

Department of Astronomy & Planetary Science

Astronomy 180 – Introduction to Astronomy

Fall 2021

Course Credits: 3
Pre/Co-requisites: None
Mode of Instruction: In-person

Instructor: Ed Anderson,

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Phone: 928-523-7096

Course Website: BbLearn for all course announcements, reporting of grades and the majority of content (<https://bblearn.nau.edu>). You are responsible for all announcements or assignments posted there. The course shell will open one week prior to the start of the class, *i.e.*, on Monday, August 16.

Mode of Instruction:

Class Times: Tuesday and Thursday, Wettaw (Bldg. 88), 8:00am – 9:15am.

Office Hours: Mondays (1:30 pm – 2pm), Wednesdays (10am – 11am) and Fridays (3:00pm – 4:00pm), or by appointment.

Course Purpose and Learning Outcomes

“Introduction to Astronomy” presents the astronomical phenomena of the universe—*i.e.*, the night sky, planets, stars, galaxies, and cosmology—in the context of physical science. Core topics include the scale of the universe, technological tools of astronomy, the Copernican revolution, gravitation and the motion of the planets, electromagnetic radiation and spectra, contents of the solar system, the life cycle of stars, origin and structure of galaxies, and big bang cosmology. The instructor as guided by the textbook will choose the order of topics.

The thematic focus of the course is Technology and Its Impact on Human Knowledge and Understanding, as we will be examining how our changing technology over the centuries has affected our view of the universe. This liberal studies course meets a 3-hour Science and Applied Science requirement if taken by itself; and meets the Lab-science requirement if the separate lab, AST 181, is taken as well. This course will address several of the liberal studies essential skills, focusing on the logic of scientific inquiry.

The overarching goals of this course are for you to understand the nature of science through the eyes of astronomy; to understand the big ideas in astronomy; and to develop a lifelong interest in astronomy and current events surrounding astronomy.

Required Materials & Technology

1. OpenStax etext: Astronomy

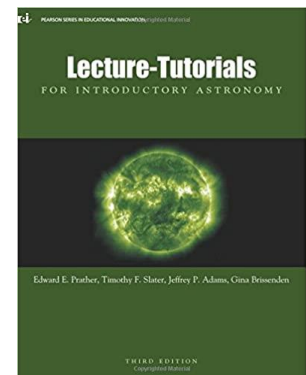
Good news: your textbook for this class is available **FREE** online in web view and PDF formats! You can also purchase a print version, if you prefer, from OpenStax on Amazon.com.



You can use whichever formats you want. Web view is recommended -- the responsive design works seamlessly on any device. If you buy on Amazon, make sure you use the link on your book page on openstax.org so you get the official OpenStax print version. (Simple printouts sold by third parties on Amazon are not verifiable and not as high quality)

Astronomy from OpenStax, Print ISBN 1938168283, Digital ISBN 1947172247,
www.openstax.org/details/astronomy

2. Lecture-Tutorials for Introductory Astronomy, 3rd Edition, Edward E., Prather, Slater Timothy F, Jeff P. Adams, Gina Brissenden ISBN-13: 978-0321820464 ISBN-10: 0321820460



This book provides a collection of 44 collaborative learning, inquiry-based activities to be used with introductory astronomy courses. Based on education research, these have been proven to lead to a deeper, more complete understanding through a series of structured questions that prompt you, using reasoning, to identify and correct any misconceptions.

3. Using BbLearn

3.1. BbLearn Content

All course material presented in class will be posted to BbLearn.

3.2. BbLearn Quizzes & Surveys

All quizzes/surveys and, of course, exams, will be done in BbLearn.

3.3. BbLearn Discussion Boards

There is a general discussion board, *Questions and Answers*, set up for you to post questions and thoughts, and receive responses from the rest of us.

Occasionally, I will ask you to submit a short (*e.g.* paragraph or two) report/reflection on a topic or question. Sometimes these will be submitted in a BbLearn **Discussion**, sometimes as an assignment that only I will see.

Please be respectful of your classmates—no flame wars! ☺

Assignments/Assessments of Course Student Learning Outcomes

–Active engagement with group activities occurring daily: It is our belief that you can only learn a limited amount of information from lecture alone, no matter how clear or entertaining. Therefore, this course is composed of a series of mini-lectures augmented by collaborative classroom activities called Lecture Tutorials (LT) and Ranking Tasks (RT), which target specific ideas presented in lecture. These were designed to be completed in pairs, or small groups—during class by talking through the questions and writing detailed consensus responses.

