

# AST 183: Life in the Universe

## General Information

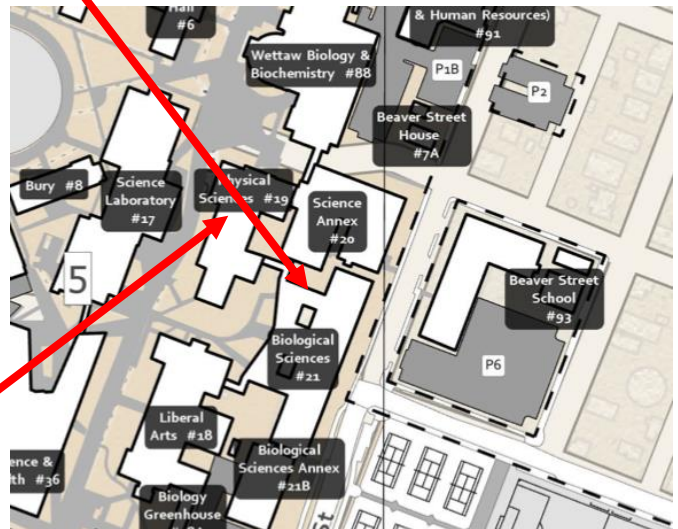
- Department: Astronomy and Planetary Science
- Course: AST 183: Life in the Universe, Class Number 1057, Section 001
- Term: Fall 2024
- Total Units of Course Credit: 3
- Pre- and Co-Requisite(s): None
- Mode of Instruction: In-Person
- Meeting Time: Tuesday/Thursday 4:00pm – 5:15pm
- Location: Liberal Arts Rm 120

## Instructor Information

- Instructor: Dr. Jean-François Smekens
- Preferred Contact Method: Canvas Messaging
- Email: [Jean-Francois.Smekens@nau.edu](mailto:Jean-Francois.Smekens@nau.edu)
- Office Hours: Tu/Th 9:00-10:30am
- Office Location: Biological Sciences (Bldg. #21), Room 158 (“Postdoc alley”, hallway between bldg. #19)
- Office hours by appointment may be requested if needed
- Zoom office hours may be requested if needed

## TA Information

- TA: Nicolas Ulvin
- Email: [nju9@nau.edu](mailto:nju9@nau.edu)
- Office Hours: Tu/Th 12:45-2:00pm
- Office Location: Physical Sciences (Bldg. #19), Room 225 (“Postdoc alley”, hallway between bldg. #19)



## Course Purpose

Course will survey the scientific topics that comprise the key elements of “Astrobiology”. These include the philosophical foundations of astrobiology as a science, astronomical sources of life’s chemical building blocks and habitable environments, extremophilic organisms, the history of life on Earth, the role of asteroid/comet impacts and micro-meteoritic dust, feasibility of space travel, and the search for life in the solar system and beyond. Letter grade only.

**Career Ready Resources.**

LinkedIn:

CEFNS Career Development

[www.linkedin.com/in/cefns-career-development-072715233](https://www.linkedin.com/in/cefns-career-development-072715233)

NAU Career Development

<https://www.linkedin.com/company/nau-career-development/>

Handshake:

<https://nau.joinhandshake.com/login>

Udemy: Online courses and career searching advice

<https://in.nau.edu/its/udemy/>

Log in with your NAU email account and search 'NAU Career Steps'

O\*net Online: Occupation exploration reports

<https://www.onetonline.org/>

**Course Objectives and Learning Outcomes**

This course has several objectives and learning outcomes that will be addressed during the lecture and assessed through in-class assignments, homework and examinations. By the end of the semester, students will be able to:

- Demonstrate an understanding of the scientific method and how scientific research is conducted.
- Identify how biology, chemistry, geology, and astronomy all contribute to the field of astrobiology.
- Define “life” and its chemical, physical, and environmental requirements.
- Describe the origin and evolution of life on Earth.
- Critically and scientifically assess the possibility of life beyond Earth.
- Demonstrate an understanding of structure, scale, and history of the universe.
- Discuss the scientific, ethical, political, and spiritual consequences of (the search for) life outside of Earth in a civil, respectful, and engaging fashion.

