

# ASTRONOMY + DATA SCIENCE, BSLAS

*for the degree of Bachelor of Science in Liberal Arts & Sciences in Astronomy plus Data Science*

The **Astronomy + Data Science** major incorporates simultaneously strong foundations in Data Science (<https://datascience.illinois.edu/>) and Astronomy (<https://astro.illinois.edu/>) to develop an appreciation and understanding of how big data is transforming science. Graduates of the Astronomy + Data Science program will have gained experience working with modern large data sets using current computational and statistical methods, with a strong grounding in data curation and ethics.

**STEM designated\***; **BSLAS Degree (Bachelor of Science in Liberal Arts & Sciences)**

The Astronomy Department undergraduate program also includes majors in Astronomy (<http://catalog.illinois.edu/undergraduate/las/astronomy-bslas/>), Astrophysics (<http://catalog.illinois.edu/undergraduate/las/astrophysics-bslas/>), and Computer Science & Astronomy ([http://catalog.illinois.edu/undergraduate/eng\\_las/computer-science-astronomy-bs/](http://catalog.illinois.edu/undergraduate/eng_las/computer-science-astronomy-bs/)), as well as a minor in Astronomy (<http://catalog.illinois.edu/undergraduate/las/minors/astronomy/>).

## Astronomy Major

The LAS major in Astronomy (<http://catalog.illinois.edu/undergraduate/las/astronomy-bslas/>) is a flexible program for students who are fascinated by the cosmos and plan to pursue technical or professional careers in areas requiring a solid grounding in physical science and mathematics. It is based upon both a broad and an in-depth exploration into astronomy and allied disciplines, and is an excellent way to gain a general science education.

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## Astrophysics Major

Astrophysics (<http://catalog.illinois.edu/undergraduate/las/astrophysics-bslas/>), the study of how the universe works by applying the methods and principles of physics, is the cornerstone of modern astronomy. Students majoring in Astrophysics must complete advanced coursework in both astronomy and physics, allowing them to demonstrate the rigorous preparation necessary for graduate study in astronomy, physics, and planetary and space sciences.

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## Computer Science + Astronomy Major

The LAS major in Computer Science + Astronomy ([http://catalog.illinois.edu/undergraduate/eng\\_las/computer-science-astronomy-bs/](http://catalog.illinois.edu/undergraduate/eng_las/computer-science-astronomy-bs/)) is a flexible program for students who wish to combine a solid grounding in computer science with technical knowledge of astronomy. This blended curriculum helps develop a unique approach to problem solving and offers novel perspectives in interdisciplinary work, such as data visualization, data mining, astrophysical simulations, and image processing.

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## Astronomy Minor

The minor in astronomy (<http://catalog.illinois.edu/undergraduate/las/minors/astronomy/>) is designed to broaden the student's knowledge of science and our place in the universe. The minor in Astronomy will benefit especially those students who are eager to learn astronomy but who do not anticipate it to be their career. The Astronomy minor is also suitable for students who intend to pursue careers in areas that may benefit from a good knowledge of astronomy such as the aerospace industry, science writing, scientific journalism, or science teaching in schools.

## QUESTIONS?

To get answers to your questions about our undergraduate programs in astronomy or to schedule a visit, contact Astronomy Advising ([advising@astro.illinois.edu](mailto:advising@astro.illinois.edu)).

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- **Minimum required major and supporting course work** normally equates to 62-66 hours
- **General education:** Students must complete the Campus General Education requirements including the campus general education language requirement.
- Twelve hours of 300 and 400-level courses must be taken on this campus.
- **Minimum hours required for graduation:** 120 hours
- **Departmental distinction:** To graduate with distinction requires a specified minimum grade point average in all Computer Science, Statistics, Information Science, and Mathematics courses listed below. A GPA of 3.25 is required for Distinction, 3.5 for High Distinction, and 3.75 for Highest Distinction.

### Graduation Requirements

Minimum hours required for graduation: 120 hours.

Minimum hours required major and supporting course work: normally equates to 62-66 hours. Twelve hours of 300- and 400-level courses in the major must be taken on this campus.

### University Requirements

Minimum of 40 hours of upper-division coursework, generally at the 300- or 400-level. These hours can be drawn from all elements of the degree. Students should consult their academic advisor for additional guidance in fulfilling this requirement. The university and residency requirements can be found in the Student Code (<https://studentcode.illinois.edu/article3/part8/3-801/>) (§ 3-801) and in the Academic Catalog (<http://catalog.illinois.edu/general-information/degree-general-education-requirements/>).

