ASTRONOMY

Overview and Contact Information

Modern astronomy is concerned with understanding the nature of the universe and the various structures—galaxies, stars, planets, atoms—within it. We are interested not only in describing these things, but in understanding how they are formed and how they change, and, ultimately, in reconstructing the history of the universe.

This understanding is always based upon the same set of theories and practices—physics, chemistry, biology, materials science, geology, mathematics, computer science—that we use to understand the earth and its immediate surroundings. Thus, all students are strongly encouraged to base their study of the universe upon a firm grounding in one of these disciplines.

All 100-level courses are taught by Mount Holyoke faculty and staff. Courses at the 200 level and above are staffed collectively by faculty in the Five College Department (as listed above); many of them will be offered off-campus. Students are urged to consult the department to assist in planning a program of study that takes advantage of the rich variety of course opportunities. Through advising, the exact program is always tailored to the student's particular strengths, interests, and plans.

Astronomical facilities at all five institutions are available for student use. The Williston Observatory at Mount Holyoke includes a historic Clark 8" telescope as well as several Unistellar eVscope 2 telescopes that can image nebulae and galaxies even in areas with light pollution.

Contact Information

Kerstin Nordstrom, Chair
Loryn Engelbrecht, Academic Department Coordinator

206 Kendade Hall
413-538-2238
https://www.mtholyoke.edu/academics/find-your-program/astronomy (https://www.mtholyoke.edu/academics/find-your-program/astronomy/)

Learning Goals

Learning goals for introductory-level astronomy classes:

- Understand fundamental concepts in astronomy such as gravity, the nature of light, the origin of the universe, and physical characteristics of matter.
- Demonstrate skills for quantitative analyses, including the ability to form a hypothesis, graphically represent and interpret data, estimate error and understand sampling bias.
- Critically evaluate representations of science in all types of media.

Learning goals for advanced astronomy classes:

- Demonstrate proficiency in fundamental concepts in each of the major areas of astronomy: cosmology, planetary science, galaxies, stellar structure, and the universe.
- Show a working knowledge of a broad array of physical phenomena that are based upon fundamental concepts.
- Gain familiarity with instrumentation, computational methods and software resources utilized by professional astronomers.
- Understand the variety of career paths and opportunities that are open to students who have majored in astronomy.
- Exhibit a proficiency in the methods of scientific inquiry in laboratory and/or research projects.
- Demonstrate use of critical thinking skills in well-organized, logical and scientifically sound oral and written scientific reports.

Mount Holyoke Faculty

This area of study is administered by the PHYSICS AND Astronomy department and is a collaborative program through the Five College Department of Astronomy (FCAD):

Darby Dyar, Kennedy-Schelkunoff Professor of Astronomy, On Leave 2024-2025

Benjamin Boatwright, Visiting Assistant Professor in Astronomy

Thomas Burbine, Visiting Assistant Professor in Astronomy

Kathryn Lester, Visiting Assistant Professor in Astronomy

Requirements for the Major

The astronomy major is designed to provide a good foundation in modern science with a focus on astronomy. Taken alone, it is suited for students who wish to apply scientific training in a broad general context. If coupled with additional course work in related fields, the astronomy major or minor provides the foundation to pursue a career as a professional astronomer or planetary scientist. Thus, advanced courses in geology, mathematics, physics, biology, and/or chemistry, as well as a facility in computer programming, are strongly encouraged.

Students should note that completion of this major will likely require them to travel to other institutions within the Five Colleges.

