Department of Astronomy

Professor: *Bauer, French (Chair)*

Associate Professor: *McLeod*

Instructor in Astronomy Laboratory: *Slivan*

Astronomy is the study of the universe—from planets and stars to the Milky Way and distant galaxies, from the instant of the Big Bang to the current era of rapid expansion and beyond to the distant future. Modern astronomers rely on careful observations of the cosmos and on their understanding of physical laws to make sense of our often baffling, but always fascinating universe. The astronomy curriculum emphasizes hands-on observations at the Whitin Observatory, using a fleet of small telescopes in introductory courses and the 24-inch research telescope for advanced classes and student research. The underlying physical principles of astronomy are elucidated at all levels, from introductory courses for nonscience majors to upper level classes in advanced astrophysics.

Goals for the Major

For students intending to pursue a Ph.D. in Astronomy, we offer, jointly with the Department of Physics, a major in Astrophysics. For students interested in other pursuits, such as education, journalism, computing, and public outreach in museums, we offer a major in Astronomy. Majors in Astronomy will have a broad understanding of the varied phenomena in the heavens, from the solar system and stars to the realm of galaxies and the large-scale structure and evolution of the universe. They will understand the motions of the night sky, be familiar with modern observational techniques and computational tools, and have carried out an independent project using our 24-inch telescope. They will have the problem solving and critical thinking skills necessary to understand astronomical research, and the ability to communicate these results with clarity and precision, both orally and in writing.

The astronomy department offers two introductory survey courses geared to nonscience majors: 100 and 101. These courses are taught at a similar level and both fulfill the Natural and Physical Science distribution requirement; 101 fulfills the Mathematical Modeling requirement. Students who elect to take both may do so in either order. ASTR 108 is a seminar for first year students emphasizing hands-on astronomy. ASTR [109] and 206 fulfills the Quantitative Reasoning overlay course requirement.

ASTR 100 Life in the Universe
Bauer, McLeod
This course investigates the origin of life on the earth and the prospects for finding life elsewhere in the cosmos, and begins with an overview of the earth's place in the solar system and the universe. The course examines the early history of the earth and the development of life, changes in the sun that affect the earth, characteristics of the other objects in our solar system and their potential for supporting life, the detection of planets around stars other than the sun, and the search for extraterrestrial life. Some nighttime observing will be required. *This course does not count toward a major in Astrophysics.*

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement.
Distribution: Natural and Physical Science
Semester: Fall, Spring Unit: 1.0

ASTR 101 Introduction to Stars, Galaxies, and Cosmology with Laboratory
French, Bauer
This course examines the life stories of stars, from birth in clouds of gas and dust, through placid middle age, to violent explosive demise, leaving white dwarfs, neutron stars, or black holes. It also explores the makeup and structure of galaxies, which contain billions of stars and are racing away from each other as part of the overall expansion of the universe. Finally, it presents modern cosmological models for the origin and ultimate fate of the universe. The course emphasizes the interaction of observations and the mathematical models developed from these data. Weekly hands-on astronomy laboratory introduces visual observing and astronomical imaging, including both historical (visual, film astrophotography, darkroom) and modern (electronic imaging) equipment and techniques. *Evening laboratory at the observatory.*

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement. Not open to students who have already taken [110].
Distribution: Mathematical Modeling or Natural and Physical Science
Semester: Fall, Spring Unit: 1.25

ASTR 104/PHIL 104 Stars and the Sages: Philosophy and the Cosmos
de Warren (Philosophy), French
This First Year Seminar explores the changing views of the universe from the Ancient Greeks, through the emergence of the scientific revolution to the startling advances in cosmology during the twentieth century, and includes visits to the Special Collections Library and observations from the Whitin Observatory; no particular competence in mathematics is required. We begin with readings from Plato, Aristotle and ancient Greek astronomers and their concern to understand the inherent rationality of the universe. We next turn to the discoveries of Copernicus, Kepler, Galileo, and Newton. Our exploration of philosophy and astronomy will then address Einstein's theories of special and general relativity, evidence for the Big Bang, and contemporary perplexity regarding the presence of dark matter and dark energy. *Students may register for either ASTR 104 or PHIL 104 and credit will be granted accordingly.*

Prerequisite: None. Open only to first-year students.
Distribution: Epistemology and Cognition
Semester: Spring Unit: 1.0

ASTR 108 Discovering Our Universe with Laboratory

McLeod

This course leads first-year students through hands-on exploration of the structure of the Universe and our place within it. We will measure the size, shape, and spin of the earth by using simple homemade instruments to observe the sky. We will learn to use Wellesley's own telescopes to explore the arrangement and contents of our own Solar System. Finally, we will determine our place within the Milky Way galaxy and the universe using data obtained from the National Virtual Observatory. No prior experience in astronomy is required, but algebra and trigonometry will be used. *Evening laboratory at the observatory. Mandatory credit/noncredit.*

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement. Open only to first-year students.
Distribution: Natural and Physical Science or Mathematical Modeling
Semester: Fall Unit: 1.0

ASTR 201 Motions in the Sky: Archaeoastronomy and the Copernican Revolution

Bauer

This course examines the motions of the sun, moon, and planets in the sky and how humans have interpreted them through time. Archaeoastronomy is the study of astronomical knowledge in a culture as revealed through the archaeological record, written records, and ethnography. We will discuss the archaeoastronomy of several cultures, including the Mayans and the Anasazi. We will follow the beginnings of modern astronomy from the ancient Greeks through the Copernican revolution and Newton's formulation of the laws of motion. *Normally offered in alternate years.*

