

AST309N: "LIVES & DEATHS OF THE STARS: ELEMENTS OF THE COSMOS"

BASIC DATA:

Website and email platform for contacting the professor and TAs: **Canvas**

Course Unique No. & Semester: **46175, Spring 2020**

Class Meetings: **Tues. & Thurs., 9:30 – 10:45 AM, Painter Hall 3.02**

Instructor: **Prof. Harriet Dinerstein**, contact via *Canvas email*, (512) 471-3449

Professor Office Hours: Wed. 1:30-2:30 PM; PMA (RLM) 16.324, or by appointment

Teaching Assistants: **Ajit Gopalakrishnan** and **Byung Tark (B. T.) Lee**

T.A. Office Hours: times to be announced; held in PMA (RLM) 16.304B

Help Sessions: (some weeks), Wed., 6:30 – 7:30 PM, PMA (RLM) 15.216B

PREREQUISITES AND CREDIT:

All of the Ast 309 classes have a prerequisite of **Ast 301** or an equivalent one-semester introductory astronomy course. While this is not enforced at the time of registration, we recommend against taking Ast 309N without having had the prerequisite. If this is your first astronomy course, you may be unfamiliar with many common astronomical terms and concepts, putting you at a disadvantage. This is particularly true for Ast 309N since we begin the semester with topics that are usually not covered until the very end of the semester in introductory courses. However, we recognize that some students may have missed or forgotten some material and will review relevant background as we go along.

This course is intended and designed for students who are *not* majoring in Natural Sciences or Engineering. Science majors are permitted to take Ast 309N but it will not count towards their major. Ast 309N does not carry a quantitative reasoning (QR) flag, but it counts towards the Natural Science and Technology Part I or II core requirement.

WHAT THIS COURSE IS ABOUT:

The “stars” of astronomy are ... well, the stars! They provide the light and heat that makes life-bearing planets like Earth possible. They are the building blocks of galaxies, as atoms are building blocks of matter. Yet, despite their huge masses, sizes, and energies, stars are deeply connected to the tiny scales of atoms and nuclei. Nearly every atom in the cosmos of all elements heavier than helium was made inside a star that existed long ago. This is what Carl Sagan meant when he said “We are star stuff.”

Your introductory astronomy course probably started out by discussing the night sky and continued with our Solar System, stars, galaxies, and cosmology. We will tell this story in the opposite direction. We begin at the beginning, when the universe was made solely of hydrogen and helium, and follow the increasing chemical complexity that resulted from stars “cooking up” all the other elements and dispersing them back into space, where they became part of later generations of stars and the planets that orbit them. This course is about cosmic chemistry in a very broad sense.

RECOMMENDED BOOKS AND CLASS RESOURCES:

There is no book that perfectly matches the content of this course. If you still have a book from your introductory astronomy class you may find it useful as a reference. To provide an inexpensive resource, I have ordered (and strongly recommend) the small paperback book “**Stars: A Very Short Introduction**,” by Andrew King. It costs only about \$12 new (\$9 used) at the Co-op. You can buy the Kindle ebook from Amazon for \$6.15. Another resource is the free OpenStax book “Astronomy” by Andrew Fraknoi, David Morrison, and Sidney Wolff, at <https://openstax.org/details/books/astronomy>. I will post relevant readings for various topics in both books.

Many other materials will be posted on Canvas. These will include most class slides, **posted after, not before, class** (to ensure they match what we covered). Other items will include feedback (but not answer keys) for quizzes, exams, and in-class activities; most of the video clips; an archive of class announcements; and access to grades.

COURSEWORK AND GRADING:

My grading philosophy is that students should be able to earn a grade based on their own work. A table will be posted after Exam 1 is graded, specifying correspondences between the total number of points earned (on a scale of 0-100) and letter grade. This is **not** a “curve,” since I don’t force fixed proportions of A’s, B’s, etc.; in other words, there are no quotas on A’s! We will use plus/minus grades, e.g. A-, B+, etc.

