

**Syllabus for ASTR 1303**  
**Stellar Astronomy, Section # 93504**  
**9:00 – 10:20 Monday and Wednesday HLC 2104**

**Instructor:** James (Jim) Heath

**Office Hours:** Highland Campus 2408      MW 1:30 – 4:00 PM  
TTh 9:00 AM – 10:30 AM  
TTh 3:00 – 4:00 PM  
Fridays by appointment

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**Class Website:** <http://www2.austincc.edu/jheath> (click on “The Starry Site”)

**Text:** *Astronomy Today*, 9<sup>th</sup> Edition by Chaisson and McMillan (Prentice Hall)  
We will only be using Volume 2: Stars and Galaxies

I will also be “assigning” videos from the Crash Course Astronomy section on YouTube. You can find them by typing “Crash Course Astronomy” into the search window on YouTube.

**Course Overview:**

**Description from the ACC catalogue: A study of stars, galaxies, and the universe. Discussion of atomic spectra, nuclear energy, and astronomical tools (such as optical, radio, and other telescopes and image enhancers) as they provide knowledge about distant objects. Emphasis on recent discoveries about quasars, black holes, and cosmology.**

After a brief introduction to the history and terminology of astronomy, basic laws of physics which are essential to the study of stars and galaxies will be presented. Then we will discuss the external properties of stars, followed by a discussion of the internal processes that give rise to these properties. The star that we know best, the Sun, will be our example. Finally, the "life histories" of stars will be presented as we examine the changes a star undergoes from its "birth", throughout its "life", to its inevitable "death". Okay, that's quite enough quotation marks.

Next, we will expand our scale outward to investigate the stellar neighborhood we live in, the Milky Way. The properties and make-up of our galaxy will be discussed, as will its origin and evolution. But our galaxy is just one of many, and we will discover many other shapes, sizes and types of island universe as we expand our sight further to encompass the entire Universe. Some galaxies will be like the Milky Way, but others will be strange indeed, and could contain keys to the scale of the Universe. Finally, we will discuss the Universe as a single object, where it came from, what it is now, and what it will become.

## **Instructional Methodology and Course Rationale:**

This course is a lecture-based course which may include class discussions, student projects and demonstrations. It is an introduction to Stellar Astronomy, providing students with a science course suitable for transfer to a four-year college or university. Therefore, the course will be taught at the university level. The course prerequisites are MATD 0390 (Intermediate Algebra) or one year of high school algebra or the equivalent. One year of high school science is recommended, but not required.

## **Student Learning Outcomes**

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

- Demonstrate understanding of the nature of science and the Scientific Method.
- Demonstrate knowledge of the basic laws of physics that pertain to the study of the stars and galaxies.
  - Demonstrate knowledge of the basic properties of stars, and how those properties are determined.
  - Demonstrate knowledge of the different stages in a star's development, including its birth, life, and death.
  - Demonstrate knowledge of the properties of galaxies, and how those properties originate.
  - Demonstrate knowledge of the nature of the expansion of the Universe, and what that expansion tells us about the past, present, and future of the Universe.

## **General Education Student Learning Outcomes**

Upon completion of this course, students will demonstrate competence in:

- Critical Thinking – Gathering, analyzing, synthesizing, evaluating and applying information.
- Interpersonal Skills – Interacting collaboratively to achieve common goals.
- Quantitative and Empirical Reasoning – Applying mathematical, logical and scientific principles and methods.
- Technology Skills – Using appropriate technology to retrieve, manage, analyze, and present information.

## **Purpose of this Course:**

I've heard it said that the purpose of education is to give people the ability to tell when someone is "talking rot" and when they are making sense. This skill is becoming even more important in the modern day, surrounded as we are by science and technology. Con-artists and opportunists are learning to wrap themselves up in technology to better deceive people: astrologers are starting to carry around laptop computers, for example. I believe that science courses should help give people the tools they need to become scientifically literate, and be able to evaluate scientific claims in their lives as consumers and voters. It is my hope that this course can serve part of that purpose.

## **Goals and Objectives:**

The simplest and most obvious goal for this course is to convey to you the basic concepts of stellar astronomy. I realize that only a few of you would even consider a career in astronomy, so this course is not necessarily "pitched" to future scientists. I hope to be able to give you enough of a background in the facts and theories of astronomy to be able to understand claims made by astronomers in the popular media, and maybe even enjoy astronomy as a hobby.