Prerequisite: Any 100-level astronomy course, and familiarity with trigonometric functions.
Distribution: Natural and Physical Science
Semester: Spring Unit: 1.0

ASTR 203/GEOS 213 Planetary Geology

NOT OFFERED IN 2009-10. OFFERED IN 2010-11. Spacecraft observations have revealed a breathtaking diversity of geologic features in the solar system, from ancient river valleys on Mars and violent volcanic eruptions on Io to ice fountains on Enceladus and the complex surfaces of comets and asteroids. From a comparative point of view, this course examines the formation and evolution of the planets and small bodies in the solar system. Topics will include: volcanism, tectonic activity, impacts, and tides. *Students may register for either ASTR 203 or GEOS 213 and credit will be granted accordingly. Normally offered in alternate years.*

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement and any 100-level ASTR or GEOS course.
Distribution: Natural and Physical Science
Semester: N/O. Offered in 2010-11. Unit: 1.0

ASTR 205 Relativity and Cosmology

NOT OFFERED IN 2009-10. OFFERED IN 2010-11. Einstein's theories of space and time have brought about a fundamental change in our conceptual understanding of the universe. Using trigonometry and algebra, this course explores special and general relativity, space travel, black holes, gravitational lensing, galaxy evolution, dark matter, and the expanding universe. *Normally offered in alternate years.*

Prerequisite: 101, 108, or permission of the instructor.
Distribution: Mathematical Modeling or Natural and Physical Science
Semester: N/O. Offered in 2010-11. Unit: 1.0

ASTR 206 Astronomical Techniques with Laboratory

McLeod

This course provides an introduction to modern methods of astronomical observation. Students will learn to use the Whitin Observatory's 24-inch research telescope. Topics include: planning observations, modern instrumentation, and the acquisition and quantitative analysis of astronomical images. This course requires substantial nighttime telescope use and culminates with an independent observing project.

Prerequisite: 101, 108, or [110]
Distribution: Mathematical Modeling or Natural and Physical Science. Fulfills the Quantitative Reasoning overlay course requirement.
Semester: Fall Unit: 1.25

ASTR 301 Seminar. Topics in Multiwavelength Astronomy

NOT OFFERED IN 2009-10. OFFERED IN 2010-11. The newest generation of Earth- and space-based telescopes has allowed astronomers to survey the entire sky across the entire electromagnetic spectrum, from gamma rays to radio waves. This course provides an introduction to modern astronomical research, making use of multiwavelength observations.

Prerequisite: 206
Distribution: Natural and Physical Science
Semester: N/O. Offered in 2010-11. Unit: 1.0

ASTR 311/PHYS 311 Elements of Astrophysics

Bauer

Astrophysics is the application of physics to the study of the universe. We will use elements of mechanics, thermodynamics, electromagnetism, quantum mechanics, special relativity, and nuclear physics to investigate selected topics such as planets, the life stories of stars and galaxies, dark matter, and the origin of the universe. Our goals will be to develop insight into the physical underpinnings of the natural world, and to develop a "universal toolkit" of practical astrophysical techniques that can be applied to the entire celestial menagerie. These tools include scaling analysis, numerical solutions to complex problems, and other research approaches advanced in professional literature. *Students may register for either ASTR 311 or PHYS 311 and credit will be granted accordingly. Normally offered in alternate years.*

Prerequisite: PHYS 202 and 203
Distribution: Mathematical Modeling or Natural and Physical Science
Semester: Spring Unit: 1.0

ASTR 350 Research or Individual Study

Prerequisite: By permission of department.
Distribution: None
Semester: Fall, Spring Unit: 1.0

ASTR 360 Senior Thesis Research

Prerequisite: By permission of department. See Academic Distinctions.
Distribution: None
Semester: Fall, Spring Unit: 1.0

ASTR 370 Senior Thesis

Prerequisite: 360 and permission of department.
Distribution: None
Semester: Fall, Spring Unit: 1.0

Related Courses

For Credit Toward the Major

PHYS 202 Introduction to Quantum Mechanics and Thermodynamics with Laboratory

PHYS 203 Vibrations, Waves, and Special Relativity with Laboratory

PHYS 216 Mathematics for the Sciences II

Requirements for the Major

The Astronomy Major consists of 10 courses. Required courses include ASTR 101, 108, or [110]; ASTR 206; ASTR 301; PHYS 107; and either PHYS 106 or PHYS 108. The other five courses include one additional ASTR course at the 300-level; two in ASTR at the 200-level or above; one in MATH at the 200-level; and an additional course in ASTR or a related field. Students should consult with faculty about choosing electives and research opportunities appropriate for their fields of study. For example, students interested in earth science should elect ASTR 203/GEOS 213 (Planetary Geology) and add courses in geosciences and chemistry. Students working towards teacher certification would add courses in other sciences and in education, and might coordinate their fieldwork with ASTR 350, while those planning to enter the technical workforce might elect additional courses in computer science. Students planning to pursue graduate study in astronomy should instead elect an interdepartmental major in Astrophysics.

Requirements for the Minor

A minor in astronomy (five units) consists of: 101, 108, or [110]; 206, 301; and two additional units in astronomy.

Honors

To earn honors in the major, students must have a grade point average of at least 3.5 in all work in the major field above the 100-level; the department may petition on her behalf if her GPA in the major is between 3.0 and 3.5. The student must complete a significant research project culminating in a paper and an oral examination. The project must be conducted after the junior year and approved in advance by the department, and might be satisfied by a thesis, a summer internship, or a 350. See Academic Distinctions.

See description of Whitin Observatory and its equipment.