**100% Career Ready:**

One of the primary goals of this course is to provide skills that are in-demand from STEM employers to help NAU CEFNS students pursue careers of confidence and lives of purpose. Below is a list of in-demand skills from the National Association of Colleges and Employers (NACE) that students may be able to practice in this course:

1. Career & Self-Development: Proactively develop oneself and one's career through continual personal and professional learning, awareness of one's strengths and weaknesses, navigation of career opportunities, and networking to build relationships within and without one's organization.
2. Communication: Clearly and effectively exchange information, ideas, facts, and perspectives with persons inside and outside of an organization.
3. Critical Thinking: Identify and respond to needs based upon an understanding of situational context and logical analysis of relevant information.
4. Equity & Inclusion: Demonstrate the awareness, attitude, knowledge, and skills required to equitably engage and include people from different local and global cultures. Engage in anti-racist practices that actively challenge the systems, structures, and policies of racism.
5. Leadership: Recognize and capitalize on personal and team strengths to achieve organizational goals.
6. Professionalism: Knowing work environments differ greatly, understand and demonstrate effective

work habits, and act in the interest of the larger community and workplace.

7. **Teamwork:** Build and maintain collaborative relationships to work effectively toward common goals, while appreciating diverse viewpoints and shared responsibilities.

8. **Technology:** Understand and leverage technologies ethically to enhance efficiencies, complete tasks, and accomplish goals.

### **NACE Competencies**

The National Association of Colleges and Employers (NACE) is a leading source of information on employment for the college educated. They identified eight Career Readiness Competencies (CRC) that are “a foundation from which to demonstrate requisite core competencies that broadly prepare the college educated for success in the workplace and lifelong career management.” More information can be found at <https://www.naceweb.org/career-readiness/competencies/career-readiness-defined>. The following are the CRCs that apply to this course.

1. **Communication:** Clearly and effectively exchange information, ideas, facts, and perspectives with persons inside and outside of an organization.
2. **Critical Thinking:** Identify and respond to needs based upon an understanding of situational context and logical analysis of relevant information.
3. **Professionalism:** Knowing work environments differ greatly, understand and demonstrate effective work habits, and act in the interest of the larger community and workplace.
4. **Technology:** Understand and leverage technologies ethically to enhance efficiencies, complete tasks, and accomplish goals.

### **Course Schedule**

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| Week | Date      | Topic  | Reading                      | Homework Due |
|------|-----------|--|------------------------------|--------------|
| 1    | Tu, 8/27  | Course Introduction  | Ch. 1                        |              |
|      | Th, 8/29  | The Scientific Method  | Ch. 2                        |              |
| 2    | Tu, 9/3   | From Atoms to Zygotes: Introduction to Inorganic Chemistry             | Ch. 3.3, 5.2                 |              |
|      | Th, 9/5   | Physical Structure of the Universe                                     | Ch. 3.1-3.2                  | Homework 1   |
| 3    | Tu, 9/10  | Physical Structure of the Solar System                                 | Ch. 3.4-3.5, 4.6, 10.1, 10.3 |              |
|      | Th, 9/12  | Introduction to Terrestrial Geology                                    | Ch. 4.1-4.4                  | Homework 2   |
| 4    | Tu, 9/17  | Conditions Resulting in Life on Earth                                  | Ch. 4.4-4.5                  |              |
|      | Th, 9/19  | <b>MIDTERM #1</b>  |                              |              |
| 5    | Tu, 9/24  | Defining Life  | Ch. 5.1-5.4, 9.4             |              |
|      | Th, 9/26  | The Theory of Evolution  | Ch. 5.1, 5.5-5.6             | Homework 3   |
| 6    | Tu, 10/1  | Formation of Life on Earth   | Ch. 6.1-6.2                  |              |
|      | Th, 10/3  | Evolution (and Extinctions of Life on Earth)                           | Ch. 6.3-6.4                  |              |
| 7    | Tu, 10/8  | Evolution of Humans and Artificial Life                                | Ch. 6.5-6.6                  |              |
|      | Th, 10/10 | Conditions Necessary for Life Outside of Earth                         | Ch. 7.1                      | Homework 4   |
| 8    | Tu, 10/15 | Life in the Inner Solar System   | Ch. 7.2, 10.2                |              |
|      | Th, 10/17 | Mars: Geological Evolution   | Ch. 8.1-8.2                  |              |
| 9    | Tu, 10/22 | Mars: Environmental Evolution  | Ch. 8.3-8.5                  |              |
|      | Th, 10/24 | Life in the Outer Solar System?  | Ch. 9                        | Homework 5   |
| 10   | Tu, 10/29 | The Future of Life on Earth  | Ch. 10.4-10.5                |              |
|      | Th, 10/31 | <b>MIDTERM #2</b>  |                              |              |
| 11   | Tu, 11/5  | <b>ELECTION DAY – NO CLASS – GO VOTE!</b>                              |                              |              |
|      | Th, 11/7  | Habitability Outside of Our Solar System                               | Ch. 11.1-3, 11.5             |              |
| 12   | Tu, 11/12 | Habitability of Extrasolar Planets                                     | Ch. 11.4                     |              |
|      | Th, 11/14 | The Search for Extraterrestrial Planets                                | Ch. 12.1-12.3                | Homework 6   |
| 13   | Tu, 11/19 | UFOs and Aliens  | Ch. 12.4                     |              |
|      | Th, 11/21 | Human Exploration of Our Solar System                                  |                              |              |
| 14   | Tu, 11/26 | Interstellar Travel  | Ch. 13.1-13.2                | Homework 7   |
|      | Th, 11/28 | <b>THANKSGIVING – NO CLASS</b>   |                              |              |
| 15   | Tu, 12/3  | The Fermi Paradox / <i>Should We</i> Search for Extraterrestrial Life? | Ch. 13.3                     |              |
|      | Th, 12/5  | Final Exam Review  |                              | Homework 8   |
| 16   | W, 12/11  | <b>FINAL EXAM (Open 6:00am – 11:59pm)</b>                              |                              |              |

