

ASTRONOMY 116
Introductory Astronomy
With Laboratory
Spring, 1997

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Astronomy is the science of the Universe, its origin, its structure, its contents, its processes, its evolution, and its ultimate fate. Astronomy is the oldest of the natural sciences and continues as a human enterprise because humanity continues to believe that the Universe is comprehensible.

This course provides an introduction to the science of astronomy, its history and its place in the history of human thought, its techniques, and its discoveries. The course emphasizes the principles of discovery and understanding.

Textbook and Readings. The textbook on which the course is based is Kaufmann and Comins, Discovering the Universe fourth edition, published by W. H. Freeman and Co., 1996. A schedule of lecture topics and associated readings is distributed at the beginning of the course. Students are expected to read the assigned sections of the text both in preparation for class and after the lecture. Additional readings from other sources may be assigned. You are asked to bring your textbook to class every class day since we will often refer to tables, graphs and pictures in the textbook.

Class Attendance. The student is responsible for the course material discussed in class; therefore, the student is expected to attend all classes. An inordinate number of absences will be handled in accordance with College policies.

Laboratory. Laboratory activities are designed to provide deeper understanding of subject matter through direct contact with nature and use of the methods of science. Attendance at laboratory sessions is mandatory. Students are expected to arrive at laboratory sessions on time. Appropriate penalties will be imposed, if this becomes necessary. Excused absences will be handled on an individual basis and will be granted only for reasons such as illness, serious emergency and religious observance (if prearranged). In the case of an excused absence, a make-up laboratory will be required. In the case of an unexcused absence, a grade of zero for the laboratory will be assigned.

A laboratory schedule is distributed at the beginning of the course.

The laboratory is divided into two parts:

Part A (Mondays 2:00 p.m.) These sessions will generally involve investigation using *Voyager II* software and the required laboratory manual *Voyages Through Space and Time*, by Jon K. Wooley, Wadsworth Publishing Co., 1995. These sessions will be held in the **Multi-Media Center in Humanities Hall**. Most of the laboratory work will be finished by 3:30 p.m., but the student should be prepared to remain in lab until 4:00 p.m. when the work to be accomplished takes longer.

Students will submit reports of laboratory work in connection with this part of the laboratory. All reports will require written work and will be judged on the basis of the quality of writing, as well as on presentation of collected data. The laboratory schedule will indicate the due date for laboratory reports. Appropriate non-negotiable penalties for late reports will be imposed.

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Part B (Wednesday evenings): These sessions will generally involve group observing and field trips. The student is expected to have the *Edmund Mag 5 Star Atlas* as a reference for laboratory observing and for observing outside laboratory periods. Laboratory reports may be assigned for B-labs, but generally reports of observing activities will be reported in the Observation Journal (see below).

Since observing conditions are highly unpredictable and may affect the choice of activity, your professor reserves the right to change the starting time of an observing session to suit that activity. In general, however, with the **possible exception of one late night or early morning observing session**, the Wednesday (Part B) laboratory periods will not begin before 7:00 p.m. nor end after 11:00 p.m. Most sessions will last about an hour and a half. Wednesday laboratory sessions will begin in **Pierce Hall, Room 102**, unless you are instructed to begin elsewhere. In the interest of maintaining an appropriate amount of laboratory time it may be necessary occasionally to work indoors, usually in the Multi-Media Center, and do our "observing" using Voyager 2 or other software. In particular, the first one or two Wednesday evening sessions may be devoted to work with Voyager 2 in the Multi-Media Center in the manner of the Monday lab sessions.

Tests. The tests in Astronomy 116 will include objective as well as essay questions. Some questions will be quantitative in nature. A significant number of test questions will, in general, stress reasoning with principles. Laboratory material may be included. Laboratory rules of attendance apply to tests. In the case of an excused absence, unless it is inappropriate to the excuse, a make-up test will be given prior to the scheduled time of the test.