Your semester grade will be based on points earned from in-class **hour exams**, short answer **quizzes**, and **participation activities**. The latter two work on a *cumulative credit* basis. You can earn quiz or participation points up to a pre-set maximum or “cap,” after which no more points are added but you still get valuable practice on material that will be on exams. Since there will be a larger number of quizzes and activities than needed to reach the cap, there will be no make-ups for individual missed quizzes or activities. You replace these instead with *equivalent* credit from a different activity, quiz, or extra credit.

In-class Exams: The hour exams will be multiple-choice format with options for giving short explanations for your choices for a limited number of questions. Exams will be taken in two shifts: you will be assigned to a specific shift (first or second half) and **must** take that particular exam. Expect to be assigned to different shifts on different exams.

Preliminary exam dates, subject to change, are **Feb. 27, Apr. 2, May 7**. All are Thursdays, and there will be a help session on the Wednesday evening before each exam. The **optional final**, covering the whole course, is **Saturday, May 16, 9:00 A.M. – 12:00 noon**. If you have taken all 3 hour exams and are happy with your grade, you don’t need to take the final exam unless you want a (no-risk) chance at improving your course grade.

Each hour exam will cover material from the previous few weeks, and will be equally weighted, **24%** each, for a total of **72%**. There are no make-ups for missed hour exams during the semester. If you miss an exam for any reason, *no matter how legitimate*, that exam will be dropped and you must take the final exam, which will replace the missed exam. If you did not miss an exam, you may still take the final, which will count only if it improves your grade. All students (including SSD-approved) must take exams *at the same time*. **No one may take an exam earlier or later than the rest of the class.**

Quizzes: We will have about 7 “pop” quizzes consisting of two short-answer questions each. Their purpose is to test your ability to respond quickly, so these are not subject to SSD-approved accommodations for extra time. Quizzes may be given at any time during class. Quiz credits accumulate up to a maximum of 14 points, which would translate to **14% of your course grade**. You may reach this cap with high scores on a few quizzes or lower scores on more quizzes. (Typical scores are 2 points out of 4.) There are no make-ups for individual missed quizzes; missed points can be earned *only* on later quizzes.

Participation Credit: The remaining **14%** of the grade will come from credits earned over the semester through in-class activities. Most participation activities will be carried out in small groups and collected on index cards. Credit will be given for any *honest effort* on these; your responses need not be entirely correct but must be on-topic. Activities must be done in class in order to earn credit; you can't get credit for doing them afterwards.

Extra Credit: A few extra points (**1%** of the course grade) can be earned via approved out-of-class activities. These include *documented* attendance at **up to three (3)** UT Star Parties, 1 point for each. The Astronomy Department offers Star Parties most Wed., Fri., and Sat. evenings: <https://astronomy.utexas.edu/outreach/star-parties> . You will need to obtain an official signed slip from the person in charge, making sure to write your name and EID, and give it to one of the TAs in class or office hours. You can also earn credit by attending an approved public lecture and turning in a satisfactory write-up; a suitable lecture is expected to take place on Saturday, February 29.

CLASSROOM EXPECTATIONS AND POLICIES:

We expect everyone to be respectful of the instructor and their classmates. Talking to your neighbor or using a cell phone distracts others. **Turn off the volume on your phone before the beginning of class, and do not use it for texting or internet access during class.** With very few exceptions, I do not allow use of tablets or laptops in class. There is documented evidence not only that students who use the internet for unrelated purposes during class receive lower grades, but that such use has also been shown to *lower the grades of students sitting near them*. Students must also refrain from other activities that may distract the instructor and other students, such as entering or leaving the room loudly, conversing with neighbors except during assigned activities, snoring, etc.

It is expected that you will attend and participate regularly in class. This is the best way to keep up with the material and be prepared for quizzes and exams. Dates and times of the quizzes and activities will not be announced in advance, so if you skip a class you may miss one of these. If you are looking for a class to take by just showing up for major exams, this is **not** it! Enrolling but failing to attend regularly is a losing strategy in this course, and absence/failing reports will be filed with your Dean.