A minimum of 32 credits:

Code	Title	Credits
MATH-101, MATH-102, and PHYS-110 must be completed as prerequisites for the courses in this major.		
Select one of the following:		4
ASTR-100	Stars and Galaxies	
ASTR-102	Solar Systems	
ASTR-104	Planet Earth	
ASTR-105	The Sky	
PHYS-201	Electromagnetism	4
Two astronomy courses at the 200 level (8 credits) from the offerings of the Five College Astronomy department		8
One astronomy course at the 300 level (4 credits) from the offerings of the Five College Astronomy department		4
Two additional courses at the 300 level, in astronomy or a related field such as mathematics, physics, geology, biology, computer science, or the history or philosophy of science		8
One additional course at any level in astronomy or a related field such as mathematics, physics, geology, biology, computer science, or the history or philosophy of science		4
Total Credits		**32**

Additional Specifications

- Students planning graduate study should generally regard this as a minimum program and include additional 300-level work. Advanced course work in physics and mathematics is especially encouraged for students wishing to pursue graduate studies in astronomy.

Requirements for the Minor

The goal of an astronomy minor is to provide a practical introduction to modern astronomy. If combined with a major in another science or mathematics-related field, such as geology, chemistry, or computer science, it can provide a versatile scientific background that prepares a student for future work as a scientist or technical specialist. Alternatively, the minor may be combined with a major in a nonscientific field, such as history, philosophy, or education, for students who wish to apply their astronomical backgrounds in a broader context that could include history of science, scientific writing or editing, or science education.

A minimum of 16 credits:

Code	Title	Credits
One 300-level astronomy, physics, or geology course		4
Three additional 200-level or 300-level courses in astronomy		12
Total Credits		**16**

Course Offerings

ASTR-100 Stars and Galaxies
Fall and Spring. Credits: 4
Discover how the forces of nature shape our understanding of the cosmos. Explore the origin, structure, and evolution of the earth, moons and planets, comets and asteroids, the sun and other stars, star clusters, the Milky Way and other galaxies, clusters of galaxies, and the universe as a whole.
Applies to requirement(s): Math Sciences
K. Lester

ASTR-102 Solar Systems
Not Scheduled for This Year. Credits: 4
Travel through our solar system using results of the latest spacecraft. Explore the origins of our worlds through the study of planet formation, meteorites, asteroids, and comets. Discover the processes that shape planetary interiors, surfaces, and atmospheres. Compare our solar system to others by learning about newly discovered exoplanets. Trace the conditions that may foster life throughout the solar system and beyond.
Applies to requirement(s): Math Sciences
The department

ASTR-104 Planet Earth
Fall and Spring. Credits: 4
This course traces the origins of the universe, our solar system, and Earth and provides an introduction to the field of planetary science. It follows the evolution of terrestrial planets and asteroids through geologic processes. Topics include planetary origins, atmospheres, interiors, and magnetic fields; plate tectonics; volcanism, weathering, earthquakes, faults and folding on terrestrial planets; distribution and limitations of resources on Earth and other bodies; and the search for the origins of life.
Applies to requirement(s): Math Sciences
B. Boatwright

ASTR-105 The Sky
Fall and Spring. Credits: 4
A hands-on introduction to observing and understanding the extraterrestrial sky. Daily and annual motions of the sun, moon, planets, and stars; celestial coordinate systems; apparent brightnesses and colors of the stars; time; calendars. Observations at the Williston Observatory with the unaided eye, visually with the eight-inch telescope, and by electronic camera with computer-controlled telescopes.
Applies to requirement(s): Math Sciences
T. Burbine

ASTR-223 Planetary Science
Spring. Credits: 4
This intermediate-level course covers fundamentals of spectroscopy, remote sensing, and planetary surfaces. Discussions will include interiors, atmospheres, compositions, origins, and evolution of terrestrial planets; satellites, asteroids, comets, and planetary rings.
Applies to requirement(s): Math Sciences
B. Boatwright
Prereq: One course in Geology, Astronomy, Physics, Math, or Computer Science.

ASTR-226 Cosmology
Fall. Credits: 4
Cosmological models and the relationship between models and observable parameters. Topics in current astronomy that bear upon cosmological problems, including background electromagnetic radiation, nucleosynthesis, dating methods, determinations of the mean density of the universe and the Hubble constant, and tests of gravitational theories. Discussion of questions concerning the foundations of cosmology and its future as a science.
Applies to requirement(s): Math Sciences
K. Lester
Prereq: ASTR-100, ASTR-101, ASTR-102, or ASTR-115; one semester of Physics; and one semester of calculus at high school or college level.