## **Required Materials & Technology**

### **1. Textbook (optional but recommended)**

Bennett, J., & Shostak, S. (2017), Life in the Universe (4<sup>th</sup> Edition). Pearson, San Francisco, CA. ISBN: 978-0-13-408908-9.

*(Note: You may be able to find used copies of the 3<sup>rd</sup> Edition of this text for much cheaper than the 4<sup>th</sup> Edition. Feel free to purchase this earlier edition, but be aware that some content and page numbers might be different. It is your responsibility to identify these differences and to keep up with the required readings.)*

Students are encouraged to complete the assigned reading (either in the textbook or provided as supplemental materials prior to each class. These readings will provide additional information regarding the lecture materials.

### **2. Top Hat**

In the navigation bar on the left side of the Canvas course, click the link labeled “Top Hat 1.3” and follow the instructions. You should have received an invitation to join the course, but if not, the join code is 626654. Top Hat is now FREE for all NAU students. You should not be asked to pay when you sign up. If you are, please contact me immediately.

Should you require assistance with Top Hat at any time, due to the fact that they require specific user information to troubleshoot these issues, please contact their Support Team directly by way of email ([support@tophat.com](mailto:support@tophat.com)), the in-app support button, or by calling 1-888-663-5491.

## **Assessment**

Students WILL be assessed through a series of in-class assignments, homework, and examinations.

**In-Class Assignments:** Success in this course is strongly dependent on student participation and attendance. This will be measured by in-class questions through Top Hat that will test the student’s knowledge and help the instructor identify where students may be lacking in comprehension. Questions will be graded for both correctness and participation and will be available to answer for 2 business days after they were asked in class. Participation will not count towards the student’s grade until after the Add/Drop deadline of 1/25/23. No points will be dropped from this category. NACE CRCs: **Professionalism, Critical Thinking**

Interruptions and inappropriate behavior will not be tolerated, as it is disrespectful to others and to the academic learning environment. Your professionalism, courtesy, and engagement in the class are critical components of your success.