Academic Integrity and Academic Dishonesty: The University of Texas at Austin holds its students and community to high standards of academic integrity. Details can be found at <http://deanofstudents.utexas.edu/conduct> . *We will not tolerate copying or cheating on exams, quizzes, or other classwork.* In cases of duplicated work or other evidence of cheating, neither student will receive credit. More severe academic penalties are also possible, such as an F for the course and a report to the Dean of Students.

Students with Disabilities: The University of Texas at Austin provides selected adjustments for students with certified disabilities. To be assessed for certification and accommodations, contact the SSD (Services for Students with Disabilities) office: ssd@austin.utexas.edu, or visit <http://diversity.utexas.edu/disability/>. It is necessary to reapply for accommodations at the beginning of each semester, so do this as soon as possible. In order to arrange special exam accommodations such as extra time or alternate settings it is *essential* that you provide the instructor with a letter and test scheduling form **as soon as possible** at the start of the semester. *You must meet with the instructor in her office*, during the instructor's office hours or by advance appointment. All alternate exam-taking for this course must be proctored by SSD. Your exam times must fully overlap with the exam period for the rest of the class, but you may start early or end late in order to allow more time.

GETTING HELP IN THIS CLASS:

There will be several opportunities each week to ask questions and get help. At least on weeks when exams are given (and possibly more often if there is sufficient student demand), there will be help sessions on Wednesdays from 6:30 – 7:30 PM in PMA (RLM) 15.216B. We will also hold office hours. We prefer that you come during regular office hours of the professor or Teaching Assistants if at all possible, but we can also set up individual appointments in advance if none of those times work for you (email us through Canvas!). You may also send questions through Canvas to the T.A.s and instructor. If you have questions on procedures, please check the website and recent announcements first, to see whether the answer might already be posted.

KEY DATES FOR SPRING 2020: (from UT's academic calendar)

First class meeting: **Tues., Jan. 21**

Last day of online adds/drops: **Fri., Jan. 24**; no adds allowed after this date

Last day to drop a course or switch between letter grade and pass/fail: **Mon., Apr. 6**

After this date, drops require dean's approval and are *only* for non-academic reasons.

Last class meeting and date of the last hour exam: **Thurs., May 7**

Optional Final Exam: **Sat., May 16, 9:00 AM – 12:00 noon**

GENERAL COMPETENCIES FOR SCIENCE CORE COURSES:

These are required components for all science core courses.

1. Effectively communicate what scientific theories and methods tell us.
2. Work with others in approaching a scientific question (teamwork).
3. Identify, analyze, and synthesize information needed to answer a scientific question.
4. Apply quantitative methods to a scientific question.

SPECIFIC LEARNING OBJECTIVES FOR THIS COURSE:

- Be able to identify the major element groups of the Period Table and the nuclear reactions that create them. [The nuclear physics of the elements]
- Identify the astronomical sites where each of these reactions happens (e.g. type of stars, interior or surface, early Universe, etc.) [The astrophysics of the elements]
- Summarize the composition of the Sun and present-day stars; explain why this differs from the past composition of the universe. [Cosmology: the history of the universe]
- Explain why some elements are much more common than others. [The story of stellar aging and “element cooking” = Lives and Deaths of the Stars]
- Describe the composition of the Earth and other planets, and why it differs from that of the Sun and stars. [Star and planet formation; history of the Earth]
- Interpret and draw diagrams; understand and apply the concept of proportionality. [General quantitative skills]

PRELIMINARY SCHEDULE OF TOPICS: (subject to change)

Jan. 21, 23: Intro, background survey, Atoms and Elements, Energy and Force

Jan. 28, 30: The Sun, Nuclear Reactions in the Sun and Stars

Feb. 4, 6: Properties of Light and Reading the Messages it Carries

Feb. 11, 13: The Big Bang, early nucleosynthesis, Cosmic Microwave Background

Feb. 18, 20, 25: Gravitational lenses and waves, dark matter, first stars and galaxies