A deeper goal for this course is to give you practice in thinking scientifically. In-class materials, as well as most graded activities, are intended to help you improve your abilities to organize, reason, make conclusions based on evidence, and otherwise think logically. Other activities will help you practice other aspects of a scientific mind, such as creativity, ability to observe, and the practice of examining your own attitudes and biases. These are skills that employers are looking for, and skills a scientifically aware citizen should have. Everyone has these skills inside them, and part of my job is to help you sharpen these skills.

Of course, the most important goal in this class is to have fun. Astronomy is an exciting field that is changing every day, and a fun hobby to pursue. I hope some of my enthusiasm about science and astronomy will be infectious. Remember that a lot of the responsibility for this rides on you: you can only have as much fun as you allow yourself to have. Be involved in the class! Be energetic!

## **Grading System:**

### **I. Tests**

To evaluate student progress in the course, four tests will be given, approximately one every six class days. Each test will be worth 17% of the final grade, for 68 % total. The tests will NOT be comprehensive (but there will be certain concepts that will recur throughout the semester, so don't forget everything too quickly!), and there will be no final or midterm exams. Exams will consist of definitions and essay questions, some of which can be chosen from lists. Since I realize that many students have "math anxiety," no required essay question will be mathematical in nature. This math deficiency will be compensated for on the homework assignments.

The exams will be mostly essay because I am interested in testing your understanding of the material, not just your raw knowledge. The emphasis will be on the ability to analyze (break things apart) and synthesize (put things together), rather than your ability to memorize facts. Accordingly, I will focus more on whys and wherefores in my lectures, instead of throwing a stream of trivia at you, which would bore all of us. However, I do NOT want my own words regurgitated back at me on the tests. You will be expected to explain things in your own words, and in plain English. I also prefer essay questions because I am a believer in partial credit.

**Research Paper** – Since anyone can have a bad day, any student wishing to do so may submit a short paper (approximately 1000 words/five pages) on a topic appropriate to solar system astronomy. You must have at least five references. To insure that only the latest information is used, the references for the paper are required to be magazine articles from the past five years; no books allowed. Internet articles may also be used, but they may not outnumber magazine articles! The grade received on this paper will take the place of the WORST test grade received during the semester. In the interest of time and sanity (both mine and yours), please try to decide on a topic and discuss it with me by April 29 at the latest and have it turned in by May 11.

## **II. Homework Assignments**

In addition, five homeworks will be given over the course of the semester, each 3 questions in length. Each will be worth 3% of the final grade, for 15% total. As answers will be posted on the Website the day homeworks are due, no late homework will be accepted. Students are allowed to cooperate on homeworks, but deliberate copying will be severely punished! I am a great believer in rewarding effort, so partial credit will be happily given to people who attempt the problems, but for some reason or another, can't follow through to the end. Thus, I encourage you to show all your work on the homeworks. Answers without explanation will receive NO CREDIT!

My philosophy behind homeworks is as follows. Many times we read a fact in a textbook, like "the density of Saturn is so small it would float in water" or "the mass of Jupiter is such-and-such", and blindly accept it. Such blind acceptance, both in science and in "real life", is dangerous. The purpose of the homeworks is to get you to confirm these "facts" for yourselves. Many of the great computations of astronomy can be done by non-science majors using high school freshman algebra and a calculator!

High-school algebra is a pre-requisite for this class, so I will not (and should not be expected to) take up class time to re-teach it. Please go over the section of the Website titled "Basic Math"; I will be glad to discuss it with you during my office hours. I generally discuss homeworks only briefly in class, but I will happily discuss problems in detail during my office hours, either in person or on the phone.

Finally, I often hear students (especially fine arts students) complain that they are not "mathematically inclined", whatever that means. I look upon such remarks with the same displeasure as I would look upon a computer jock's whinings about not being "artistically" or "linguistically inclined". Art, mathematics, philosophy, etc., are all integral parts of the human experience, and the total person should have some proficiency in all of them. Science is not the exclusive purview of fat, balding, old males with German-sounding names; far too many people that do not fit this description sell themselves short, just like society tells them to. Such beliefs are not allowed in my class. You can all do it!

### III. Opinion Paper

10% of the grade will be determined by a short (3-5 page) opinion paper. The purpose of this paper is to motivate you to think about your own attitudes and feelings towards science, and a chance to be creative in your writing. The topic will be more fully discussed in class, and details of the paper are on the Website. The Opinion Paper will be due April 20.