You may be asked to submit some, but not all, of the activities done for a particular class for grading. You are responsible for making sure you have the correct answers written down, so participation in class is essential. Any one submission has a low point value, so there is no need to stress—but it is necessary to complete the assignments on time. ☺

The questions in the LTs and RTs, as well as those that you find within the class presentations, are quite similar to the questions you will find on our exams. You are, therefore, strongly encouraged to consider these activities as a critical component to your success in the course.

–Attendance at all classes is REQUIRED: Class is a time to think, not a time to sit back and wait for information to be poured into you. Since this course is built around daily activities to accompany the lecture, your attendance and full participation at each class period will be an essential component of your success in the course.

- We will use the iClicker App, which is available to all NAU students and faculty for both classroom response polling and attendance for classes and events. We will only be using this for attendance and hence you will not be charged any fees.

Students may use many different devices to participate in polling or attendance, such as SmartPhones (iPhone or Android), Tablets (Apple or Android), Chromebooks, laptops or iPod Touch. **For students who have none of the devices listed above, free semester loaners will be available through Cline Library.**

Instructions for downloading and registering this app, are found at [Student Checklist: Getting Started with iClicker Student App](#). **Be sure to register using your NAUID (*e.g.*, abc123), so that your list of classes will show.**

Each day's attendance is worth 1 participation point.

- On occasion, we may administer unscheduled questionnaires in class that will be collected during that class. These questionnaires will not be graded; rather you will be given credit for what you complete, on an all or nothing basis (e.g., 3 of 4 questions completed = 3 points), and your grade on these questionnaires will contribute to your overall participation grade.
- In addition, conceptual questions will be asked periodically to assess your understanding of course concepts. Sometimes, your answers will be gathered, and you will be given credit for participation regardless of the correctness of your answer.

–**Carefully studying the text is REQUIRED:** The course mini-lectures are designed to focus on the really difficult aspects of astronomy or to provide structure for your out-of-class study. You are accountable for all material, concepts, and interrelationships presented in the mini-lectures, the text, and, most importantly, the in-class activities. Therefore, it is imperative to your success in this course that you complete the assigned readings *prior* to coming to class. Otherwise, the mini-lectures and class activities will be less useful in helping you develop a deep understanding of the course topics.

– **ExpertTA is REQUIRED:** Homework assignments having to do with testing your comprehension of the text and class materials will be done with this system. See the separate document in the BbLearn “Syllabus & Info” content area regarding how to sign up (\$35.00).

– **Other Homework:** As mentioned earlier, I will from time to time, ask you to submit via BbLearn, one of the exercises you were asked to complete. Again, these have low point values so there is no need to stress—but it is necessary to complete the assignments on time. ☺

Each of the submitted assignments will be graded on a 4 point grading scale:

- 4 - Thorough, detailed, correct response, maybe one **minor** science content error;
- 3 - Major ideas present, but with an abbreviated or somewhat incomplete description; more than half the science content correct;
- 2 - Major errors in science content, but thoughtful response;
- 1 - Major errors in science content and very incomplete/abbreviated description; OR unreadable;
- 0 - No meaningful attempt worthy of grading.

–**Activities Outside of Class are REQUIRED:** During the semester, you are required to participate in an evening of observing the night sky at the Barry Lutz Telescope of the Atmospheric Research Observatory (Bldg. 47; on San Francisco, east of Reilly Hall). The observatory is open to the public, free of charge, on *clear* Friday nights from 7:30pm – 10:00pm. Additionally, one evening each week, rotating Monday-thru-Thursday, will be reserved for AST180. The schedule will be posted to BbLearn once it is ready—it will most likely start Tuesday, Sept. 7.

Each student is expected to go to two different sessions throughout the semester to complete this portion of the grade, so please do not wait until late in the semester to do this. For these assignments, take the worksheet, "Observing Log Worksheet", found in the BBLearn Assignment Files folder, to the telescope. Be sure to have the telescope operator sign your worksheet.

Submit your Observing Log in class, preferably right after your night of observing. **No late Observing Logs will be accepted for ANY reason beyond the end of class on December 2nd.**

-Extra Credit Activities:

With COVID-19 shutdowns, many of the things we usually suggest for extra credit—*e.g.* visiting the campus observatory; attending a star party, attending a colloquium either in our department, or at Lowell during the semester—are almost all suspended. In addition, many of you are not in Flagstaff while taking this course. However, many opportunities exist online, so check out some websites for your area.

If you attend any of the events or sites below, you can earn 5 points for each event towards your Class Participation! NOTE: Extra credit points will be limited to accumulating no more than 20% of the possible class participations points. Please write a brief summary and address the following: What did you attend and where did you go? What is the event about? Can you relate the event back to anything we have covered in class? If not, tell me something new that you learned that would be interesting to cover in the future classes. If you observed, what objects did you see and what did you learn about them? Was an object one that we discussed in class? Is there anything you can tell about it from your naked eye observations? Color? Brightness?

