

# Astronomy

*Chair:* Andrea K. Dobson

Jessica Sutter

Courses are concerned with the planets, stars, and galaxies which compose the physical universe, and with the techniques for investigating the nature of these objects. The introductory courses contribute to a general understanding of our place in the universe. The advanced courses have frequent relevance for students in physics, chemistry, and other sciences.

Students interested in graduate work in astronomy are encouraged to major in physics-astronomy or in physics with an astronomy minor, since most graduate schools look for the equivalent of an undergraduate degree in physics. Some students with other interests also have designed individual combined majors such as astrobiology.

**Learning goals:** Upon graduation, a student will be able to:

- Clearly and accurately articulate in qualitative terms, both orally and in writing, our current understanding of various components of the Universe and describe the observations on which that understanding is based.
- Read and comprehend moderately technical astronomical literature.
- Solve problems using discipline-specific knowledge and techniques

**Distribution:** Some courses completed in astronomy apply to the science and quantitative analysis distribution areas.

**Total credit requirements for an Astronomy major:** A student who enters Whitman College with no prior experience in Astronomy will need to complete 35 credits in Astronomy; 8 credits in Physics; 10 credits in Mathematics and Statistics.

## The Astronomy major:

- Total Credits 57 credits; if no course work prior to Whitman
  - 35 credits in astronomy
  - 12 credits in physics
  - 10 credits in mathematics and statistics
- Required Courses
  - Astronomy 177, 178, 179, 310, 320, and 330
  - Physics 145 or 155, 156, 245, and 255
  - Mathematics 124 or 125, 126, and 225
  - At least seven credits from Astronomy courses numbered 200-392; one course from a related area may be approved by the department to count toward this requirement.
  - At least four credits from 490 (senior research) and/or 498 (honors thesis)
- Other notes
  - Courses in geology and computer programming are strongly recommended
  - No courses for the major may be taken P-D-F after the major is declared
- Senior Requirements
  - 490 and/or 498 (senior research and/or honors thesis)
  - 490 must be approved Spring of junior year
  - Comprehensive written exam
  - One hour oral exam
- Honors
  - Students submit a Honors in Major Study Application to their department
  - Students must submit a proposal for their thesis or project
    - Must be submitted within the first six weeks of the two-semester period in which student is eligible

- Accumulated at least 87 credits
- Completed two semesters of residency at Whitman.
- Cumulative GPA of at least 3.300 on all credits earned at Whitman College
- Major GPA of at least 3.500
- Complete a written thesis or research project prepared exclusively for the satisfaction of this program
- Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
- Pass the senior assessment with distinction
- The department will submit the Honors applications to the Registrar's Office of students pursuing Honors by the specified deadline
- The department submit "Senior Assessment/Major Study Certificate" to the Registrar's Office no later the Reading Day
- An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

**The Astronomy minor:**

- 18 Credits
- Required Courses
  - Astronomy 177, 178, 179
- Other minor requirements
  - Six credits numbered 200 or above
- Other notes
  - No P-D-F courses after minor has been declared

**The Astronomy-Geology combined major**

- 61-63 total credits
  - 20 credits in astronomy
  - 27-28 credits in geology
  - 4 credits in chemistry
  - 4 credits in physics
  - 6-7 credits in mathematics and statistics
- Required astronomy courses:
  - Astronomy 177, 178, and 179
  - Astronomy 310, 320, 330, 350, 360, or 380
  - At least two additional credits in Astronomy courses numbered 310-392
  - Two credits of Astronomy 490
- Required geology courses:
  - Introductory geology (Geology 110 and 111, or 120 and 121, or 125 and 126)
  - Geology 227, 270, 350, and 358
  - Two of the following: Geology 310, 405, or 420
  - Two credits of Geology 490
  - During senior year: Geology 470
- Other required courses:
  - Chemistry 125 and 135, or 140
  - Mathematics 124 or 125, 126
  - Physics 145 or 155
- Notes on courses:
  - No courses for the major may be taken P-D-F
  - Strongly recommended courses: Computer Science 167; Mathematics 225, 244; Chemistry 126, 136; Physics 156, 245, 255
- Senior requirements:

- Astronomy 490, Geology 470 and 490
- Senior assessment:
  - Comprehensive written exams in both geology and astronomy
  - One-hour oral exam by astronomy and geology faculty
- Requirements for honors in Astronomy-Geology:
  - Students do not apply for admission to candidacy for honors;
  - Earn a cumulative GPA of at least 3.300 and a major GPA of at least 3.500
  - Write a thesis graded A or A- by department faculty;
  - Pass the senior assessment with distinction;
  - Department Chairs will notify the Registrar of students attaining Honors no later than the third week of April
  - An acceptable copy of the Honors Thesis must be submitted to Penrose Library no later than reading day