There will be four tests, all during class time in Pierce 102, scheduled as follows:

Friday, 7 February - introductory principles
Wednesday, 3 March - the Solar System
Wednesday, 2 April - stellar astronomy
Monday, 21 April - the Milky Way and extragalactic astronomy

Calculator & Binder. Students will need a scientific calculator for laboratory. It will be helpful, too, if you bring your calculator to class. Calculators will be permitted on tests. It is also recommended that you have a medium-sized looseleaf binder for lab reports, class notes and handouts.

Other. In addition to tests and laboratory reports, the student will be asked to submit other work for credit. Such additional work will include the following:

Papers - Two short papers will be required. Both will involve reading and interpreting an article from a popular scientific magazine. Further description of the nature of these papers will be distributed, along with a list of articles from which to choose, well in advance of the due dates of these papers. The due dates of the papers are as follows:

Paper I (Solar System) - due on Wednesday, 26 February

Paper II (stars, galaxies, etc.) - due on Wednesday, April 16

Observation Journal - The student will be required to maintain a record of all observing in a separate notebook, preferably a small spiral notebook and in a format to be specified by the time of the first observing session. Journals will be checked after the first observing session (see Laboratory Schedule) and at the end of the course. The student will be expected to observe on at least two occasions outside laboratory periods and report observations in the journal.

Grading. The course grade will be assigned on the basis of 1000 points, computed as follows:

Tests (4 @ 100 points)	400 points
Laboratory	225 points
Papers and Other Assignments	150 points
Journal	50 points
Final Exam	<u>175 points</u>
	1000 points

In general, letter grades will be determined as follows:

A	900 or more points
B	800 to 899 points
C	700 to 799 points
D	600 to 699 points
F	fewer than 600 points

Grades of A-, B+, B-, C+, C-, D+ may be assigned for sums of points near the above cut-offs in total points.

THE HONOR CODE OF OXFORD COLLEGE APPLIES TO ALL WORK SUBMITTED FOR CREDIT IN THIS COURSE, AND ALL SUCH WORK WILL BE PLEDGED TO BE THAT AND ONLY THAT OF THE INDIVIDUAL STUDENT SUBMITTING THE WORK.

Office Hours:

Mondays: 4:00 - 5:00 p.m.
Tuesdays: 9:45 - 10:45 a.m.; 1:30 - 2:30 p.m.
Wednesdays: 2:30 - 3:30 p.m.
Thursdays: 4:30 - 5:30 p.m.

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Lecture Schedule & Textbook Reading Assignments

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Wednesday, 15 January	Overview of the course and its subject matter; astronomical scales	Foundations I Intro. (pp. 1 - 9)
Friday, 17 January	Constellations; apparent motions; the Celestial Sphere; seasons; lunar phases; eclipses	Chapter 1 (pp. 10 - 35)
Wednesday, 22 January	The Ptolemaic (geocentric) and Copernican (heliocentric) systems; parallax	Chapter 2 (pp. 36 - 41)
Friday, 24 January	Kepler's Laws; Galileo's contributions; Newton's Laws	Chapter 2 (pp. 42 - 53)
Monday, 27 January	The electromagnetic spectrum; Planck's Law; elementary optics; simple telescopes	Chapter 3 (pp. 54 - 68)
Wednesday, 29 January	Modern telescopes; observational considerations Blackbody radiation (Wien's Law; Stefan-Boltzmann Law; Planck's Law)	Chapter 3 (pp. 68 - 79) Chapter 4 (pp. 80 - 84)
Friday, 31 January	Spectra; Kirchhoff's Laws; the Rutherford atom	Chapter 4 (pp. 84 - 90)
Monday, 3 February	The Bohr atom and spectral lines; the Doppler Effect	Chapter 4 (pp. 89 - 96)
Wednesday, 5 February	Review	
Friday, 7 February	Test 1	

