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## ASTR 142N.80: The Evolving Universe - Honors

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# The Evolving Universe:

## *Recent Theories and Observations in Modern Astronomy*

**INSTRUCTOR:** Diane Friend  
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**PHONE:** 243-4299  
**OFFICE:** CHCB 129 (inside the Physics/Astronomy dept. office)  
**OFFICE HOURS:** Mon. 10-11 & 1-2, Wed. 10-11 & 3-4, Thurs. noon-1 and by appt.  
Wed. 3-4 You can find me in CHCB 13 if I'm not in my office!

**Course meets:** M, W, F 9:10-10:00 a.m. in CHCB 230/231  
and M 3:10 – 5:00 p.m. in CHCB 230/231 or CHCB 13  
Weather permitting, we will also have a few night meetings for astronomical observing.

**Moodle:** All course announcements, resources, and materials will be on the *Evolving Universe* Moodle course supplement.

### **Readings: Required Texts**

1. *An Introduction to the Sun and Stars*  
edited by Simon Green and Mark H. Jones
2. *An Introduction to Galaxies and Cosmology*  
edited by Mark H. Jones and Robert J. A. Lambourne

### **Magazine and journal articles:**

Since we are exploring current topics in the field of astronomy, a number of course readings will be taken from periodicals and journals such as Nature, Science, Scientific American, Sky and Telescope, etc. You will be able to access these articles as links on Moodle or through the Mansfield Library e-journals.

**Supplies:** Scientific calculator, headlamp or small flashlight. For some labs it may be nice to have your own laptop, but this is not essential.

### **Course Description**

New technologies and space-based observations have fueled a renaissance in our understanding of the universe. From the discovery of extrasolar planets, to theories postulating the properties of dark matter, dark energy, and accelerated expansion, we will explore many of the exciting, recent advances in the field of astronomy. How has the intricate interplay between theory, observation, and experiment evolved our understanding of the universe? What fundamental questions remain?

### **Learning Objectives**

- To gain a basic understanding of many of the methods astronomers use to study the universe
- To gain a working knowledge of some of the basic physics that astronomers use to understand the universe (properties of light, matter, motion, and force)
- To gain an appreciation of how astronomical ideas have evolved over recent decades
- To get an overview of some of the important research topics in astronomy today
- To learn how to access resources useful for following developments in the field and explore opportunities for accessing astronomical information, datasets, and research opportunities
- To discover fundamental questions which remain

## Course Requirements

This course will require you to think critically, conceptually, and quantitatively. It will give you lots of opportunities for hands-on explorations through laboratory, computer, and astronomical observing activities integrated throughout the course. Everyone will be expected to be an active participant in class discussions, projects, and activities.

### Your grade for this course will be based on the following:

|  |          |
|--|----------|
| Exams (2 midterms: 15% each; 1 final: 20%):  | 50%      |
| Laboratory and Class Discussion activities:  | 25%      |
| Homework:  | 15%      |
| Project:   | 10%      |
| Extra Credit:  | up to 4% |
| (instructor's discretion for outstanding projects, participation above and beyond, etc.) |          |

**Exams:** Each exam will be short answer (conceptual and quantitative). The Final Exam will be comprehensive. No make-ups will be given for midterms or the Final unless prior arrangements are made (for exceptional, documentable circumstances) or an unexpected (documentable) emergency.

**Laboratory activities:** This class will be blurring the distinction between participatory demonstrations and bona fide laboratory activities. As we go through the semester, some activities will be much more in-depth than others. I will assign a point system for discussion activities and labs based on their length and difficulty.

**Homework:** These assignments will give you insight into the more quantitative aspects of the course and encourage you to explore current research. Homework assignments will be due every 1-3 weeks. DO NOT leave these assignments until the last minute! DO NOT hesitate to come see me outside of class with any questions you may have. I am very happy to discuss homework questions with you *before* they are due!

**Project:** Over the course of the semester, you will be involved with a research project of your choice. These projects can be done in groups of 2-3 students (this will make the workload quite manageable), or you can work by yourself if you prefer. Different types of projects will lend themselves to different sized groups. I will provide a list of possible project topics that complement what we will be covering in class, but I encourage you to suggest other topics that reflect your particular interests. I will have checkpoints throughout the semester to help you keep your project on track.