**The Physics-Astronomy combined major: 59 Credits**

- 22 credits in astronomy
- 24 credits in physics
- 13 credits in mathematics and statistics
- Required Courses
  - Astronomy 177, 178, 179,
  - Two courses from Astronomy 310, 320, 330
  - At least two credits from: Astronomy 310, 320, 330, 350, 360, 380, 391, 392 or 490
  - Physics 145 or 155 or 347
  - Physics 156, 245, 255, and 267
  - Two courses from Physics 325, 339, 347, 357, 385
  - One physics course 300-480 or BBMB 324 and 334
  - Mathematics 225 and 244
- Other notes
  - If students place out of Physics 155, they must take Physics 347
  - Physics 347 may not be used to satisfy multiple requirements
  - Additional physics courses, Computer Science 167, Mathematics 240, 367, and 368 are recommended
  - No courses may be taken P-D-F
- Senior Requirements
  - Senior assessment consisting of a
    - Two-part comprehensive written examination
    - One-hour oral exam conducted jointly

**Honors**

- Students submit a Honors in Major Study Application to their department
- Students must submit a proposal for their thesis or project
  - Must be submitted within the first six weeks of the two-semester period in which student is eligible
- Accumulated at least 87 credits
- Completed two semesters of residency at Whitman.
- Cumulative GPA of at least 3.300 on all credits earned at Whitman College
- Major GPA of at least 3.500
- Complete a written thesis or research project prepared exclusively for the satisfaction of this program
- Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
- Pass the senior assessment with distinction
- The department will submit the Honors applications to the Registrar's Office of students pursuing Honors by the specified deadline

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### **110 Principles of Astronomy**

**Spring**

**Sutter**

**4 credits**

This course offers an introduction to our present knowledge of the universe and the historical development of humanity’s changing understanding of the cosmos. Emphasis not only on the nature of planets, stars, and galaxies, but also on the evolutionary processes which occur in the universe, including cosmology and the origin of the elements, the formation and life cycles of stars, and the development of planetary systems. Three lecture/lab sessions per week. Not open to physical science majors. Astronomy 110 does not count toward Astronomy or Astronomy-combined majors.

### **177 Sky and Planets**

**Not offered 2023-24**

**4 credits**

A survey of planets and their motions, planetary satellites, comets, meteorites, and interplanetary material. Several problem sets and exams, short research paper, and one evening lab session each week. Offered in rotation with Astronomy 178, 179. *Prerequisites:* three years of high school mathematics and one year of high school physics, or consent of instructor; Mathematics 124 or 125/126 recommended.

### **178 Sun and Stars**

**Fall**

**A. Dobson**

**4 credits**

An introduction to the properties of stars, their motions, and their distributions in space. Several problem sets and exams, short research paper, and one evening lab session each week. Offered in rotation with Astronomy 177, 179. *Prerequisites:* three years of high school mathematics and one year of high school physics, or consent of instructor; Mathematics 124 or 125/126 recommended.

### **179 Galaxies and Cosmology**

**Spring**

**A. Dobson**

**4 credits**

An introduction to the structure of galaxies and to the large-scale structure and evolution of the universe. Several problem sets and exams, short research paper, and one evening lab session each week. Offered in rotation with Astronomy 177, 178. *Prerequisites:* three years of high school mathematics and one year of high school physics, or consent of instructor; Mathematics 124 or 125/126 recommended.

### **227 Finding Our Place in the Universe**

**Not offered 2023-24**

**3 credits**

A survey of cosmological discoveries and their impact on our understanding of our location in space and time. Several problem sets and exams, short research paper and oral presentation, and occasional outdoor labs. This course applies to the science distribution area, but not science with a laboratory. *Prerequisites:* three years of high school math and one year of high school physics. *Recommended prerequisite:* one previous college course in astronomy.

### **228 Exoplanets and the Search for Life in the Universe**

**Not offered 2023-24**

**3 credits**

A survey of planetary systems around other stars and current research into the possibilities for life elsewhere in the universe. Several problem sets and exams, short research paper and oral presentation, and occasional outdoor labs. This course applies to the science distribution area, but not science with a laboratory. *Prerequisites:* three years of high school math and one year of high school physics. *Recommended prerequisite:* one previous college course in astronomy.

