

ASTRONOMY

Natural and Applied Sciences Division

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Astronomy A.S. Degree

Modern astronomy is an interdisciplinary field applying knowledge of physics, mathematics, planetary sciences, atmospheric sciences, and computational numerical methods to the study of planetary systems, stars, galaxies, and the universe as a whole. A B.S. Degree qualifies one to work as a scientific computer programmer, direct a planetarium, enter a teacher credential program, work at support position an observatory, and work in positions requiring a general technical knowledge. An M.S. Degree broadens the opportunities to include community college instructor, major observatory telescope operator, some space science positions, and many more positions in technical field. A Ph.D. Degree qualifies one for a university professorship, and to do sponsored research, either theoretical or observational, at a major observatory or university. This advanced degree also opens up opportunities to work as an astronaut, space engineer, space scientist. Astronomers are also in high demand in investment finance modeling, because of their skills in analyzing heterogeneous systems characterized by incomplete data.

University level astronomy curricula generally stress very strong initial preparation in mathematics and physics, and increasingly in computational numerical methods, atmospheric/climate science, planetary sciences, and chemistry. The most rapidly expanding area of astronomy today is planetary and atmospheric sciences, driven by the discoveries of planets around other stars and the urgent need to better understand planetary atmospheres, including our own. Many recommend that those planning on an advanced degree obtain their B.S. in physics or mathematics, but successful astronomers also emerge from atmospheric sciences majors and physics-related sciences. While most astronomy courses are taken at the upper division or graduate level, lower division astronomy will prepare students for choosing which area of astronomy interests them, and helps prepare them for a wide variety of science careers with the unique skills that astronomers must bring to the study of systems which include differing physics and data often not amenable to standard controlled experiments. The terms "astronomy" and "astrophysics" are interchangeable. Transfer students must also complete the admission and general education requirements of the intended transfer institution.

High School Preparation: Four years of college preparatory mathematics and one year of physics. Cabrillo offers courses which can substitute for this preparation; however, the major will then require more than two years to complete.

Students may double count one ASTRO course and one MATH course from the Core courses to fulfill Cabrillo general education, CSU GE Breadth, or IGETC. Note that Astro 25 however only transfers as a CSU science elective. If your goal is to do astronomy as a career, astronomers tend to be focused in either planetary science - which is rapidly expanding thanks to new space missions and technology - or into stellar, cosmology, and galactic astronomy. It's unusual to find astronomers doing extensive work in both. There is some important overlap,

for example in the importance of star formation (covered in Astro 4) for understanding planet formation and planetary chemical make-up. The appropriate lower division course choices will differ slightly, as reflected below.

Learning Outcomes

The Cabrillo College Core Competencies (with an emphasis in the study of Astronomy):

1. Communication: Reading, Writing, Listening, Speaking and/or Conversing
2. Critical Thinking and Information Competency: Analysis, Computation, Research, Problem Solving
3. Global Awareness: An appreciation of Scientific Processes, Global Systems and Civics, and Artistic Variety.
4. Personal Responsibility and Professional Development: Self-Management and Self-Awareness, Social and Physical Wellness, Workplace Skills

Model Program for Astronomy

This Associate Degree requires 60 units appropriate to your educational goal, to include general education and at least 30 units in a major. Courses should be selected to meet the lower-division major preparation requirements at your intended transfer university - these specific requirements can be found at www.assist.org for 4-year public institutions in California. Please see a counselor for advisement to ensure you are taking the best possible courses given your goal.

The department presents the following suggested Model Program for this major. The courses listed below may or may not be appropriate depending on your specific goal. Please see a counselor for advisement for transfer to any 4-year institution. This degree may be completed as a transferable Associate in Science degree with the addition of university admission requirements and increased general education requirements.

A.S. General Education 21 Units

Students may choose between a focus on planetary science or on stellar, galactic, and cosmology.

Planetary Science Focus: Core Courses (37 Units)		Units
ASTRO 3	**Solar System Astronomy.....	3
ASTRO 7	Planetary Climate Science.....	3
ASTRO 8A	Observational Astronomy.....	1
MATH 5A	Analytic Geometry and Calculus I.....	5
MATH 5B	Analytic Geometry and Calculus II.....	5
MATH 5C	Analytic Geometry and Calculus III.....	5
PHYS 4A	Physics for Scientists and Engineers I.....	5
PHYS 4B	**Physics for Scientists and Engineers II.....	5
PHYS 4C	*Physics for Scientists and Engineers III.....	5
Approved Electives (2 units)		Units
ASTRO 4	Stars, Galaxies, and the Origin of the Universe....	3
ASTRO 9A	**Astrophotography.....	1.5
ASTRO 25	Field Astronomy in the California Mountains.....	1
CHEM 1A	General Chemistry I.....	5
CIS 90	Introduction to UNIX/Linux.....	3
CS 19	C++ Programming.....	4
GEOL 10	Physical Geology.....	4
MATH 7	Introduction to Differential Equations.....	3
MATH 12	Elementary Statistics.....	5
or		
MATH 12H	Honors Elementary Statistics.....	5

Stellar, Galactic, Cosmology Focus: Core Courses (37 Units) Units

ASTRO 4	Stars, Galaxies, and the Origin of the Universe.....	3
ASTRO 8A	Observational Astronomy	1
MATH 5A	Analytic Geometry and Calculus I.....	5
MATH 5B	Analytic Geometry and Calculus II.....	5
MATH 5C	Analytic Geometry and Calculus III.....	5
PHYS 4A	Physics for Scientists and Engineers I.....	5
PHYS 4B	**Physics for Scientists and Engineers II.....	5
PHYS 4C	*Physics for Scientists and Engineers III.....	5
PHYS 4D	Modern Physics for Scientists and Engineers.....	3