Lowell Observatory Evening Programs (\$14 or \$20)



Lowell Observatory at Mars Hill, Flagstaff offers a variety of events and night sky viewing programs **from 10am-10pm, Monday to Saturday, and 10am- 5pm on Sunday.** There is a regular Meet An Astronomer event every Sat. night.

Evening programs are slowly starting up for a smaller number of visitors, but there are several online opportunities to meet Lowell astronomers and learn about their research. Visit: lowell.edu.

Astronomy on Tap Flagstaff is free night of engaging science presentations from local astronomers, interactive trivia, and prizes! Topics range from telescopes to black holes and galaxies. These events take place at the **Southside Tavern** in downtown Flagstaff. There are also **Science on Tap** events, not necessarily astronomical, held at the **Green Room** on every 3rd Thursday each month from 6:30-8pm that you can attend.



I don't know if these have started up again, but there are online events occurring around the country that you can join. Visit: <https://astronomyontap.org/events/>

Meteor Crater (\$22)



The world's best preserved meteorite impact site on Earth, located near Winslow, is about an hour's drive from Flagstaff. Meteor Crater is the spectacular result of a collision that rocked the American Southwest approximately 50,000 years ago with the energy of more than 20 million tons of TNT. Visit: meteorcrater.com.

International Dark Sky Locations



You have probably heard that Flagstaff is the world's first International Dark Sky City, recognized by the International Dark Sky Association in 2001. There are more cities, locations, national parks etc. that have been recognized, and many are located near us. Visit these locations and learn about them:

www.flagstaffdarksbies.org and darksky.org.

Any other Observatories, Science Museums, or Astronomy-related Facilities/Locations

There are a few public/private observatories in Arizona as well as research facilities that are not mentioned above, such as USGS (US Geological Survey) near Buffalo Park, NOAO (National Optical Astronomy Observatory) in Tucson, Kitt Peak Observatories near Tucson etc. If you get a chance during holidays or breaks, visit observatories or science museums! (Note: visiting Dark Sky Brewing Company, or Roswell UFO museum in NM, do not count, sorry...)

Anything else? If you find an event (online or in-person) that interests you, let me know and we can discuss its acceptability!

Your class participation grade is calculated using the total points earned from each of the various types of questions/assignments/extra-credit discussed above. All items are low stakes in and of themselves, in the sense that no one question/response/assignment from you will kill your grade. Additionally, to allow for the unavoidable occasional absences, which naturally arise during the semester, without heavily penalizing your overall course grade your participation, ***the participation portion of your grade will be determined as follows:***

- 80% or more of participation points – A
- 70% – 79% of participation points – B
- 60% – 69% of participation points – C
- 50% – 59% of participation points – D
- 49% or less of participation points – F

Let me stress again, that there will be many small assignments, no one of which will be a grade killer if you miss it. Late submissions will be penalized at the rate of ½ point per day late.

—**Final Exam**

The final exam will be **Thursday, December 9, from 7:30am - 9:30am.**

- If you have an irresolvable conflict with another course's final exam, you must contact the instructor well in advance to make other arrangements.
- If you are certified as needing to take an exam under special circumstances, please contact Disability Resources well in advance of the exam date (at least 10 days).

I suggest that you take the final on a computer with a reliable network connection — *i.e.*, not on your phone at the local coffee shop.

—**Grading Schema**

Everybody is worried about COVID-19; and doing well in class and I don't want to add to that worry, so the point system is simple.

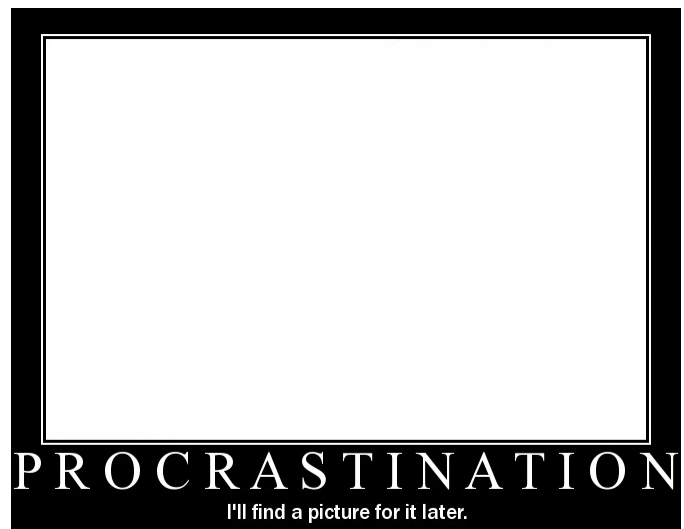
- 1) Final Exam: 20%
- 2) Participation (*i.e.*, everything else we do): 80%

NOTE: No midterm exams!

