances occur and are here to support you - but it is up to you to let us know before the submission deadline. Submission of assignment assumes 'fit to submit'. **If you have anything impacting on your studies (such as your own illness or serious illness of an immediate relative) please act as soon as these issues appear. If uncertain, speak with the course coordinator.**

Feedback on assessment

Feedback on assessments will appear online with a breakdown of marks. If you are concerned for any reason that your mark is incorrect or you are unsure as to why you have received a specific mark, don't hesitate to contact the course staff.

6. 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 draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism. APA referencing is used in this course. How to do that is located at <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.¹ 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, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

The *Current Students* site <https://student.unsw.edu.au/plagiarism>, and

The *ELISE* training site

<http://subjectguides.library.unsw.edu.au/elise/presenting>

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>.

7. Additional support for students

The Current Students Gateway: <https://student.unsw.edu.au/>

Academic Skills and Support: <https://student.unsw.edu.au/academic-skills>

Student Wellbeing, Health and Safety: <https://student.unsw.edu.au/wellbeing>

Disability Support Services: <https://student.unsw.edu.au/disability-services>

UNSW IT Service Centre: <https://www.it.unsw.edu.au/students/index.html>

Virtual contact hours

You can also request a one-on-one virtual meeting at a time convenient for you by e-mailing Carol Oliver carol.oliver@unsw.edu.au.

I am is very happy to answer any questions or provide advice and arrange tutorials.

I generally aim to respond to your enquiries relatively immediately but usually within 12 hours, 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.