### General Education Requirements

Follows the campus General Education (Gen Ed) requirements (<https://courses.illinois.edu/gened/DEFAULT/DEFAULT/>). Some Gen Ed requirements may be met by courses required and/or electives in the program.

Code	Title	Hours
Composition I		4-6
Advanced Composition		3
Humanities & the Arts (6 hours)		6
Natural Sciences & Technology (6 hours)		6
fulfilled by PHYS 211 and PHYS 212		
Social & Behavioral Sciences (6 hours)		6
Cultural Studies: Non-Western Cultures (1 course)		3
Cultural Studies: US Minority Cultures (1 course)		3
Cultural Studies: Western/Comparative Cultures (1 course)		3
Quantitative Reasoning (2 courses, at least one course must be Quantitative Reasoning I)		6-10
fulfilled by MATH 220 or MATH 221, STAT 107, STAT 207, PHYS 211, MATH 231, MATH 241		
Language Requirement (Completion of the fourth semester or equivalent of a language other than English is required)		0-20

### Major Requirements

Code	Title	Hours
<b>Required Data Science Core</b>		<b>28-31</b>
<b>Mathematical Foundations</b>		
MATH 220 or MATH 221	Calculus Calculus I	4-5
Linear Algebra: Select one of the following (MATH 227 or MATH 257 is recommended)		2-4
MATH 227	Linear Algebra for Data Science	
MATH 257	Linear Algebra with Computational Applications	
MATH 225	Introductory Matrix Theory	
MATH 415	Applied Linear Algebra	
<b>Data Science Fundamentals</b>		
STAT/CS/IS 107	Data Science Discovery	4
STAT 207	Data Science Exploration	4
CS 307	Modeling and Learning in Data Science	4
<b>Computational Fundamentals</b>		
CS 277	Algorithms and Data Structures for Data Science	4
<b>Ethics and Responsibility in Data Science</b>		
IS 467	Ethics and Policy for Data Science	3
IS 477	Data Management, Curation & Reproducibility	3
<b>Required Astronomy Coursework</b>		<b>31-32</b>
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
PHYS 213	Univ Physics: Thermal Physics	2
PHYS 214	Univ Physics: Quantum Physics	2
MATH 231	Calculus II	3
MATH 241	Calculus III	4
ASTR 210	Introduction to Astrophysics	3
ASTR 310	Computing in Astronomy	3
Advanced Astronomy Courses - Select two courses from the following:		6-7
ASTR 404	Stellar Astrophysics	

ASTR 405	Planetary Systems	
ASTR 406	Galaxies and the Universe	
ASTR 414	Astronomical Techniques	
<b>Research or Discovery Experience</b>		<b>3</b>
ASTR 390 or ASTR 490	Individual Study Senior Thesis	
One of the most important skills a student will gain in an Astronomy & Data Science degree will be the ability to present astronomical data in meaningful ways. A research or discovery experience is as much as pillar of this degree program as both the data science core coursework (Part 1) and the coursework in Astronomy (Part 2).		
This experience should be developed with an advisor before the end of a student's sophomore year and result in the creation of one or more artifacts documenting the experience. A minimum of 3 credit hours must be specifically designated to the preparation and the completion of the experience component.		
Examples of possible experiences may include:		
# A semester study-abroad with at one or more courses focused on discovery while attending the international institution.		
# A multi-semester capstone experience within the student's area of specialization.		
# A semester co-op experience outside Champaign-Urbana focused on a subject within the student's area of specialization.		
# A multi-semester undergraduate research experience under the direction of Illinois faculty.		
# A summer NSF REU program focused within a student's area of specialization.		
<b>Total Hours</b>		<b>62-66</b>

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## Sample Sequence

This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence.

Students must fulfill their Language Other Than English requirement by successfully completing a fourth level of a language other than English. See the corresponding section on the Degree and General Education Requirements page (<http://catalog.illinois.edu/general-information/degree-general-education-requirements/>).

