**Astronomy Courses (Physics and Astronomy) (ASTR)**

This is a list of all astronomy courses. For more information, see Physics and Astronomy.

**ASTR:1000 First-Year Seminar** 1 s.h.
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities).

**ASTR:1060 Big Ideas: Origins of the Universe, Earth, and Life** 3 s.h.
Fundamental questions (How old is the universe? What is the nature of life? How has life evolved on Earth? What are our human origins? Are there other habitable planets in the universe?) that revolve around understanding origins from different perspectives (i.e., astronomy, physics, geoscience, biology, chemistry, anthropology); work with faculty from several departments to investigate these questions; inquiry-based activities to build success in critical thinking, teamwork, effective written and oral communication; origin of the universe, biochemistry of life, and origin of life on Earth; first of a two-part sequence. Recommendations: first-year or sophomore standing. GE: Natural Sciences without Lab. Same as BIOL:1060, EES:1060.

**ASTR:1061 Big Ideas: Evolution of Life on Earth and the Search for Life in the Universe** 4 s.h.
How has life evolved on Earth? What are our human origins? Are there other habitable planets in the universe? These fundamental questions revolve around understanding the origins of life from different perspectives—astronomy and physics, geoscience, biology, chemistry, and anthropology; students will work together with faculty from across four different departments to investigate these questions using inquiry-based activities to build success in critical thinking, teamwork, and effective written and oral communication; second half of the origins sequence (though either course also may be taken alone). GE: Natural Sciences with Lab. Same as BIOL:1061, EES:1061.

**ASTR:1070 Stars, Galaxies, and the Universe** 3-4 s.h.
Survey of stars, galaxies, and the universe; life cycles of stars, including black holes and pulsars; diversity of galaxies, including the Milky Way and distant quasars; cosmology—the history, structure, and fate of the universe; current results from recent astronomical observations; night sky observation. Recommendations: closed to physics and astronomy majors. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**ASTR:1079 Introductory Astronomy Laboratory** 1 s.h.
Laboratory for ASTR:1070 or ASTR:1080. GE: Natural Sciences Lab only.

**ASTR:1080 Exploration of the Solar System** 3-4 s.h.
Survey of the solar system; physical properties of the planets, comets, and asteroids; origin of the solar system; search for extrasolar planetary systems; search for life in the universe; current results of recent planetary space missions; night sky observation. Recommendations: closed to physics and astronomy majors. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**ASTR:1085 Citizen Astronomy** 3 s.h.
Exploration of the Universe, not as spectators, but as active participants in the scientific process; survey of important environments in astronomy and astrophysics, ranging from the very local solar system to nearby stars in the galaxy, to distant galaxies and unseen black holes; focus on a growing number of citizen science projects that allow students to examine real data, make real discoveries, and in some cases, get scientific credit for their contributions; goes beyond the superficial exploration of pretty pictures as students make real contributions to understanding the universe; science and math background not required, just curiosity.

**ASTR:1091 Life in the Universe** 3 s.h.
Are we alone? Scientific foundations of this question, technology behind searches for extraterrestrial life in the solar system and on extrasolar planets; evolution of life on Earth, likelihood that such conditions exist elsewhere in the universe; cultural consequences of discovering extraterrestrial life. GE: Natural Sciences without Lab.

**ASTR:1771 General Astronomy I** 4 s.h.
Qualitative and quantitative introduction to the development of astronomy, celestial mechanics, time, electromagnetic radiation, telescopes and astronomical instrumentation, planets, smaller solar system objects; laboratory emphasis on observation with telescopes. Requirements: four years of high school math. GE: Natural Sciences with Lab.

**ASTR:1772 General Astronomy II** 4 s.h.
Continuation of ASTR:1771; qualitative and quantitative introduction to properties and evolution of sun, stars, interstellar matter, galaxies; cosmology; laboratory emphasis on observation with telescopes. Requirements: four years of high school math. GE: Natural Sciences with Lab.

**ASTR:2991 Reading in Astronomy** arr.
Selected topics in astronomy.

**ASTR:3500 Undergraduate Practicum** arr.
Undergraduate practicum experiences that provide special opportunities for students to gain practical and hands-on training related to topics in astronomy; practicums typically arranged by individual faculty members. Requirements: application and acceptance into practicum.

**ASTR:3771 Introduction to Astrophysics I** 3 s.h.
Fundamentals of astrophysical processes in solar system objects, stars, nebulae, interstellar medium, galaxies, cosmology; topics include stellar spectra, binary stars, interstellar gas and dust, stellar and galactic kinematics, stellar evolution, HII regions, radiation processes in galaxies and quasars, mathematical descriptions of the universe. Prerequisites: PHYS:2704 and ASTR:1772 and (MATH:2850 or MATH:3350) and (MATH:2700 or MATH:2550). Recommendations: computer programming experience.

**ASTR:3772 Introduction to Astrophysics II** 3 s.h.
Continuation of ASTR:3771. Prerequisites: ASTR:3771.

**ASTR:4770 Radio Astronomy** 3 s.h.
Survey of radio astronomy, emphasizing technical aspects; radiation, antennas, receivers, radio spectroscopy, interferometer arrays and aperture synthesis; emission mechanisms, pulsars, supernova remnants, radio galaxies.

**ASTR:4850 Astronomical Laboratory** 3 s.h.
Techniques and instrumentation in optical and radio astronomy. Prerequisites: PHYS:2704 and ASTR:1772 and ASTR:1771.

**ASTR:4906 Special Topics in Astronomy** arr.

**ASTR:4996 Reading in Astronomy** arr.
ASTR:6781 Galactic Astronomy 3 s.h.
Structure of the Milky Way galaxy; distance indicators, orbits in the galaxy, spiral structure; evidence for dark matter in the Milky Way, the galactic center; comparison of Milky Way with nearby galaxies.

ASTR:6782 Extragalactic Astronomy 3 s.h.
Normal and active galaxies, large scale structure, the early Universe, cosmology.

ASTR:6785 The Interstellar Medium 3 s.h.
The interstellar medium: optical properties of small interstellar grains, radiative processes in interstellar gas, structure of HII regions, interstellar shock waves, supernova remnants, modification of interstellar medium by luminous stars, molecular clouds.

ASTR:6790 Stellar Astrophysics 3 s.h.
Stellar interiors, nuclear astrophysics; advanced topics.

ASTR:6870 Radiative Processes in Astrophysics 3 s.h.
Physical mechanisms for generation of electromagnetic radiation in astrophysics; continuum mechanisms (bremsstrahlung, Compton scattering, synchrotron radiation); spectral line radiation from atoms, molecules, and nuclei, including fine structure effects; fundamental physics of processes; application to astronomical observations.

ASTR:6880 High Energy Astrophysics 3 s.h.
Detection of X-rays and gamma-rays, analysis of X-ray data, black holes and neutron stars, accretion onto compact objects, pulsars, supernova remnants, cosmic rays, gamma-ray bursts.

ASTR:7775 Special Topics in Astrophysics 1-3 s.h.
Advanced lectures.

ASTR:7830 Space and Astrophysical Plasma Physics 3 s.h.
Dynamics and evolution of space and astrophysical plasmas; heliosphere, planetary magnetospheres, accretion disks; plasma waves, shock waves, turbulence.

ASTR:7970 Seminar: Astrophysics arr.
Current research.

ASTR:7991 Research: Astronomy arr.
Original research in observational, theoretical astronomy.