**ASTRONOMY - BACHELOR OF ARTS (BA)**

The Department of Astrophysical and Planetary Sciences (APS) combines both astrophysics and planetary science. As a result, we provide a unified view of solar and space sciences, planetary systems (our solar system and others), stellar and galactic astronomy, and cosmology. We also offer hands-on experience with telescopes, optics, instrumentation, computer image processing and computer modeling. These skills are useful for students wishing to pursue graduate degrees or careers in aerospace, technical or computer industries.

The University of Colorado is recognized as a top university in the exploration and study of space. Our faculty members carry out forefront research in a wide range of disciplines, from theoretical cosmology to finding planets around other stars; from observing cosmic microwave background in Antarctica to building space probes to explore Mars' atmosphere. We offer many types of research opportunities for undergraduates including research-based courses, student positions that support research programs and individual research projects with faculty. Students can apply for funding from the Undergraduate Research Opportunities Program. The Honors Program (https://www.colorado.edu/aps/undergraduate-students/honors-program) encourages students to write research theses to qualify for Latin Honors upon graduation.

**Program Tracks**

Students pursuing an astronomy degree can choose from two tracks: general astronomy and astrophysics/physics. For more detailed information, visit the department website (https://www.colorado.edu/aps/undergraduate-studies).

### General Astronomy Track

The general astronomy track highlights the science of astronomy, observation and technology. As a major on this track, students receive core training in astronomy, mathematics, physics and computational and instrumental technology. These skills prepare students for professions in space sciences and a range of other careers in education, science and technology. The general astronomy track is also designed to provide opportunities for students to explore a minor or second major in a complementary area of study.

### Astrophysics/Physics Track

The astrophysics/physics track shares the same fundamental astronomy, math, and physics course sequences as general astronomy for the first two semesters, but then focuses on more advanced work in these topics. The track is jointly administered with the Department of Physics and requires substantial upper-division work in this field. Upon graduation, students should have solid theoretical and applied training for careers or graduate studies in the space sciences.

Students may declare either track when beginning their coursework, or wait until completion of their fundamental courses in astronomy, physics and mathematics (usually after the first 2–3 semesters). Students are mentored in groups during these first semesters, but meet individually with an APS faculty member every semester thereafter to discuss their academic progress and post-graduation plans.

We encourage all students to explore and share their enthusiasm for science and we support a wide range of extra-curricular activities. These include student groups, the Learning Assistant program, research activities and public outreach. The Sommers-Bausch Observatory (http://www.colorado.edu/sbo) and Fiske Planetarium (http://www.colorado.edu/fiske) offer opportunities for undergraduate students to become involved.

We offer you the ability to graduate with honors. This requires you maintain a minimum GPA and that you write and defend an honors thesis. More information can be obtained from the APS department office and/or the Honors Council Representative (Ann-Marie Madigan (https://www.colorado.edu/aps/ann-marie-madigan)). More general information about the honors thesis is on the Arts and Sciences Honors Program page (http://www.colorado.edu/honors).

### Requirements

#### General Astronomy Track

This is appropriate for someone aiming for a career in K–12 education, science journalism, science policy, information technology, science management or technical work that does not require a graduate degree.

Students must complete a minimum of 32 credit hours in astronomy (this must include at least 18 upper-division credit hours) and a minimum of 9 credit hours in physics.

Through the required coursework for this track of the major, students will fulfill all 12 credits of the Natural Sciences area of the Gen Ed Distribution Requirement, including the lab component, and the QRMS component of the Gen Ed Skills Requirement. If ASTR 2000 is selected, a student could also complete the Global Perspective component of the Gen Ed Diversity Requirement.

