

ASTR 170 B1 – The Physical Universe - Section 001

Spring 2022

Class Time: Tuesday and Thursday: 11:00 AM – 12:15 PM

Class Location: Steward Observatory Room N210

Description of Course

“The Physical Universe” course provides a detailed investigation of the Universe. You will learn how an understanding of light, matter, force, energy, heat, and temperature can be used to develop explanatory models for the origins and behavior of planets, stars, galaxies, space, and time. Through your investigations you will develop possible answers for fundamental questions like - How did it all begin? Where do we come from? Are we alone? What does the future hold for the Universe?

Course Prerequisites or Co-requisites

None

Instructor and Contact Information

Dr. Edward Prather

Office: Steward Observatory RM 350

eprather@arizona.edu

520-621-6530

Office Hrs: To be announced

Teaching Assistants: Charity Woodrum, cwoodrum@email.Arizona.edu

Help Sessions: To be announced, see D2L

Required Texts or Readings

- *Lecture-Tutorials for Introductory Astronomy*, Fourth Edition. BRING LECTURE-TUTORIAL BOOK TO CLASS EVERYDAY!
- *Homework for Introductory Astronomy*, Edward E. Prather, Daniel Loranz, and Gina Brissenden, 2016 (available in the UA bookstore in the notes section).

Course Communications

All information about this course is communicated through a combination of the Syllabus, announcements provided on the course D2L site, information provided in the Powerpoint slides, and announcements made in-class.

Course Learning Outcomes

Upon completion of this course, students will be able to:

- understand the nature and application of physical science
- apply ideas and processes beyond the classroom
- recognize the complexity of many scientific issues
- speak and write about scientific knowledge
- appreciate the relative scale of objects, rates of change, linear and nonlinear growth
- critically analyze and interpret data and results presented in tables, graphs and charts as well as perform appropriate mathematical calculations
- read and understand scientific literature from popular sources such as magazines and newspapers

Course Goals and Objectives

The overarching goal of this course is for you to develop scientifically accurate mental models of the objects, events, and processes of the Universe. This course is designed to help you develop your communication skills, quantitative literacy, critical reasoning ability, and evidence-based problem solving skills. By helping you improve your understanding of the big ideas in astronomy, we hope you will develop a lifelong interest in science and current events surrounding the study of the universe. Additionally, we hope to connect key discoveries in science to your worldview so that you come to appreciate the incredibly valuable role that science plays in society. To meet these goals, I have carefully designed in and out of class activities, learning resources, and assessment strategies as outlined below and in the following sections.

Engaging in student-to-student discourse is a significant component of success in this course. By working in small collaborative discussion groups, you will learn how to interpret, judge, synthesize, and communicate about a wide variety of content central to astronomy. This collaborative work will improve your astronomical thinking so that you can successfully explain your reasoning and defend your ideas about the complex science topics presented throughout the semester. The course will help you develop your quantitative skills through a wide range of predictive and estimation tasks, as well as graphical extrapolations and interpretive tasks using data provided in lecture slides and associated active learning activities. You will increase your data fluency through your generation of discipline representations that explicitly involve creation of tables, graphs and other data representations and science visualizations. Writing is a significant component of success in this course. By repeatedly being asked to create, defend, and evaluate written explanations and narratives, you will develop more expert abilities to write concise and coherent accounts of different science phenomena. Through your outside of class research and in-class historical writings, you will gain confidence in your ability to describe how important science discoveries, advancements in health and medicine, and technological innovations have ended suffering and improved the quality of life of citizens from around Earth.

Course Format and Teaching Methods

*–Active engagement in collaborative learning activities occurs daily and is **REQUIRED**.* There exists significant research to document that students’ intellectual engagement and levels of learning are significantly limited in classrooms that only use lecture, no matter how clear or entertaining. Therefore, we will use a series of mini-lectures that will be augmented by many active-learning activities, including Think-Pair-Share questions, Lecture-Tutorials (LT), Ranking Tasks (RT), Student Representation Tasks (SRT) and on-line Lab investigations. These active-learning activities are designed to promote a deep level of intellectual engagement, as well as foster discourse on specific ideas that are known to be difficult for students to develop a robust understanding of from lecture alone. By working earnestly and collaboratively with your peers, you will develop a more expert-like knowledge of the topics under investigation. A significant emphasis of course homework and exams is placed on assessing how well you are able to explain your reasoning (both verbally and in writing) to the types of questions asked in these active-learning activities. Since the questions in these activities are similar to the questions on course homework and quizzes/exams, you will greatly benefit from working outside of class to be sure you fully understand the answers and the explanations for your answers. You should consider these activities as “ungraded homework” deserving of a significant amount of out-of-class study time. Many students find that working on their LTs, RTs, SRTs Labs and Homework with course teaching assistants in outside of class help sessions to be extremely helpful in preparing for course quizzes and the Final Exam.