Monday, 10 February	The Solar System - overview, criteria for comparison of planets, theories concerning its origin	Foundations II Intro. (pp. 99 - 109)
Wednesday, 12 February	The Earth and Moon	Chapter 5 (pp. 110 - 132)
Friday, 14 February Monday, 17 February	The other inner, terrestrial planets (Mercury, Venus, Mars)	Chapter 6 (pp. 133 - 155)
Wednesday, 19 February Friday, 21 February	The outer planets: the Jovian planets and their satellites; Pluto	Chapter 7 (pp. 156 - 184)
Monday, 24 February	Asteroids, meteoroids and comets	Chapter 8 (pp. 185 - 204)
Wednesday, 26 February	The atmosphere of the Sun	Chapter 9 (pp. 205 - 215)
Friday, 28 February	Review	
Monday, 3 March	Test 2	
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Wednesday, 5 March	The Sun's interior	Chapter 9 (pp. 215 - 222)
	Introduction to stellar astronomy; distances to stars	Foundations III Intro. (pp. 225 - 231)
Friday, 7 March	The nature of stars: temperature, color, spectral type, luminosity; the Hertzsprung-Russell diagram	Chapter 10 (pp. 232 - 240)
Monday, 17 March	Binary stars; stellar mass	Chapter 10 (pp. 240 - 247)
Wednesday, 19 March	Protostars and their development	Chapter 11 (pp. 248 - 259)

Friday, 21 March	Main sequence stars; giant stars; variable stars	Chapter 11 (pp. 259 - 269)
Monday, 24 March	How stars expire and what is left	Chapter 12 (pp. 270 - 281)
Wednesday, 26 March	Neutron stars and pulsars; novae and bursters	Chapter 12 (pp. 281 - 291)
Friday, 28 March	Black holes	Chapter 13 (pp. 292 - 303)
Monday, 31 March	Review	

Wednesday, 2 April **Test 3**

Friday, 4 April	Introduction to the larger universe	Foundations IV Intro. (pp. 305 - 310)
Monday, 7 April	The Milky Way Galaxy	Chapter 14 (pp. 311 - 322)
Wednesday, 9 April	Classification of galaxies	Chapter 15 (pp. 323 - 331)
Friday, 11 April	Galactic clusters; the Hubble Law	Chapter 15 (pp. 331 - 345)
Monday, 14 April	Quasars; active galaxies	Chapter 16 (pp. 346 - 360)
Wednesday, 16 April	The Big Bang Theory	Chapter 17 (pp. 360 - 367)

Friday, 18 April Review

Monday, 21 April **Test 4**

Wednesday, 23 April	The fundamental forces; formation of galaxies	Chapter 17 (pp. 368 - 374)
Friday, 25 April	The fate of the Universe	Chapter 17 (pp. 374 - 380)
Monday, 28 April	The search for extraterrestrial intelligence Review	Chapter 18 (pp. 381 - 388)

The final examination is to be given on Thursday, 1 May, at 2:00 p.m. in Pierce 102.

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Laboratory Schedule
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Note: All references to page numbers pertain to the lab manual Voyages Through Space and Time
Please see additional notes at end of schedule

Wednesday, January 15	Lab 1	Voyager 2 orientation in MMC <u>beginning at 7:00 p.m.</u> Project 1 (pp. 37-51) to be done in lab. Report due on Wednesday, January 22 at lab time. Film: "Universe" if time permits.
Wednesday, January 22	Lab 2	Project 2 (pp. 53-64) and Project 3 (pp. 65-73) to be done in MMC. Session begins at 7:00 p.m. Study pp. 9-15 in advance. Report due on Monday, January 27 at lab time. Brief observation orientation at college athletic field, if time and weather permit.
Monday, January 27	Lab 3A	Project 4 (pp. 75-86) to be done in MMC. Study pp. 15-22 in advance. Report due on Monday, February 3 at lab time.
Wednesday, January 29	Lab 3B	Observing at Oxhouse Science Center. (possible project in MMC or elsewhere indoors, if weather is unsuitable) Begin in <u>Pierce 102 at 7:00 p.m.</u> Report due on Wednesday, February 5 at lab time.
Monday, February 3	Lab 4A	Project 5 (pp. 89-94) and Project 17 (pp. 181-186) to be done in MMC. Report due on Monday, February 10 at lab time.
Wednesday, February 5	Lab 4B	Observing at Oxhouse Science Center. (possible project in MMC or elsewhere indoors, if weather is unsuitable) Begin in Pierce 102 at 7:00 p.m.