### Required Courses and Credits

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 1030 &amp; ASTR 1040</td>
<td>Accelerated Introductory Astronomy 1 and Accelerated Introductory Astronomy 2</td>
<td>8</td>
</tr>
<tr>
<td>PHYS 1115 or PHYS 1110</td>
<td>General Physics 1 for Majors or General Physics 1</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1125 or PHYS 1120</td>
<td>General Physics 2 for Majors or General Physics 2</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1140</td>
<td>Experimental Physics 1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Select one of the following:</strong></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2130</td>
<td>General Physics 3</td>
<td></td>
</tr>
<tr>
<td>ASTR 2100</td>
<td>Fundamental Concepts in Astrophysics</td>
<td></td>
</tr>
<tr>
<td>PHYS 2170</td>
<td>Foundations of Modern Physics</td>
<td></td>
</tr>
<tr>
<td><strong>Select a minimum of two of the following:</strong></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>ASTR 2000</td>
<td>Ancient Astronomies of the World</td>
<td></td>
</tr>
<tr>
<td>ASTR 2010</td>
<td>Modern Cosmology-Origin and Structure of the Universe</td>
<td></td>
</tr>
<tr>
<td>ASTR 2020</td>
<td>Space Astronomy and Exploration</td>
<td></td>
</tr>
<tr>
<td>ASTR 2030</td>
<td>Black Holes</td>
<td></td>
</tr>
<tr>
<td>ASTR 2040</td>
<td>The Search for Life in the Universe</td>
<td></td>
</tr>
<tr>
<td>ASTR 2050</td>
<td>The Sun and Society: Living with an Active Star</td>
<td></td>
</tr>
<tr>
<td>ASTR 2500</td>
<td>Gateway to Space</td>
<td></td>
</tr>
<tr>
<td>ASTR 2600</td>
<td>Introduction to Scientific Programming</td>
<td></td>
</tr>
<tr>
<td><strong>Select one of the following upper-division course sequences:</strong></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>
ASTR 3720  & ASTR 3750
Planets and Their Atmospheres
and Planets, Moons, and Rings

ASTR 3730  & ASTR 3830
Astrophysics 1 - Stellar and Interstellar
and Astrophysics 2 - Galactic and
Extragalactic

Major Electives
Select four additional courses from the following or from
those sequence courses not used for the upper-division
sequence requirement above: 12-15

ASEN 4010  Introduction to Space Dynamics
ASTR 3510  Observations and Instrumentation 1
ASTR 3520  Observations and Instrumentation 2
ASTR 3560  Astronomical Instrumentation Laboratory
ASTR 3710  Formation & Dynamics of Planetary
Systems
ASTR 3740  Cosmology and Relativity
ASTR 3760  Solar and Space Physics
ASTR 3800  Astrophysical Instrumentation

Total Credit Hours 44-47

Required Ancillary Coursework

Required Ancillary Calculus Coursework
Select one of the following sequences: 8-10
APPM 1350  Calculus 1 for Engineers
& APPM 1360  and Calculus 2 for Engineers
MATH 1300  Calculus 1
& MATH 2300  and Calculus 2

Required Ancillary Science Sequence with Lab
Select one other science sequence with lab, such as: 2 7-10
CHEM 1113  General Chemistry 1
& CHEM 1114  and Laboratory in General Chemistry 1
CHEM 1133  General Chemistry 2
& CHEM 1134  and Laboratory in General Chemistry 2

Required Courses and Credits

Lower-Division Coursework
The following courses are required:
ASTR 1030  Accelerated Introductory Astronomy 1
& ASTR 1040  and Accelerated Introductory Astronomy 2
PHYS 1115  General Physics 1 for Majors
& PHYS 1125  and General Physics 2 for Majors
& PHYS 1140  and Experimental Physics 1
PHYS 2170  Foundations of Modern Physics
& PHYS 2150  and Experimental Physics 2
PHYS 2210  Classical Mechanics and Mathematical
Methods 1

Upper-Division Coursework
The following physics courses are required:
PHYS 3310  Principles of Electricity and Magnetism 1
PHYS 3320  Principles of Electricity and Magnetism 2
PHYS 3210  Classical Mechanics and Mathematical
Methods 2
PHYS 3220  Quantum Mechanics 1

Select one of the following two astronomy sequences (6-hour
minimum): 6
ASTR 3720  Planets and Their Atmospheres
& ASTR 3750  and Planets, Moons, and Rings
ASTR 3730  Astrophysics 1 - Stellar and Interstellar
& ASTR 3830  and Astrophysics 2 - Galactic and
Extragalactic

Astronomy Electives
Select three additional courses from the following or from
those sequence courses not used above (9-hour minimum):
ASTR 3510  Observations and Instrumentation 1
ASTR 3520  Observations and Instrumentation 2
ASTR 3560  Astronomical Instrumentation Laboratory

1 Or ASTR 1010 and ASTR 1020 with permission from Lead APS
Faculty Mentor.

Astrophysics/Physics Track
(Jointly Supervised by the APS and Physics
Departments)
For students aiming for a graduate program in astronomy or planetary
sciences. Similar to Physics Plan 2 (Astrophysics), with additional
astrophysics instrumentation labs and different electives.

