

# ASTRONOMY AND ASTROPHYSICS (ASTRO)

---

*Any experimental courses offered by ASTRO can be found at:*  
[registrar.iastate.edu/faculty-staff/courses/explisting/](http://registrar.iastate.edu/faculty-staff/courses/explisting/) (<http://www.registrar.iastate.edu/faculty-staff/courses/explisting/>)

## Courses primarily for undergraduates:

### ASTRO 102: North Star Astronomy

Cr. 1. F.S.

An entirely web-based course covering topics in observing the sky and navigation by the stars for students with little or no previous experience. The course combines material on common naked-eye phenomena, such as daily and seasonal variations in the sky, with information on how these helped navigators determine where they are on Earth. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities and layers of help. Graded homework and quizzes are administered via Blackboard Learn. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

### ASTRO 103: Evening Star

Cr. 1. F.S.

An entirely web-based course covering topics in celestial mechanics ("Rocket science!") for students with little or no previous experience. It combines the geography of the solar system with discussion of methods of traveling to the other planets. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities, and layers of help. Graded homework and quizzes are administered via Blackboard Learn. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

### ASTRO 106: Earth and Space Science for Elementary Education Majors

(Cross-listed with GEOL). (2-0) Cr. 2. F.S.

*Prereq: Major in elementary or early childhood education.*

Fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Online course format.

### ASTRO 106L: Earth and Space Science for Elementary Education Majors: Laboratory

(Cross-listed with GEOL). (0-2) Cr. 1. F.S.

*Prereq: Restricted to elementary and early childhood education majors; to be taken concurrently with GEOL 106/ASTRO 106*

Inquiry-based lab exploring fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Must be taken concurrently with GEOL/ASTRO 106.

### ASTRO 120: The Sky and the Solar System

(3-0) Cr. 3. F.S.SS.

For the nonscientist. A survey of our view of the universe, and the exploration of the solar system and beyond. The sky: constellations; motions of the Sun, Moon, and planets; seasons and the calendar; eclipses. The solar system: origin and evolution; characteristics of the Sun, planets, satellites, comets, meteorites, and asteroids. The detection and characterization of other solar systems, and the search for life in the universe. Extensive use of the planetarium is included. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

### ASTRO 125L: The Sky and the Solar System Laboratory

(0-2) Cr. 1. F.S.

*Prereq: Concurrent or previous enrollment in ASTRO 120*

Laboratory course to accompany Astro 120. Students carry out practical exercises involving naked eye and telescopic observing to explore and reinforce ideas covered in Astro 120. Activities based on a sky-simulation computer program and other weather-independent exercises are also included.

### ASTRO 150: Stars, Galaxies, and Cosmology

(3-0) Cr. 3. F.S.

For the nonscientist. A survey of astronomy with a focus on the universe beyond our solar system. Basic observational astronomy and the history of astronomy. Stellar astronomy: motions, distances, sizes, spectra; types of stars; variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The structure and evolution of the Milky Way Galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe.

### ASTRO 250: Astronomy Bizarre

(3-0) Cr. 3. S.

*Prereq: ASTRO 120 or ASTRO 150*

For the nonscientist. A small enrollment course examining new and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Dark Matter. Dark energy. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life.

### ASTRO 290: Independent Study

Cr. 1-4. Repeatable.

*Prereq: Permission of instructor*

**ASTRO 342: Introduction to Solar System Astronomy**

(3-0) Cr. 3. F.

*Prereq: PHYS 222*

An introduction to the physics of the Solar System and the planetary systems discovered around other stars. General characteristics of planetary systems: dynamics, thermodynamics, internal and surface structure of planets and minor bodies, physics of their atmosphere. Discovery techniques and characterization of extrasolar planets, and planetary systems formation models. "Grand tour" of the Solar System, using data and imagery from probes and telescopes that have visited these worlds. The origin and evolution of life on Earth, and the ongoing search for life in the Solar System and elsewhere in the universe.

**ASTRO 344L: Astronomy Laboratory**

(1-6) Cr. 3. F.

*Prereq: PHYS 222*

Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Data processing and analysis techniques. Astronomical software packages and online databases and resources. Available instruments include a variety of small telescopes and astronomical CCD cameras.

**ASTRO 346: Introduction to Astrophysics**

(3-0) Cr. 3. S.

*Prereq: PHYS 222*

An exploration of the universe beyond our Solar System, with emphasis on the astrophysics of stars and galaxies. Observable properties of stars, physics of stellar atmospheres and interiors. Birth, evolution and death of stars, to understand the past and future of our Sun, the Milky Way galaxy and the other galaxies in the universe. Basic concepts of cosmology, dark matter and dark energy. Use of computer models to calculate the structure and evolution of stars and protostars, and to analyze actual astronomical data obtained by professional astronomers.

**ASTRO 405: Astrophysical Cosmology**

(Dual-listed with ASTRO 505). (3-0) Cr. 3. S.