**Homework Assignments:** These assignments are designed to strengthen and assess your understanding of lecture materials and prepare for examinations. There will be approximately one homework assignment per week. See the course schedule at the end of this document for approximate due dates of these homework assignments. **Homework will be assigned and turned in on Canvas and you will have until 11:59pm on the day they are due to complete the assignment.** NACE

**CRCs: Critical Thinking, Professionalism, Technology, Communication**

**Examinations:** This course will feature of two non-cumulative mid-semester examinations and one cumulative final examination. **No make-up exams will be offered without prior approval from the instructor.** NACE CRCs: **Communication, Critical Thinking, Professionalism, Technology**

**Grading System**

The breakdown of how the final grade in the class will be calculated is given below, and any changes to the class scoring rubric will be discussed with the class prior to implementation and will only be made in the students' favor, never to their detriment.

| Category           | Point Distribution | Points | Notes                |
|--------------------|--------------------|--------|----------------------|
| Homework           | 15 points each     | 105    | Lowest score dropped |
| In-Class Questions | 2-6 points each    | 100    |                      |
| Midterm 1          |                    | 75     |                      |
| Midterm 2          |                    | 75     |                      |
| Final Exam         |                    | 100    |                      |
| Total              |                    | 455    |                      |

**The lowest homework grade throughout the semester will be dropped.**

| Midsemester Total Points<br>(Homework 1-4,<br>Exam 1, 40 in-class<br>question points) | Midsemester Grade | Semester Total Points | Final Grade |
|---|-------------------|-----------------------|-------------|
| 144 to 160  | A                 | 409 to 455            | A           |
| 128 to 143  | B                 | 364 to 408            | B           |
| 112 to 127  | C                 | 318 to 363            | C           |
| 96 to 111   | D                 | 273 to 317            | D           |
| 0 to 95   | F                 | 0 to 272              | F           |

**Grades will be kept up to date in Canvas. It is the student's responsibility to frequently check their scores in Canvas for accuracy. Any score in question must be discussed with me within two weeks of the due date. After two weeks, I will not entertain any challenges to the scores in Canvas.**

Sometimes instructors make mistakes, and I am no exception: exams end up being harder than expected, or assignments are just too ambitious for the time available. In these (hopefully rare) cases, I reserve the right to modify the final course grades upwards. This modification is subject to the following policies: (1) the same modification will be applied to the grades of all students, and (2) the modification may never result in a lower grade, but always a higher one.

**Makeup and Late Work**

Students must obtain permission in advance of a regularly scheduled examination in order to take a make-up examination. An institutional excuse is required to get an extension from an online homework assignment. In addition, if unforeseen sickness occurs, please reach out to me and I will do my best to



accommodate you in a reasonable manner. Late Top Hat questions will not be accepted. Points will be deducted from late homework assignments at a rate of 10% for every day that they are late.

### **Extra Credit**

Students have a few chances throughout the semester to obtain extra credit points. The extra credit opportunity consists of going to the on-campus observatory during the hours it is open for students. Students can go and observe with the telescope operator. To obtain the extra credit points, the student must fill out an observation log. When a completed observation log is turned in to Canvas, the student will get 10 points of extra credit towards their final grade. The observatory schedule and the observation logs will be available on Canvas.

### **Administrative Drop**

As an instructor, I am required to administratively drop students from the course who do not participate in the first week of classes. To determine if you have participated in the first week, I will be checking your Canvas attendance and activity. To not be dropped from the course please participate in Top Hat questions and access this course through Canvas during the first week of classes.

### **Academic Honesty**

**Please read this section carefully as each student is required to understand and comply with all Academic Integrity rules and standards. Both NAU and this Department/Course have standards which are written and referenced below.**

Both myself and the science/engineering profession have absolutely no patience with cheating. Anyone cheating on an exam will receive a zero on that exam, and possibly a failing grade in the course. If anyone is caught using another student's account in Top Hat, both the students may receive a zero for the entire "in class questions" portion of the grade.

Note that no student will be allowed to exit the classroom during any of the exams, unless there is an emergency. Therefore, make sure you get a drink and visit the facilities in advance. If you feel that you might need to leave the classroom during an exam, you must get advance permission from the instructor, in writing (email), before the exam. The use of cell phones at any time during an exam will be considered an act of academic dishonesty. The same holds true for smart-watches and "Google Glasses", or other enhanced vision products. You must not use or look at or touch your phone or watch (even if not a smart watch) at any time. You will be asked to place all such products securely away, out of reach and view, before the exam begins. You are not allowed to use your phone as a calculator. The same holds true for any calculator that can communicate with any other device or user. You may not bring in any paper to any exam, including "cheat sheets", and you may not take any paper out of the classroom after any exam. You are not allowed to look at the exam of another student, nor are you allowed to send or receive any information and/or signals or other forms of communication during an exam. The violation of any of these Academic codes of conduct may result in your failing the course.