Students must complete a minimum of 23 credits in astronomy and a
minimum of 28 credits in physics (this must include at least 15 upper-
division credits in astronomy and 12 in physics).

Through the required coursework for this track of the major, students will
fulfill all 12 credits of the Natural Sciences area of the Gen Ed Distribution
Requirement, including the lab component, and the QRMS component of
the Gen Ed Skills Requirement.

Total Credit Hours 15-20
Astronomy - Bachelor of Arts (BA)

ASTR 3710 Formation & Dynamics of Planetary Systems
ASTR 3740 Cosmology and Relativity
ASTR 3760 Solar and Space Physics
ASTR 3800 Introduction to Scientific Data Analysis and Computing
ASTR 4330 Cosmochemistry
ATOC 4720 Introduction to Atmospheric Dynamics
ASEN 4010 Introduction to Space Dynamics
Any ASTR 5000- or 6000-level course with instructor’s permission

Total Credit Hours 51

Required Ancillary Calculus Coursework

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPM 1350 &amp; APPM 1360</td>
<td>Calculus 1 for Engineers and Calculus 2 for Engineers</td>
<td>4-5</td>
</tr>
<tr>
<td>&amp; APPM 2350 &amp; APPM 2360</td>
<td>and Calculus 3 for Engineers and Introduction to Differential Equations with Linear Algebra</td>
<td></td>
</tr>
<tr>
<td>MATH 1300 &amp; MATH 2300 &amp; MATH 2400 &amp; APPM 2360</td>
<td>Calculus 1 and Calculus 2 and Calculus 3 and Introduction to Differential Equations with Linear Algebra</td>
<td>16-19</td>
</tr>
</tbody>
</table>

Total Credit Hours 16-19

1 Or equivalent PHYS 1110 + PHYS 1120 + PHYS 1140 sequence.

Recommended Physics Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 4150</td>
<td>Plasma Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 4230</td>
<td>Thermodynamics and Statistical Mechanics</td>
<td></td>
</tr>
<tr>
<td>PHYS 4410</td>
<td>Quantum Mechanics 2</td>
<td></td>
</tr>
<tr>
<td>PHYS 4420</td>
<td>Nuclear and Particle Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 4510</td>
<td>Optics</td>
<td></td>
</tr>
</tbody>
</table>

Four-Year Plans of Study

General Astronomy Track

Year One

Fall Semester
ASTR 1030 Accelerated Introductory Astronomy 1 | 4
APPM 1350 or MATH 1300 Calculus 1 for Engineers | 4-5
Gen. Ed. Skills course (example: Lower-division Written Communication) | 3
Elective/MAPS | 3
Credit Hours 14-15

Spring Semester
ASTR 1040 Accelerated Introductory Astronomy 2 | 4
APPM 1360 or MATH 2300 Calculus 2 for Engineers | 4-5
Gen. Ed. Distribution course (example: Arts & Humanities) | 3
Elective | 3
Credit Hours 14-15

Year Two

Fall Semester
ASTR 2000 Ancient Astronomies of the World (fulfills ASTR 2000-level elective as well as Gen Ed Diversity course: Global Perspective) | 3
PHYS 1115 General Physics 1 for Majors | 4
APPM 2350 Calculus 3 for Engineers (recommended, but not required) or an Elective | 4
Gen. Ed. Distribution course (example: Social Sciences) | 3
Elective/MAPS | 3
Credit Hours 17

Spring Semester
ASTR 2000-level course | 3
PHYS 1125 General Physics 2 for Majors | 4
PHYS 1140 Experimental Physics 1 | 1
Gen. Ed. Distribution/Diversity course (example: Social Sciences/US Perspective) | 3
Elective | 3
Credit Hours 14