Monday, February 10	Lab 5A	Project 18 (pp. 187-194) to be done in MMC. Report due on Monday, February 17 at lab time.
Wednesday, February 12	Lab 5B	Observing only if seeing conditions are excellent, in which case we will begin in Pierce 102 at <u>8:30 p.m.</u>
Monday, February 17	Lab 6A	Project 20 (pp. 203-213) to be done in MMC. Report due on Monday, February 24 at lab time.
Wednesday, February 19	Lab 6B	Observing. (possible project in MMC or elsewhere, if weather is unsuitable) Begin in Pierce 102 at <u>7:30 p.m.</u>
Monday, February 24	Lab 7A	Project 21 (pp. 215-220) to be done in MMC. Report due on <u>Friday, March 7 at class time</u>
Wednesday, February 26	Lab 7B	Observing. (possible project in MMC or elsewhere, if weather is unsuitable) Begin in Pierce 102 at 7:30 p.m.
Monday, March 3	Lab 8A	Lab after Test 2. We will begin Star Search using Voyager 2 in MMC.
Wednesday, March 5	Lab 8B	Unless seeing conditions are excellent, we will continue Star Search in MMC, beginning at 7:30 p.m. Due date for report will be announced.
Monday, March 17	Lab 9A	Project 22 (pp. 223-231) to be completed in MMC. Report due on Monday, March 24 at lab time.

Wednesday, March 19	Lab 9B	Observing. (possible project in MMC or elsewhere if weather is unsuitable) Begin in Pierce 102 at 7:30 p.m.
Monday, March 24	Lab 10A	Project 23 (pp. 233-241) to be completed in MMC. Report due on <u>Friday, March 28 at class time</u>
Wednesday, March 26	Lab 10B	Observing. (possible project in MMC or elsewhere if weather is unsuitable) Begin in Pierce 102 at 7:30 p.m.
Monday, March 31		No projects to complete today. Review session in class will probably extend into lab time, however. Reserve the time normally devoted to lab for review.
Wednesday, April 2	Lab 11B	Observing. (possible project in MMC or elsewhere if weather is unsuitable) Begin in Pierce 102 at 7:30 p.m.
Monday, April 7	Lab 12A	Project X1 to be done in MMC. This project is not in the lab manual. A preview of this project will be distributed in class on Friday, April 4. Report due on Monday, April 14.
Wednesday, April 9	Lab 12B	Observing. (possible project in MMC or elsewhere if weather is unsuitable) Begin in Pierce 102 at <u>8:00 p.m.</u>

Monday, April 14	Lab 13A	Project X2 to be done in MMC. This project is not in the lab manual. A preview of this project will be distributed in class on Friday, April 11. Report due on Wednesday, April 23.
Wednesday, April 16	Lab 13B	Observing. (possible project in MMC or elsewhere if weather is unsuitable) Begin in Pierce 102 at <u>8:00 p.m.</u>
Monday, April 21	Lab 14A	Brief lab after Test 4. Project, if any, to be announced.
Wednesday, April 23	Lab 14B	Observing. (possible project in MMC or elsewhere if weather is unsuitable) Begin in Pierce 102 at <u>8:00 p.m.</u>
Monday, April 28		No project scheduled. Review for exam may extend into lab time.

Note : The statements concerning activities for the "B" labs reflect intentions as of the beginning of the semester. With sufficient notice, activities and/or starting times may be modified by your instructor. For instance, the opportunity for a field trip may arise and necessitate a different starting time.