In general, it is not my responsibility to attempt to describe and prohibit any and all forms of Academic Dishonesty. It is your responsibility to uphold the highest ethical standards. If you have any doubt or question about this policy, it is your responsibility to ask the instructor in advance and to be clear about

the answers and policies. Again, the text above and the attached NAU policies try to be very clear about what constitutes an act of Academic Dishonesty, but we cannot anticipate every possible form of cheating in advance. So the attachments and examples above are not meant to be comprehensive. Academic Dishonesty information will be given to the Dean of Students and a written copy of any such incident may be attached to your official NAU file.

**Any student who has been found to be cheating will receive a 0 mark for the assignment.**

## **University Policies**

### **ACADEMIC INTEGRITY**

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

### **COPYRIGHT INFRINGEMENT**

All lectures and course materials, including but not limited to exams, quizzes, study outlines, and similar materials are protected by copyright. These materials may not be shared, uploaded, distributed, reproduced, or publicly displayed without the express written permission of NAU. Sharing materials on websites such as Course Hero, Chegg, or related websites is considered copyright infringement subject to United States Copyright Law and a violation of NAU Student Code of Conduct. For additional information on ABOR policies relating to course materials, please refer to [ABOR Policy 6-908 A\(2\)\(5\)](#).

### **COURSE TIME COMMITMENT**

Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224, *Academic Credit*), each unit of credit requires a minimum of 45 hours of work by students, including but not limited to, class time, preparation, homework, and studying. For example, for a 3-credit course a student should expect to work at least 8.5 hours each week in a 16-week session and a minimum of 33 hours per week for a 3-credit course in a 4-week session.



## DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conducive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's *Disruptive Behavior in an Instructional Setting* policy at <https://nau.edu/university-policy-library/disruptive-behavior>.

## NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, veteran status and genetic information. Certain consensual amorous or sexual relationships between faculty and students are also prohibited as set forth in the *Consensual Romantic and Sexual Relationships* policy. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's *Nondiscrimination and Anti- Harassment*

policy. EAO also assists with religious accommodations. For additional information about nondiscrimination or anti-harassment or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at [equityandaccess@nau.edu](mailto:equityandaccess@nau.edu), or visit the EAO website at <https://nau.edu/equity-and-access>.

## TITLE IX

Title IX of the Education Amendments of 1972, as amended, protects individuals from discrimination based on sex in any educational program or activity operated by recipients of federal financial assistance. In accordance with Title IX, Northern Arizona University prohibits discrimination based on sex or gender in all its programs or activities. Sex discrimination includes sexual harassment, sexual assault, relationship violence, and stalking. NAU does not discriminate on the basis of sex in the education programs or activities that it operates, including in admission and employment. NAU is committed to providing an environment free from discrimination based on sex or gender and provides a number of supportive measures that assist students, faculty, and staff.

One may direct inquiries concerning the application of Title IX to either or both the Title IX Coordinator or the U.S. Department of Education, Assistant Secretary, Office of Civil Rights. You may contact the Title IX Coordinator in the Office for the Resolution of Sexual Misconduct by phone at 928-523-5434, by fax at 928-523-0640, or by email at [titleix@nau.edu](mailto:titleix@nau.edu). In furtherance of its Title IX obligations, NAU promptly will investigate or equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. The Office for the Resolution of Sexual Misconduct (ORSM): Title IX Institutional Compliance, Prevention & Response addresses matters that fall under the university's Sexual Misconduct policy. Additional important information and related resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <https://in.nau.edu/title-ix>.

**ACCESSIBILITY**

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-8747 (fax), or [dr@nau.edu](mailto:dr@nau.edu) (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at [jamie.axelrod@nau.edu](mailto:jamie.axelrod@nau.edu).

**RESPONSIBLE CONDUCT OF RESEARCH**

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

**MISCONDUCT IN RESEARCH**

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University's Research Integrity Officer, Dr. David Faguy, who can be reached at [david.faguy@nau.edu](mailto:david.faguy@nau.edu) or 928-523-6117. More information about misconduct in research is available at <https://nau.edu/university-policy-library/misconduct-in-research>.

**SENSITIVE COURSE MATERIALS**

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.