Year Three

Fall Semester
ASTR 3720 or ASTR 3730 Planets and Their Atmospheres (part one of required sequence) | 3
or Astrophysics 1 - Stellar and Interstellar | |
ASTR/PHYS 2000-level course | 3
Ancillary Science Sequence with lab part one (example: GEOL, EBIO, CHEM, ATOC) (and lab, if required) | 4-5
Gen. Ed. Skills course (example: Upper-division Written Communication) | 3
Gen. Ed. Distribution course (example: Arts & Humanities) | 3
Credit Hours 16-17

Spring Semester
ASTR 3750 or ASTR 3830 Planets, Moons, and Rings (part two of required sequence) | 3
or Astrophysics 2 - Galactic and Extragalactic | |
ASTR Upper-Division Elective | 3
Ancillary Science Sequence with lab part two (example: GEOL, EBIO, CHEM, ATOC) (and lab, if required) | 3-5
Gen. Ed. Distribution course (example: Social Sciences) | 3
Gen. Ed. Distribution course (example: Arts & Humanities) - Upper-division | 3
Credit Hours 15-17

Year Four

Fall Semester
ASTR Upper-Division Elective | 3
ASTR Upper-Division Elective | 3
Astrophysics/Physics Track

Year One

Fall Semester
ASTR 1030 Accelerated Introductory Astronomy 1 4
PHYS 1115 General Physics 1 for Majors 4
APPM 1350 Calculus 1 for Engineers or MATH 1300 Calculus 1 4-5
Gen. Ed. Skills course (example: Lower-division Written Communication) 3

Credit Hours 15-16

Spring Semester
ASTR 1040 Accelerated Introductory Astronomy 2 4
APPM 1360 Calculus 2 for Engineers or MATH 2300 Calculus 2 4-5
PHYS 1125 General Physics 2 for Majors 4
PHYS 1140 Experimental Physics 1 1
Gen. Ed. Distribution/Diversity course (example: Arts & Humanities/Global Perspective) 3

Credit Hours 16-17

Year Two

Fall Semester
APPM 2350 Calculus 3 for Engineers 4
PHYS 2170 Foundations of Modern Physics 3
PHYS 2150 Experimental Physics 2 1
Gen. Ed. Distribution course (example: Social Sciences) 3
Elective 3

Credit Hours 14

Spring Semester
PHYS 2210 Classical Mechanics and Mathematical Methods 1 3
ASTR 2600 Introduction to Scientific Programming (recommended, not required) 3
APPM 2360 Introduction to Differential Equations with Linear Algebra 4
Gen. Ed. Distribution/Diversity course (example: Social Sciences/US Perspective) 3

Credit Hours 15

Year Three

Fall Semester
ASTR 3730 Astrophysics 1 - Stellar and Interstellar 3
PHYS 3210 Classical Mechanics and Mathematical Methods 2 3
PHYS 3310 Principles of Electricity and Magnetism 1 3
Gen. Ed. Skills course (example: Upper-division Written Communication) 3
Gen. Ed. Distribution course (example: Arts & Humanities) 3

Credit Hours 15

Spring Semester
ASTR 3830 Astrophysics 2 - Galactic and Extragalactic 3
PHYS 3220 Quantum Mechanics 1 3
PHYS 3320 Principles of Electricity and Magnetism 2 3
Gen. Ed. Distribution course (example: Social Sciences) 3
Gen. Ed. Distribution course (example: Arts & Humanities) 3

Credit Hours 15

Year Four

Fall Semester
ASTR 3740 Cosmology and Relativity 3
ASTR 3710 Formation & Dynamics of Planetary Systems 3
PHYS 4410 Quantum Mechanics 2 (recommended, not required) 3
Gen. Ed. Distribution course (example: Social Sciences) 3
Upper-Division Elective 3

Credit Hours 15

Spring Semester
ASTR 3510 Observations and Instrumentation 1 4
PHYS 4230 Thermodynamics and Statistical Mechanics (recommended, not required) 3
Gen. Ed. Distribution course (example: Arts & Humanities) 3
Upper-Division Elective 3

Credit Hours 16

Total Credit Hours 122-124