### IV. Website Summary and Class Participation

For 7% of the grade, I ask students to find a location on the World Wide Web that is related to astronomy, and tell me about it. Write a one page summary *in your own words* of what's on the Website, and include a printout of the first page of the site. The Website that you review CANNOT be one that is already linked to the class Website! You must find something new! The review is due February 3. Also included in this 7% is your participation in in-class discussion activities. These might be individual activities discussed with the whole class or discussions in groups of two or three. You must be in class to get these points; make-ups will only be allowed for excused absences.

#### Summary of Grading System:

Tests (4 @ 17% apiece)	68%
Homeworks (5 @ 3% apiece)	15%
Opinion Paper	10%
Website Review and Class Participation	7%
Total	100%

#### Course Policies:

**Incompletes** – In compliance with Physical Sciences Task Force Policy, I will not grant incompletes, except in the most extreme circumstances. In all circumstances, extensive documentation of reasons will be required. An instructor may award a grade of “I” (Incomplete) if a student was unable to complete all of the objectives for the passing grade in a course. An incomplete grade cannot be carried beyond the established date in the following semester. The completion date is determined by the instructor but may not be later than the final deadline for withdrawal in the subsequent semester.

**Withdrawal Policy** – It is the responsibility of each student to ensure that his or her name is removed from the roll should he or she decide to withdraw from the class. The instructor does, however, reserve the right to drop a student should he or she feel it is necessary. If a student decides to withdraw, he or she should also verify that the withdrawal is submitted before the Final Withdrawal Date. The student is also strongly encouraged to retain their copy of the withdrawal form for their records. Students who enroll for the third or subsequent time in a course taken since Fall 2002 may be charged a higher tuition rate, for that course. State law permits students to withdraw from no more than six courses during their entire undergraduate career at Texas public colleges or

universities. With certain exceptions, all course withdrawals automatically count towards this limit. Details regarding this policy can be found in the ACC college catalog.

**Attendance** – A number of studies in science education have revealed that class attendance is a very important factor in determining the final grades of college science students. Attendance is even **more important** than the teacher, the textbook, the student's GPA or even the student's IQ! Yet these same studies reveal that some college students enjoy exercising the "freedom to miss class" that college affords, and their grades suffer as a result.

Class time is when you can interact with your fellow students and with the instructor. More pragmatically, class time is when you find out what's going to be on the test! In this class, there will be nothing required on the test that is not discussed in class. Conversely, with the exception of a few personal anecdotes and historical vignettes to add flavor to the class, everything said in class will be on the test in one form or another. There is no substitute for coming to class.

Because attendance is so important to your success in this class, we will have the following attendance policy:

*After FOUR (4) unexcused absences, I reserve the right to withdraw you from the class without further notice.*

Notice that this *doesn't* mean I will automatically withdraw you, merely that I *reserve the right* to do so. It is possible to get an absence excused, by one of two methods:

1. Producing a **documented** valid excuse. Valid excuses include, but are not limited to
  - a. Personal illness or other medical emergency
  - b. Illness or death of family member
  - c. Loss of transportation (*one time only*)
  - d. Work conflict (*one time only*)
  - e. Jury duty
  - f. National Guard duty

Valid excuses **must** come with written documentation (doctor's note, mechanic's receipt, etc.) to be counted. It is your responsibility to provide this documentation, and to notify me as quickly as possible of your absence, so that I won't withdraw you!

2. An adequately detailed outline of the text reading for the missed class day. I will be the final arbiter of what constitutes an adequate amount of detail, and only one rewrite will be allowed per outline.

Attendance will be taken, either verbally, or by sign-in sheet, during class.

**Anyone not in roll is class when roll is called will be counted absent, and must have a valid excuse (see above) for not being there.**

### **A Note on Cheating:**

**I expect and demand that everything you do in this class will be your own work.** Studies have shown that increasing numbers of college students think that cheating is acceptable, and it simply is not. Claiming someone else's work as your own is plagiarism, and both the college and I have a very low tolerance for it. Please take pride in your work, and be honest. Note that this does not forbid students from working together. If you are doubtful about where the line is between collaboration and plagiarism, talk to me, and we'll work it out before you turn things in.

**Make-up Policy** – As stated before, no late homeworks will be accepted. Tests missed may be made up out of class at times to be arranged if the student possesses an adequate excuse (illness, death in the family, etc. A sudden urge to go to South Padre is NOT a valid excuse!). Extensions may be granted to papers in extreme circumstances.

### **A Note about Readings:**

**There is no substitute for reading the book.** Research has shown that one of the keys to learning science is to have "hooks," called prior knowledge, that give you someplace to "hang" new knowledge. Your own life experiences will provide some of these hooks, and I hope you will share them in class discussions. Reading material in the book before class will provide you with more hooks, so that information discussed in class will not be entirely new. To best understand the things we will discuss, you will need to "see" it from as many angles as possible. The book provides you with one such angle.