### First Year

First Semester	Hours
Free Elective course	1
MATH 220 or 221	5
Language Other Than English (3rd level)	4

STAT 107 (or Composition I)	4
<b>Total Hours</b>	<b>14</b>

**Total Hours 14****First Year**

<b>Second Semester</b>	<b>Hours</b>
PHYS 211	4
MATH 231	3
Language Other Than English (4th level)	4
Composition I or STAT 107	4
<b>Total Hours</b>	<b>15</b>

**Total Hours 15****Second Year**

<b>First Semester</b>	<b>Hours</b>
ASTR 210	3
MATH 241	4
PHYS 212	4
General Education course	3
Free Elective course	1
<b>Total Hours</b>	<b>15</b>

**Total Hours 15****Second Year**

<b>Second Semester</b>	<b>Hours</b>
PHYS 213	2
PHYS 214	2
STAT 207	4
General Education course	3
Free Elective course	3
<b>Total Hours</b>	<b>14</b>

**Total Hours 14****Third Year**

<b>First Semester</b>	<b>Hours</b>
ASTR 310	3
MATH 257, 225, 227, or 415	3
General Education course	3
General Education course	3
Free Elective course	3
<b>Total Hours</b>	<b>15</b>

**Total Hours 15****Third Year**

<b>Second Semester</b>	<b>Hours</b>
ASTR 404, 405, 406, or 414	3
CS 277	4
IS 467	3
General Education course	3
General Education course	3
<b>Total Hours</b>	<b>16</b>

**Total Hours 16****Fourth Year**

<b>First Semester</b>	<b>Hours</b>
ASTR 404, 405, 406, or 414	3
CS 307	4
General Education course	3
Free Elective course	3
Free Elective course	3
<b>Total Hours</b>	<b>16</b>

**Total Hours 16****Fourth Year**

<b>Second Semester</b>	<b>Hours</b>
ASTR 390 or 490	3
IS 477	3
General Education course	3
Free Elective course	3
Free Elective course	3
<b>Total Hours</b>	<b>15</b>

**Total Hours 15****Total Hours: 120**

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The Astronomy + Data Science program has learning objectives in both Astronomy and Data Science.

## The Astronomy learning objectives are:

- Understand the hierarchical architecture of the cosmos, increasing in scale from the Solar System to the Galaxy to the Universe, and decreasing in scale to atoms and their nuclei. Understand the interplay among these scales.
- Define and use fundamental principles and techniques of astronomy and astrophysics.
  - Identify which principles should be applied to a specified situation.
  - Show familiarity with astronomical observables and their physical origin.
  - Understand and apply basic physics and computational techniques to solve problems in astronomy, and interpret the results.
- Analyze astronomical data, and quantitative data generally.
  - Demonstrate the ability to link observation and theory.
  - Demonstrate the ability to draw qualitative conclusions from quantitative information, and vice versa.
  - Demonstrate the ability to plan observational programs, use astronomical telescopes and instrumentation, and to analyze and present astronomical data.
- Plan and perform guided research, or attain an advanced-level understanding of a topic of contemporary interest in astronomy.
- Demonstrate the ability to communicate effectively both verbally and in writing.

## **The Data Science learning objectives are:**

1. Demonstrate proficiency with statistical and computational analysis of data.
2. Create informative and accurate visualizations of data.
3. Build and evaluate data-based models.
4. Describe, curate, and manage data.
5. Understand and manage issues of reproducibility in data science.
6. Understand and address ethical issues in data science such as access, bias, and privacy.
7. Apply data science skills and concepts in projects or research, and communicate and interpret the results of data analysis.

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## **Astronomy**

Astronomy website (<https://astro.illinois.edu/>)

Astronomy Undergraduate Programs (<https://astro.illinois.edu/academics/undergraduate-program/>)

astronomy@illinois.edu

Astronomy faculty (<https://astro.illinois.edu/directory/faculty/>)

## **College of Liberal Arts & Sciences**

LAS College website (<https://las.illinois.edu/>)

## **Data Science**

Data Science program website (<https://datascience.illinois.edu>)

X+Data Science program email: [plusdatascience@illinois.edu](mailto:plusdatascience@illinois.edu)

## **Advising**

advising@astro.illinois.edu

College of LAS Advising (<https://las.illinois.edu/academics/advising/college/>)

## **Admissions**

Liberal Arts & Sciences Admissions & Requirements (<http://catalog.illinois.edu/schools/las/academic-units/>)

University of Illinois Urbana-Champaign Undergrad Admissions (<https://www.admissions.illinois.edu/>)