

AST309N: “LIVES & DEATHS OF THE STARS: ELEMENTS OF THE COSMOS”

BASIC DATA:

Web Site and email platform (for contacting the professor and TAs): **Canvas**

Course Unique No. & Semester: **46610, Spring 2019**

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; RLM 16.324

Teaching Assistants and Grader:

Yuzheng (Andy) Lan Chandra Shekhar Justin Kang

T.A. Office Hours: times and locations to be announced

Help Sessions: (certain weeks only), Wed., 4:30 – 5:30 PM, RLM 15.216B

PREREQUISITES AND CREDIT:

Ast 309N has a prerequisite of AST 301 or an equivalent college-level introductory astronomy course (if taken at UT, either Ast 301 or 307). *We strongly advise against taking Ast 309N without having previously taken an introductory class*, since we will begin the semester by discussing topics that are usually not covered until the end of the semester in introductory courses. However, we recognize that you may have forgotten some of that content, and will review relevant background material 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 Ast309N, but it will not count towards their major. Ast 309N does not carry a quantitative reasoning (QR) flag, but *can* count towards the Natural Science and Technology Part I 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 to matter. Yet, despite their huge masses, sizes, and energy output, 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 deep 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 will begin at the beginning, when the universe was made of hydrogen and helium only, and trace the increasing chemical complexity that resulted from stars “cooking” up other elements and tossing them into space. This eventually enabled rocky planets to form around stars, as we see in our universe today. This course is about cosmic chemistry in a very broad sense.

RECOMMENDED BOOKS AND CLASS RESOURCES:

There is no textbook that exactly matches the content of this course. If you still have a book from your introductory astronomy course, you may find it useful as a reference. I have ordered, and highly recommend, the short, paperback book “**Stars: A Very Short Introduction,**” by Andrew King, which will cost about \$12 at the Co-op. Alternatively, you can get it as a Kindle eBook from Amazon for only \$6.15. It discusses many of the main topics in this course, although sometimes with more math than we will use. Another resource is the free OpenStax book “Astronomy” by Andrew Fraknoi, David Morrison, and Sidney Wolff, at <http://cnx.org/content/col11992/latest>. I will announce the pages relevant to each topic we cover, in both the King and Fraknoi books.

Resources available on Canvas will include selected class slides, which **will be posted after (not before) class**, in order to match what was actually covered. Other postings will include web links; feedback (but not answer keys) for quizzes, exams, and in-class activities; an archive of all current and previous announcements; and your grades.

COURSEWORK AND GRADING:

My grading philosophy is that all students should have the opportunity to earn a grade based on their own work; there are no quotas for A's and B's. After the first exam I will post a table of numerical score to letter grade equivalents, to be used for the rest of the semester (barring extraordinary circumstances). I do use +, – grades.

The course grade will be based on a combination of in-class **hour exams**, short answer **quizzes**, and participation **activities**. The latter two categories work on a *cumulative credit* basis. You earn quiz or participation points up to a pre-set maximum or “cap,” after which they no longer add points but do give you valuable practice on the material. Because there will be more quizzes and activities than needed to reach the cap (they're “overbooked”), there will be no make-ups for individual missed quizzes or activities. Instead, you are expected to earn the equivalent credit on a later activity or quiz, or extra credit point.

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

Preliminary dates, subject to change, are **Feb. 28, Apr. 4, May 9**. All are Thursdays, and there will be a help session the Wednesday afternoon before each exam. The **optional final exam** will be **Wednesday, May 15, 9:00 A.M. – 12:00 noon**. If you take all 3 hour exams and are satisfied with your course grade, you don't need to take the final exam.

Each hour exam will cover material from the previous few weeks, and will be equally weighted, **22%** each, for a total of **66%**. 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 may improve 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; no exceptions.**

Quizzes: We will have about 7 “pop” quizzes consisting of two short-answer questions. The purpose of these 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 will accumulate up to a cap of 16 points. Earning full credit on quizzes will add **16% to your course grade**. You may reach the cap through high scores on a few quizzes, or lower scores on a larger number of quizzes. There will be no make-ups for individual missed quizzes; the missed points can be earned *only* on later quizzes.

Participation Credit: The remaining **18%** 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 or worksheets. Credit will be given for any *honest effort* on these (the answers don’t need to be entirely correct). These activities must be performed in class in order to earn credit; they cannot be done outside of class.

Extra Credit: A few extra points (each point = **1%** of the course grade) can be earned through pre-approved out-of-class activities. These include *documented* attendance at **up to three** 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> . When you attend a Star Party, 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. It is also possible to earn credit by attending an approved public lecture and turning in a short write-up. There will be a suitable public talk on a Saturday in February. Any additional approved out-of-class activities will be announced in advance.

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 is highly distracting to 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. Apart from the ample documented evidence that not only do students using the internet for unrelated purposes during class receive lower grades (half a letter grade on average), but such use also *lowers the grades of students sitting near them*. This is going to particularly be an issue in our crowded. 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 class and to be prepared for quizzes and exams. Also, the 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! Please take this warning seriously; every semester there are students who enroll but fail to attend regularly. This is guaranteed to be 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 take these rules seriously. *We will not tolerate copying or cheating on exams, quizzes, or other classwork.* If we find duplicated work or other evidence of cheating, neither student will receive credit. We may also impose more severe academic penalties depending on circumstances, not excluding 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 4:30 – 5:30 PM in RLM 15.216B. We will also hold office hours. We prefer that you come during the 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 about procedures, please check the website first.

KEY DATES FOR SPRING 2019: (from UT's academic calendar)

First class meeting: **Tues., Jan. 22**

Last day of online adds/drops: **Fri., Jan. 25**

Last day to drop a course or switch between letter grade and pass/fail: **Mon., Apr. 8.**

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

Last class meeting and date of last hour exam: **Thurs., May 9**

Optional Final Exam: **Wed., May 15, 9:00 AM – 12:00 noon**

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 diagrams and understand concept of proportionality. [General quantitative skills]

PRELIMINARY SCHEDULE OF TOPICS: (subject to change)

Jan. 22, 24: Introduction, Survey, Syllabus, Elements, Force, Motion, & Energy

Jan. 29, 31: The Sun, Our Local Star, Nuclear Reactions in the Sun

Feb. 5, 7: Reading the Messages in Light

Feb. 12, 14: The Big Bang, early nucleosynthesis, the Cosmic Microwave Background

Feb. 19, 21, 26: Gravity, grav. lenses & waves, dark matter, first stars

Feb. 28

Exam 1

Mar. 5, 7: Stellar Properties, Lives, Deaths, and Nucleosynthesis in high-mass stars

Mar. 12, 14: Lives, Deaths, and Nucleosynthesis in low-mass stars

Spring Break

Mar. 26, 28: White dwarfs (WDs), WD's in binary systems

Mar. 28, Apr. 2: Neutron stars (NS), pulsars, NS's in binary systems

Apr. 4

Exam 2

Apr. 9, 11, 16: Black holes, gamma-ray bursts, X-ray binaries

Apr. 18, 23: Interstellar clouds, star birth

Apr. 25, 30: Formation and evolution of the Solar System

May 2, 7: Other planetary systems (“exoplanets”), Course-Instructor Survey

May 9

Exam 3

May 15:

Optional Comprehensive Final Exam

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 that the course will cover, 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:

Milos Milosavljevic
Chair, Astronomy Undergrad Studies Committee
(Office: RLM 17.220, Phone: 471-3397)

or

Shardha Jogee
Chair, Astronomy Department
(Office: RLM 15.218, Phone: 471-3302)

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, Abby Black, black@astro.as.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.