### **Some truths about taking this class:**

- **It is not unreasonable for me to expect you to come to class on time every day that you are physically able.**
- **It is not unreasonable for me to expect you to take notes in class.**
- **It is not unreasonable for me to expect you to do all the assignments.**
- **It is not unreasonable for me to expect you to read the book.**

All of the above are essential to your learning in this class, or any science class. You are all adult learners, and I will treat you like adults, responsible for your own learning. I provide the opportunities; you must provide the energy. If you think that any of the above are unreasonable, then you will have a difficult time in this class!

And remember, the only *really* stupid question is "Who cares?"

## COURSE OUTLINE

### Section 1: The Foundations of the Scientific Method

JAN 22	Introduction to course	
JAN 27	The Scientific Method <i>Crash Course Astronomy #1</i>	Ch 1, 1-12
JAN 29	The History of Stellar Astronomy <i>Crash Course Astronomy #2</i>	Ch 2, 34-44
FEB 3	Isaac Newton <i>Crash Course Astronomy #7</i>	Ch 2, 49-56
FEB 5	The Nature of Light <i>Crash Course Astronomy #6</i>	Ch 3, 60-65
FEB 10	Electromagnetic Radiation <i>Crash Course Astronomy #24</i>	Ch 3, 65-75
FEB 12	The Nature of Matter	Ch 4, 80-88
FEB 17	Spectroscopy	Ch 4, 88-95
FEB 19	TEST #1	

### Section 2: Stars, Outside and In

FEB 24	The Sun, a “Typical” Star <i>Crash Course Astronomy #10</i>	Ch 16, 386-406
FEB 26	Nuclear Fusion	Ch 16, 407-413, Ch 21, 525-533
MAR 2	Parallax and Space Motion <i>Crash Course Astronomy #25</i>	Ch 17, 415-421
MAR 4	The Magnitude System	Ch 17, 421-424
MAR 9	Stellar Temperatures	Ch 17, 424-429
MAR 11	The Hertzsprung-Russell Diagram <i>Crash Course Astronomy #26</i>	Ch 17, 430-435
MAR 23	Binaries and Stellar Mass <i>Crash Course Astronomy #34</i>	Ch 17, 436-440
MAR 25	TEST #2	



### Section 3: The Life and Death of Stars

MAR 30	The Interstellar Medium and Star Formation	Ch 18, 445-462
	<i>Crash Course Astronomy #28 and #36</i>	Ch 19, 465-481
APR 1	The Life Story of the Sun	Ch 20, 490-504
	<i>Crash Course Astronomy #29</i>	
APR 6	The Lives of Massive Stars	Ch 20, 504-507, 510-512
	<i>Crash Course Astronomy #31</i>	
APR 8	Stellar Explosions	Ch 21, 516-534
APR 13	Stellar Corpses I: Pulsars and Neutron Stars	Ch 22, 537-549
	<i>Crash Course Astronomy #32</i>	
APR 15	Stellar Corpses II: Black Holes	Ch 22, 549-566
	<i>Crash Course Astronomy #33</i>	
APR 20	Star Clusters	Ch 19, 481-485
	<i>Crash Course Astronomy #35</i>	Ch 20, 507-510

### Section 4: The Big Picture

APR 22	The Milky Way Galaxy	Ch 23, 572-597
	<i>Crash Course Astronomy #37</i>	
APR 27	Types of Galaxies	Ch 24, 601-608
	<i>Crash Course Astronomy #38 and #39</i>	
APR 29	Galaxy Clusters and Formation	Ch 24, 608-615
	<i>Crash Course Astronomy #41</i>	Ch 25, 632-643
MAY 4	Active Galaxies and Quasars	Ch 24, 615-628
	<i>Crash Course Astronomy #40</i>	Ch 25, 645-655
MAY 6	The Expanding Universe	Ch 26, 657-677
MAY 11	The Big Bang Theory and the Early Universe	Ch 27, 682-702
	<i>Crash Course Astronomy #42 and #43</i>	
MAY 13	TEST #4	

DUE DATES

February 3	Website Review
February 17	Homework #1
February 19	TEST #1
March 9	Homework #2
March 23	Homework #3
March 25	TEST #2
April 13	Homework #4
April 20	Opinion Paper
April 20	Take-Home Test handed out
April 27	Take-Home Test turned in
May 11	All Extra Credit
May 11	Homework #5
May 11	Research Papers
May 13	TEST #4