Each group will be tasked with the following:

1. Research the topic by accessing both fundamental background literature and a variety of recent, peer-reviewed research articles. Depending on your topic, you will want to access appropriate astronomical datasets or take some of your own astronomical observations.
2. Construct a well-written, illustrated (with relevant tables, graphs, and/or images) Moodle wiki page on your research. As per standard Wiki format, all references should be cited in the text and listed at the end of your page. Making your own high quality visuals will earn you extra points!
3. Each person will be asked to peer review two project wikis prior to project presentation. Each group must address any issues brought up by your peer reviewers (and your instructor) before project completion.
4. Present a 10 minute power point overview of what you found to be the most intriguing aspects of your topic/results to the class, to be followed by a general class discussion that your group will moderate. (The class will be required to read your wiki page prior to your discussion and submit to you a short list of what they found most interesting and would like to see you address.)
5. Each person will write-up a brief description of the contributions of *each* group member to sign and turn in individually at the end of the project. (Groups only.)

Note: Everyone in your group should be able to intelligently discuss your topic, but it is EXPECTED that you will divide up tasks according to the individual expertise of your group members. Groups with diverse backgrounds will be very useful. Science background, math background, creativity, writing skills, artistry, research skills, organizational skills, etc, will all be equally important qualities to have within your group members. Curiosity and a good work ethic will undoubtedly be most important!

**Participation:** Active and thoughtful participation will undoubtedly influence your final grade in this class. Come prepared to think, question, and contribute!

**Academic conduct statement:**

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at [http://life.umt.edu/ypsa/student\\_conduct.php](http://life.umt.edu/ypsa/student_conduct.php).

**EQUAL ACCESS:** A fair and inclusive learning environment benefits us all. I encourage students from different cultural backgrounds, students for whom English is not their native language, and/or any student who has a disability that may adversely affect their academic performance to contact me within the first few days of class to discuss appropriate accommodations. If you think you may have a disability and have not registered with DSS, please contact them in Lommasson 154, call (406) 243-2243, or view the DSS website at <http://life.umt.edu/dss>. The folks at DSS are very helpful!

**ADD/DROPS:** The last day to add/drop on Cyber Bear is Friday, February 14. The last day to use a Drop/Add form to drop or change grading option, with the signatures of your instructor and advisor is Monday, April 7. A drop, or change of grading option after April 7 requires the signature of the Dean and written documentation of exceptional circumstances.

**Brief Course Outline**

*Note:* Detailed schedule information, assignments, learning objectives, and all course materials will be posted throughout the semester on Moodle. You should be accessing the Moodle course supplement frequently!

| WEEK | DATES            | TOPIC   | READINGS  |
|------|------------------|---|---|
| 1    | Jan 27-31        | Introduction to course<br>A sense of place and scale<br>Getting familiar with the night sky<br>Learning to read the stories told by light           | <b>Sun and Stars</b><br>Box 1.1, 1.2, 1.3, Section 1.3.2<br>Peruse the links and resources on Moodle and get familiar with e-journal resources at the Mansfield Library |
| 2    | Feb 3-7          | The Sun- Observations and fundamentals<br>Solar structure and variability   | Remainder of Chapter 1<br>Chapter 2   |
| 3    | Feb 10-14        | Measuring stellar properties  | Chapter 3   |
| 4    | Feb 18-21        | <b>Holiday Monday- President's Day</b><br>Stellar properties and the H-R Diagram  | Chapter 4   |
| 5    | Feb 24-28        | Star and Planetary system formation<br><b>Friday, Feb. 28: EXAM 1</b>   | Chapter 5   |
| 6    | Mar 3-7          | Discovering planets beyond the solar system-<br>Discovery methods, surprises, insights, and questions   |   |
| 7    | Mar 10-14        | The evolution of stars  | Chapter 6-8   |
| 8    | Mar 17-21        | The death of stars- stellar remnants<br>White dwarfs, neutron stars, and black holes  | Chapter 9   |
| 9    | Mar 24-28        | Exploring our own galaxy- the Milky Way   | <b>Galaxies and Cosmology</b><br>Chapter 1-2  |
| 10   | Mar 31-<br>Apr 4 | <b>SPRING BREAK</b>   |   |
| 11   | Apr 7-11         | The structure and evolution of galaxies through time<br>Massive black holes, dark matter, and colliding galaxies<br><b>Friday, April 11: EXAM 2</b> | Chapter 3-4   |
| 12   | Apr 14-18        | Modeling the universe: Hubble's discovery and recent developments   | Chapter 5, Chapter 7.2-7.3  |
| 13   | Apr 21-25        | Important cosmological parameters and possible models   | Chapter 5   |
| 14   | Apr 28-<br>May 2 | Evidence supporting the Big Bang  | Chapter 6-7   |
| 15   | May 5-9          | Outstanding questions   | Chapter 8   |
| 16   | May 12-16        | <b>Final Exam is Thursday, May 15 from 10:10 a.m. – 12:10 p.m.</b>  |   |