90 – 100	A
80 – 89.9	B
70 – 79.9	C
60 – 69.9	D
< 59.9	F
<i>No plus or minus grades.</i>	

Your course grades are accessible via Bb-Learn. If you find a mistake on your grade listing, please contact me as soon as possible.

**A Tip For Success In
Ast180:
DON'T PROCRASTINATE**



Class Outline or Tentative Schedule (Subject to change as the class evolves).

Dates	Required Reading	Subject
08/24	Ch. 1, Ch. 2.1	Thinking Like an Astronomer Observing the Sky
08/26	Ch. 4	Motions in the Sky
08/31	Ch. 4 Ch. 2.2 - 2.4	Motions in the Sky Ancient Astronomy (Geocentrism)
09/02	Ch. 2.4 Ch. 3	Birth of Modern Astronomy (Heliocentrism)
09/07	Ch. 6 Ch. 5	Light & Telescopes Light & Atoms
09/09	Ch. 6 Ch. 5	Light & Telescopes Light & Atoms
09/14	Ch. 17	Analyzing Starlight
09/16	Ch. 15 - 16	Measuring Stars
09/21	Ch. 15 - 16	Measuring Stars
09/23	Ch. 18	Properties of Stars
09/28	Ch. 18	Properties of Stars
09/30	Ch. 20 - 24	Star Formation Stellar Evolution
10/05	Ch. 20 - 24	Star Formation Stellar Evolution
10/07	Ch. 25	The Milky Way
10/12	Ch. 25	The Milky Way
10/14	Ch. 26, 27, 28	Galaxies
10/19	Ch. 26, 27, 28	Galaxies
10/21	Ch. 26, 27, 28	Galaxies
10/26	Ch. 28 - 29	Cosmology
10/28	Ch. 29	Cosmology
11/02	Ch. 29	Cosmology
11/04	Ch. 7 - 14	Our Solar System
11/09	Ch. 7 - 14	Our Solar System
11/15	Ch. 7 - 14	Our Solar System
11/18	Ch. 7 - 14	Our Solar System
11/22	Ch. 30	Life on Other Worlds
11/30	Ch. 30	Life on Other Worlds
12/01		Catch Up Day / Review for Final

Class Policies

Academic Dishonesty: I have no patience with cheating. Anyone cheating on an exam will receive a zero on that exam, and possibly a failing grade in the course.

In general, it is not my responsibility to attempt to describe and prohibit any and all forms of Academic Dishonesty. It is your responsibility to uphold the highest ethical standards. You are required to complete a mandatory BbLearn course on Academic Dishonesty. If you have any doubt or question about this policy, it is your responsibility to ask the professor in advance and to be clear about the answers and policies. Again, the text above and the attached NAU policies try to be very clear about what constitutes an act of Academic Dishonesty, but we cannot anticipate every possible form of cheating in advance. So the examples above are not meant to be comprehensive.

Academic Dishonesty information will be given to the Dean of Students and a written copy of any such incident may be attached to your official NAU file.

Respect for Diversity: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

NAU Policy Statements

COVID-19 REQUIREMENTS AND INFORMATION

Additional information about the University's response to COVID-19 is available from the **Jacks are Back!** web page located at <https://nau.edu/jacks-are-back>.

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224, *Academic Credit*), each unit of credit requires a minimum of 45 hours of work by students, including but not limited to, class time, preparation, homework, and studying. For example, for a 3-credit course a student should expect to work at least 8.5 hours each week in a 16-week session and a minimum of 33 hours per week for a 3-credit course in a 4-week session.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conducive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's *Disruptive Behavior in an Instructional Setting* policy at <https://nau.edu/university-policy-library/disruptive-behavior>.

NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited as set forth in the *Consensual Romantic and Sexual Relationships* policy. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's *Nondiscrimination and Anti-Harassment* policy. EAO also assists with religious accommodations. For additional information about nondiscrimination or anti-harassment or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or visit the EAO website at <https://nau.edu/equity-and-access>.

TITLE IX

Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a "Title IX Coordinator" to monitor the institution's compliance with this important civil rights law. NAU's Title IX Coordinator is Elyce C. Morris. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3515, by fax at 928-523-0640, or by email at elyce.morris@nau.edu. In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <https://in.nau.edu/title-ix>.

ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

MISCONDUCT IN RESEARCH

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University's Research Integrity Officer, Dr. David Faguy, who can be reached at david.faguy@nau.edu or 928-523-6117. More information about misconduct in research is available at <https://nau.edu/university-policy-library/misconduct-in-research>.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

Last revised August 1, 2021