Approved Electives (2 units) Units

ASTRO 3	Solar System Astronomy.....	3
ASTRO 9A	**Astrophotography.....	1.5
ASTRO 25	Field Astronomy in the California Mountains.....	1
CHEM 1A	General Chemistry I.....	5
CHEM 1B	General Chemistry II.....	5
CIS 90	Introduction to UNIX/Linux.....	3
CS 19	C++ Programming	4
MATH 7	Introduction to Differential Equations.....	3
MATH 12	Elementary Statistics	5
or		
MATH 12H	Honors Elementary Statistics	5

Total Units **60**

*spring only; **fall only

Astronomy Courses

ASTRO 3 Solar System Astronomy

3 units; 3 hours Lecture
 Recommended Preparation: MATH 154.
 Repeatability: May be taken a total of 1 time.
 Presents a survey of the sun, planets, asteroids, comets, and the growing list of new solar systems around other stars for non-science majors. Additional topics include principles of scientific reasoning, applications to the structure and evolution of planetary systems, and methods astronomers use to discover and study other solar systems.
Transfer Credit: Transfers to CSU; UC.

ASTRO 4 Stars, Galaxies, and the Origin of the Universe

3 units; 3 hours Lecture
 Recommended Preparation: MATH 154.
 Repeatability: May be taken a total of 1 time.
 Surveys the lives of stars and galaxies, and the relationship of life to the origin of universes, for non-science majors. Describes how astronomers use science to arrive at our current ideas on the evolution of stars and galaxies. Investigates how the nature of life relates to the origin of our universe and possible parallel universes. Includes optional star party at Cabrillo Observatory.
Transfer Credit: Transfers to CSU; UC.

ASTRO 7 Planetary Climate Science

3 units; 3 hours Lecture
 Recommended Preparation: Eligibility for MATH 154.
 Repeatability: May be taken a total of 1 time.
 Applies scientific principles to explain planetary atmospheres, climate in general and Earth’s climate in particular, including current climate change causes and effects.
Transfer Credit: Transfers to CSU; UC.

ASTRO 8A Observational Astronomy

1 unit; 3 hours Laboratory
 Hybrid Requisite: Completion of or concurrent enrollment in ASTRO 3 or ASTRO 4 or ASTRO 7.
 Recommended Preparation: MATH 154.
 Repeatability: May be taken a total of 1 time.
 Involves observatory lab projects on stars, planets, the moon, galaxies, and in-class labs and demos on cloudy nights. Sometimes offered as a field course involving camping at dark-sky locations.
Transfer Credit: Transfers to CSU; UC.

ASTRO 9A Astrophotography

1.5 units; 1 hour Lecture, 2 hours Laboratory
 Repeatability: May be taken a total of 1 time.
 Covers photographic theory and practice at Cabrillo Observatory using telescopes and computers to image and optimize deep sky photo projects. Most imaging will be digital, but students with access to the photo lab may substitute some film projects. Includes optional weekend trip for dark sky work.
Transfer Credit: Transfers to CSU.

ASTRO 9B Astrophotography

1.5 units; 1 hour Lecture, 2 hours Laboratory
 Prerequisite: ASTRO 9A.
 Repeatability: May be taken a total of 1 time.
 Builds on ASTRO 9A, and includes more advanced digital and video imaging projects, and additional image processing software. Includes optional weekend trip for dark sky imaging.
Transfer Credit: Transfers to CSU.

ASTRO 9C Astrophotography

1.5 units; 1 hour Lecture, 2 hours Laboratory

Prerequisite: ASTRO 9B.

Repeatability: May be taken a total of 1 time.

Builds on skills from ASTRO 9A and 9B using more creative and advanced techniques: experimental testing, high magnification photography, and videocam planetary imaging. Includes optional field trip for dark-sky work.

Transfer Credit: Transfers to CSU.

ASTRO 25 Field Astronomy in the California Mountains

1 unit; 1 hour Lecture, 0.5 hour Laboratory

Recommended Preparation: Eligibility for MATH 154.

Repeatability: May be taken a total of 1 time.

Studies physical and evolutionary processes of galaxies and stars, and relates the evolution of stars to the formation and evolution of planets at dark-sky mountain campsites. On-campus session followed by a weekend camping trip.

Transfer Credit: Transfers to CSU.

ASTRO 27 Field Astronomy at the Pinnacles

1 unit; 1 hour Lecture, 0.5 hour Laboratory

Repeatability: May be taken a total of 1 time.

An intensive one weekend field lecture class in general astronomy, using direct visual and telescope observations in explaining planetary geology, solar system, star and galaxy formation, and evolution, and the origin of the universe. Includes car-camping at Pinnacles National Monument. Camping fees may apply.

Transfer Credit: Transfers to CSU.

ASTRO 28A-Z Special Topics in Field Astronomy

1 unit; 1 hour Lecture, 0.5 hour Laboratory

Repeatability: May be taken a total of 1 time.

Presents a weekend field lecture/lab experience of descriptive astronomy in dark sky locations in park lands and camping areas. Emphasis on direct observations to explore how the universe works. Car camping is required. Similar to ASTRO 27 but each section is designed around a unique astronomical event and/or location: e.g. meteor shower, lunar occultation, professional observatory tour, comet appearance.

Transfer Credit: Transfers to CSU.