Feb. 27: **Exam 1**

Mar. 3, 5: Observing Stars; Lives, Deaths, and Element Synthesis in high-mass stars

Mar. 10, 12: Lives, Deaths, and Element Synthesis in low-mass stars

Spring Break

Mar. 24: End-states of low-mass stars: White dwarfs

Mar. 26, 31: End-states of high-mass stars I: Neutron stars and pulsars

Apr. 2: **Exam 2**

Apr. 7, 9, 14: End-states of high-mass stars II: Black holes

Apr. 16, 21: Interstellar clouds, the birth of stars

Apr. 23, 28: Formation and evolution of the Solar System

Apr. 30, May 5: Planets around stars other than the Sun

May 7: **Exam 3**

May 16: **Optional Comprehensive Final Exam, 9:00 AM - noon**

General Memo for Undergraduate Astronomy Students

Welcome to this undergraduate Astronomy course. We wish to clarify the ground rules for Astronomy Department courses. These courses operate with mutual responsibilities between faculty and students. For each of our classes:

- A written syllabus will be handed out at the first class meeting containing a description of the course, the material to be covered, all requirements in the course, and an explanation of what fraction of your grade is derived from each activity. These requirements or percentages are not to be changed during the semester.
- This course, although designed for non-science majors, is nevertheless a **science** course. You will be exposed to scientific reasoning in the course, which you will be required to use on tests, quizzes, and activities. Only simple mathematics is used; the level varies from instructor to instructor.
- Students in the College of Natural Sciences should note that AST 301 and AST 309 courses do NOT count towards your degree requirements. We encourage you to consider taking AST 307 instead.
- There will normally be help available outside of class at least once a week. If you have trouble understanding the material, or other problems, such as illness, arise, *let your instructor know as soon as possible*. Don't wait until the end of the semester, for it may then be too late to find a solution.
- You should not need to pay for any outside tutoring. The outside help that is provided with the courses should be adequate. If you need extra help, please see your instructor or T.A. during office hours. Should you still feel the need of a tutor, be aware that astronomy graduate students generally cannot tutor for money. The Learning Skills Center runs sessions on general study techniques and math review. Many of their services are free. Go to JES A332A or phone 471- 3614.

Note that our undergraduate courses are taught by faculty members who are professional astronomers. In addition to their obligations to you and other students in this and other courses, faculty members have responsibilities to their graduate students and to remain professionally competent through research. As a consequence, your instructor may occasionally be away conducting research or attending a scientific meeting. Usually another faculty member will conduct the class when the regular instructor is absent.

We expect, and usually find, honesty in our students. Your instructor will explain any special rules, such as the encouragement of genuine collaboration on assignments. However, submission of another's work or cheating on exams are grounds for failure in the course and reporting to the Dean of Students.

If you have any complaints or problems, please try to work out a solution with your instructor first. If you and your instructor cannot find an amicable solution, then please see either:

Dr. Adam Kraus
Chair, Astronomy Undergrad Studies Committee
(Office: RLM 15.310B, alk@astro.as.utexas.edu)

or
Dr. Volker Bromm
Chair, Astronomy Department
(Office: RLM 15.214, chair@astro.as.utexas.edu)

If you are in crisis and need immediate assistance, please telephone the Office of the Dean of Students Emergency Staff: 512-471-5017. They can help you with a number of services, and may be able to contact your professors for you if you have an emergency that prevents you from attending class.

<http://deanofstudents.utexas.edu/emergency/>

For questions about undergraduate courses, please see the Academic Program Coordinator in the Astronomy Student Office, RLM 15.204, Kalyn Williams: kalyn.williams@austin.utexas.edu .

Students are encouraged to attend our free Astronomy events, such as Star Parties at the 9-inch telescope on the roof of Painter Hall or the 16-inch on the roof of RLM. More information is available through links from our class home page. You can also call our Skywatchers' Report at 471-5007.