*Prereq: ASTRO 346 or permission of instructor*

Introduction to modern cosmology and large-scale structure; mathematical and observational fundamentals associated with the origin, structure, and evolution of the Universe. Scale of the Universe, Hubble's Law, the cosmic microwave background, Big Bang nucleosynthesis, the origin of elements, dark energy and the accelerating universe, and dark matter. For senior undergraduates and graduate students in all areas of physics.

**ASTRO 450: Undergraduate Research**

Cr. 1-6. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Research under supervision of astronomy faculty.

**ASTRO 450L: Undergraduate Research**

Cr. 1-6. Repeatable. F.S.SS.

*Prereq: ASTRO 344L and permission of instructor*

Laboratory or observational project under supervision of astronomy faculty.

**ASTRO 490: Independent Study**

Cr. 1-4. Repeatable, maximum of 9 credits.

*Prereq: 6 credits in astronomy, permission of instructor*

No more than 9 credits of Astro 490 may be counted toward graduation.

**ASTRO 490H: Independent Study: Honors**

Cr. 1-4. Repeatable, maximum of 9 credits.

*Prereq: 6 credits in astronomy, permission of instructor*

No more than 9 credits of Astro 490 may be counted toward graduation.

**Courses primarily for graduate students, open to qualified undergraduates:**

**ASTRO 505: Astrophysical Cosmology**

(Dual-listed with ASTRO 405). (3-0) Cr. 3. S.

*Prereq: ASTRO 346 or permission of instructor*

Introduction to modern cosmology and large-scale structure; mathematical and observational fundamentals associated with the origin, structure, and evolution of the Universe. Scale of the Universe, Hubble's Law, the cosmic microwave background, Big Bang nucleosynthesis, the origin of elements, dark energy and the accelerating universe, and dark matter. For senior undergraduates and graduate students in all areas of physics.

**ASTRO 510: Observational Astrophysics**

(2-3) Cr. 3. Alt. F., offered odd-numbered years.

*Prereq: ASTRO 405 or ASTRO 505 or permission of instructor*

Techniques in optical and near-IR astronomy, including spectroscopy and CCD photometry. Emphasis on projects involving proficiency in the use of research telescopes and modern instrumentation. Project topics range from photometric studies of pulsating and binary star systems to deep CCD imaging of faint nebulae and galaxies.

**ASTRO 580: Stellar Astrophysics**

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq: ASTRO 405 or ASTRO 505 or permission of the instructor*

The interior structure and atmospheric properties of stars: Stellar structure equations and constitutive relations: energy generation, energy transport by radiation and convection; equation of state, nuclear energy generation and nucleosynthesis. Numerical and analytic solutions to the equations of structure and evolution. Observational connections through the theory of radiative transfer. Line and continuum processes and sources of opacity. Non-LTE and statistical equilibrium. Line profiles. Interpretation of stellar spectra: temperature, pressure, and abundance determinations. Stellar evolution from formation to final phases.

**ASTRO 582: High Energy Astrophysics**

(3-0) Cr. 3. Alt. F., offered even-numbered years.

*Prereq: ASTRO 405 or ASTRO 505 or permission of the instructor*

Interactions of high-energy particles, non-thermal radiation processes, spectral evolution of non-thermal systems, cosmic rays, active galactic nuclei, pulsars, neutrinos, measurement techniques for relativistic charged particles, high energy photons, and neutrinos.

**ASTRO 584: Galactic Astronomy**

(3-0) Cr. 3. Alt. S., offered even-numbered years.

*Prereq: ASTRO 405 or ASTRO 505 or permission of instructor*

Overall structure of our Galaxy and the interstellar medium. Physical processes in the interstellar medium (e.g., heating and cooling mechanisms, turbulence). Observational techniques for studying the interstellar medium. Kinematics and chemical evolution of the Galaxy.

**ASTRO 586: Extragalactic Astronomy**

(3-0) Cr. 3. Alt. F., offered odd-numbered years.

*Prereq: ASTRO 405 or ASTRO 505 or permission of the instructor*

Galaxy evolution, dynamics of external galaxies, evolution and classification of galaxies, groups and clusters of galaxies, extragalactic radio sources, quasars, structure formation, cosmological models and their observational consequences.

**ASTRO 590: Special topics**

Cr. arr. Repeatable.

**ASTRO 599: Creative Component**

Cr. arr.

*Prereq: Permission of instructor*

Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

**Courses for graduate students:****ASTRO 650: Advanced Seminar**

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest in astronomy and astrophysics. Offered on a satisfactory-fail basis only.

**ASTRO 675: Advanced Stellar Astrophysics**

(3-0) Cr. 3. Alt. S., offered even-numbered years.

*Prereq: ASTRO 580 or permission of instructor*

Advanced topics in stellar astrophysics. Dynamic and extended atmospheres, chromospheres, coronae, and stellar winds. MHD, stellar activity, and dynamo theory. Radiative transfer and the transition from extended atmospheres to the interstellar medium. Diffusive processes in stellar atmospheres and interiors. Techniques for quantitative analysis of planetary and stellar spectra including detailed modeling and spectrum synthesis. Evolution in interacting binaries. Nucleosynthesis II. Variable stars. Supernovae. Neutron stars and black holes.

**ASTRO 699: Research**

Cr. arr. Repeatable.