### **270 Astronomical Computing**

**Not offered 2023-24**

**1 credit**

Astronomical study and research is heavily dependent on the use of computers for analyzing data as well as communicating that data to collaborators, other scientists, and the public. We regularly carry powerful computers in our pockets, ostensibly to make telephone calls, but the normal course of education does not teach how to undertake technical tasks on the computer. In this class, students will gain proficiency in many areas required for professional proficiency in astronomy. Namely, this will include Linux use and file management using a variety of desktop managers, typesetting documents in LaTeX, construction of scientific figures, and an introduction to astronomical programming in FORTRAN and python. *Prerequisite:* Astronomy 177 or 178 or 179.

### **310 Stellar Astrophysics**

**Spring**

**Sutter**

**4 credits**

Of interest to majors in physics or physics-astronomy, this course considers the application of the principles of atomic structure and the radiation laws to the interpretation of the spectra of stars and nebulae; the physical principles underlying the study of the structure of stars, energy generation by thermonuclear reactions, and nucleosynthesis; and theoretical and observational aspects of stellar evolution. Several problem assignments and a midterm examination. *Prerequisites:* Astronomy 178 and Physics 156 or consent of instructor. *Recommended prerequisite:* Physics 245. Offered in alternate years with Astronomy 320.

### **320 Galactic Astronomy**

**Not offered 2023-24**

**4 credits**

Intended for physics-astronomy majors but also open to majors in related sciences. The constituents and structure of our own and other galaxies, the nature of quasars and active galaxies, and the large-scale structure of the universe itself. Reading assignments will be made in various books and scientific journals. Several problem assignments and a mid-term test. *Prerequisites:* Astronomy 179, and Physics 156, or consent of instructor. *Recommended Prerequisite:* Physics 245. Offered in alternate years with Astronomy 310.

### **330 Cosmology**

**Fall**

**A. Dobson**

**4 credits**

Intended for majors in physics-astronomy and related sciences. The study of the universe: how it originated, the formation and evolution of structures, the curvature of space and time. Several problem sets, exams, research paper. *Prerequisites:* Astronomy 179 and Physics 156, or consent of instructor. *Recommended Prerequisite:* Physics 245. Offered in alternate years.

### **350 Planetary Science**

**Fall**

**A. Dobson**

**4 credits**

Intended for majors in astronomy, astronomy-geology, and related sciences. The study of solar system objects: interiors, surfaces, atmospheres, and orbital mechanics. Several problem sets, exams, research paper. *Prerequisites:* Astronomy 177, Physics 155, and Geology 110 or 120, or consent of instructor.

### **360 Observational Astronomy**

**Not offered 2023-24**

**4 credits**

Intended for majors in astronomy, physics-astronomy, and related sciences. The study of observational astronomy across the full electromagnetic spectrum as well as gravitational waves. Specifically looking at detector technologies, telescope design, data reduction, the current state of the art in both ground-based and space-based observational astronomy missions, and the physics governing emission across the spectrum. Several problem sets, exams, project. *Prerequisites:* Astronomy 177, 178, and 179, or consent of instructor.

### **380 Special Topics in Astronomy**

**4 credits**

Selected topics in contemporary astronomy and astrophysics; the precise area of study will be designated prior to registration for the semester in which the course is offered. *Prerequisite:* consent of instructor. Any current offerings follow.

**391, 392 Directed Project****Fall, Spring****A. Dobson****1-4 credits**

Discussion and directed reading and/or observational work on a topic of interest to the individual student.

*Prerequisite:* consent of instructor.

**482 Astronomy Seminar****Not offered 2023-24****1 credit**

Oral reports by students on reading and research projects. Faculty and visiting scientist guest lectures. Discussion of recent works of importance to the field and problem-solving exercises. No examinations. One meeting per week.

May be repeated for a maximum of two credits. *Prerequisite:* consent of instructor.

**490 Senior Research****Fall, Spring****A. Dobson****1-4 credits**

An advanced interdisciplinary independent study project for astronomy or astronomy-combined majors; students wishing to do a senior research project should choose project advisors and propose an interdisciplinary topic during the second semester of their junior year. *Prerequisite:* consent of instructor.

**498 Honors Thesis****Fall, Spring****A. Dobson****2-4 credits**

Preparation of an honors thesis. Required of and limited to senior honors candidates in astronomy. *Prerequisite:* admission to honors candidacy.