ASTR-228 Astrophysics I: Stars and Galaxies
Spring. Credits: 4
A calculus-based introduction to the properties, structure, formation, and evolution of stars and galaxies. The laws of gravity, thermal physics, and atomic physics provide a basis for understanding observed properties of stars, interstellar gas, and dust. We apply these concepts to develop an understanding of stellar atmospheres, interiors, and evolution, the interstellar medium, and the Milky Way and other galaxies.
Applies to requirement(s): Math Sciences
K. Lester
Prereq: PHYS-110 and MATH-102.
Advisory: PHYS-201 and MATH-203 strongly suggested.

ASTR-295 Independent Study
Fall and Spring. Credits: 1 - 4
The department
Instructor permission required.

ASTR-330 Topics in Planetary Science
In-class discussions will be used to formulate a set of problems, each designed to illuminate a significant aspect of the topic at hand. The problems will be difficult and broad in scope: their solutions, worked out individually and in class discussions, will constitute the real work of the course. Students will gain experience in both oral and written presentation. Topics vary from year to year.

ASTR-330MA Topics in Planetary Science: 'Mars'
Not Scheduled for This Year. Credits: 4
This course will survey the past, present, and future of Mars exploration and science. We will focus on the evolution of Mars as a paradigm for terrestrial planets, with specific units on missions, formation, volcanism, impacts, glaciers and water, spectroscopy and mineralogy, climate, and issues pertaining to the possibilities of life on Mars. This is a discussion-based, interactive seminar with students and faculty reading current papers from the literature, supported by many outside speakers. Weekly writing assignments focus on critical thinking.
Applies to requirement(s): Math Sciences
The department
Prereq: Any intermediate-level Astronomy or Geology course.
Advisory: ASTR-223 recommended.

ASTR-330MN Topics in Planetary Science: 'Moon'
Fall. Credits: 4
This course will survey the past, present, and future of the exploration and science of the Earth's Moon. We will have specific units on interiors, heat flow, thermal evolution, magnetism, volcanism, impacts, crustal composition and mineralogy, and spectroscopy of its surface. This is a discussion-based, interactive seminar with students and faculty reading current papers from the literature.
Applies to requirement(s): Math Sciences
B. Boatwright
Prereq: Any intermediate-level Astronomy or Geology course.
Advisory: ASTR-223 recommended but not required.

ASTR-335 Astrophysics II
Not Scheduled for This Year. Credits: 4
This is a course in applied physics with the ultimate goal of describing how stars work. Topics include gravitation, stellar mass determination, stellar structure, stellar atmospheres, stellar evolution, and the physics of pulsating stars. We will approach each of these topics from fundamental concepts and we will work our way to a detailed understanding. On the way we will review the structure of the atom, radiative processes, and some basic principles of thermodynamics.
Applies to requirement(s): Math Sciences
The department
Prereq: ASTR-228.

ASTR-352 Astrophysics III
Not Scheduled for This Year. Credits: 4
Advanced course covering physical processes in the gaseous interstellar medium, including photoionization in HII regions and planetary nebulae, shocks in supernova remnants and stellar jets, and energy balance in molecular clouds. Dynamics of stellar systems, star clusters, and the viral theorem will also be discussed, along with galaxy rotation and the presence of dark matter in the universe, as well as spiral density waves. The course concludes with quasars and active galactic nuclei, synchrotron radiation, accretion disks, and supermassive black holes.
Applies to requirement(s): Math Sciences
The department
Prereq: ASTR-335 or two Physics courses at the 200 or 300 level.

ASTR-395 Independent Study
Fall and Spring. Credits: 1 - 8
The department
Instructor permission required.