COVID-19 Course Policies:

Due to the ongoing COVID-19 pandemic, we must all agree to follow certain protocols in order to conduct our class in-person in a safe and responsible environment. The University of Arizona has already instituted protocols (which may change during the semester). You will find the current protocols under which we will operate at: <https://covid19.arizona.edu/>

We ask you to observe the following protocols to ensure a safe classroom experience:

- If you are feeling ill or in any type of quarantine due to the University's COVID -19 protocols on the day of class, please do NOT come to class. The class presentation will be recorded for you to watch on-line.
- There is another class that meets in N210 before our class. If you arrive early and must wait outside, please remember to social distance.
- There are sanitizing station located throughout Steward Observatory. Please sanitize your hands when you enter the lecture hall and when you exit. Like President Robbins likes to say: "GEL in...GEL out!"

Finally, you will *not* be penalized in this course for being in COVID-19 quarantine or for following standard public health practices. See the "Absence and Class Participation Policy" section for more information about excused absences.

Absence and Class Participation Policy

As outlined in the Course Format and Teaching Methods section above, a significant amount of the course content and course work will be presented and done in-class. Participating in collaborative student discussion, active learning activities, and completing in-class writings are an essential part of course success. As such, attendance at all class meetings is considered mandatory. Missing a significant amount of class meetings will result in a significantly lower overall course grade. This course complies with the UA's policy concerning Class Attendance, Participation, and Administrative Drops (available at:

<https://catalog.arizona.edu/policy/grades-and-grading-system>). Making up missed class work will be handled on a case-by-case basis. If you know you will be missing class and wish to have your case considered for make-up, you are required to communicate the date and circumstances for your absence via an email to the professor at least one week in advance. Students who miss class due to illness or emergency are required to bring documentation from their healthcare provider or other relevant, professional third parties. Failure to submit appropriate documentation will result in unexcused absences. If you are attending a university sanctioned sports or club event you are required to obtain a dean's excuse for this absence. This course complies with the UA policy regarding absences relating to religious belief, observance or practice (see policy at <http://policy.arizona.edu/human-resources/religious-accommodation-policy>), and with the policy regarding absences pre-approved by the UA Dean of Students.

–Participation and Writing is REQUIRED. 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 – and should be considered mandatory. Periodically we will conduct "un-scheduled in-class writings" for participation points. These writings will be completed and collected during class. Additionally we will conduct "scheduled in-class writings". All information about the schedule and topics of the "scheduled in-class writings" will be communicated in-class through lecture, in the course Powerpoint slides (available on D2L), and through announcements posted on the course D2L webpage. In general, you will not be allowed to make up any missed un-scheduled or scheduled in-class writings (see the "Absence and Class Participation Policy" section below for more information on arranging for make-up work related to excused absences). Additionally, working with your group, you will be doing in-class Student Representation Tasks and Lab investigations, which will be turned in during class and graded, contributing to your participation grade. To allow for the unavoidable periodic absences (that naturally arise during the semester) without heavily penalizing your overall course grade, we will calculate your end of the semester participation and writing grade based on the following points/grading scheme:

- 80% or more of participation and writing points – A
- 70% - 79% of participation and writing points – B
- 60% - 69% of participation and writing points – C

50% - 59% of participation and writing points – D

49% or less of participation and writing points – E

This grading scheme is only for your participation and writing grade, not your overall end-of-semester grade (which is calculated from all components of class).

NOTE: YOU DO NOT NEED TO NOTIFY US WHEN YOU ARE ABSENT FROM CLASS (unless you will be using a Dean's Excuse or have the appropriate medical documentation).

Required Outside of Class Activities

During the semester you are required to participate in **ONE** evening of observing the universe using the Steward Observatory public telescope, located in the courtyard of the Steward Observatory building on campus. Observing times are available Monday – Thursday evenings starting at approximately 7:00 PM. You are required to sign up for your observing time before going to the telescope using the observing roster/sign-up sheets located in the main floor (lobby) of the Steward Observatory building. Bring the “*Observing Log*” sheet that is attached to the end of this syllabus with you to the telescope. **You must have the Observing Log stamped by the Telescope Operator.** See further details written on the Observing Log for additional information regarding what to draw and what to write to complete your Observing Log. Note: the Steward Observatory telescope is only open at night, it cannot operate when it is cloudy, and there is a limited number of people who can sign up for any given timeslot. Therefore, we recommend that you sign up early in the semester. Although we recommend that you submit your Observing Log very soon after completing your night of observing, they will also be accepted through **Tuesday, May 3rd (In Class)**. **No late Observing Logs will be accepted for ANY reason past Tuesday, May 3rd.**

Homework Assignments, Quizzes and Examinations: Schedule/Due Dates

Homework is a significant part of course success. A large number of homework problem sets have been provided in the course homework workbook. The purpose of these homework problem sets is to help you access and strengthen your understanding of key course topics and to better prepare you for the course quizzes/exams. The content of EVERY homework problem set will be emphasized on the corresponding quiz/exam. As a result, it is expected that you will work through ALL of the homework problem sets in sequence with the flow of topics presented in the course (see the “In Class Activity Schedule” below). You are required to turn in your best 10 completed homework problem sets from the homework workbook at the end of the semester. You must submit these 10 problem sets in a folder (do NOT use a three ring binder, or a paperclip) with your name and Student ID number CLEARLY written on BOTH the FOLDER and EACH of the 10 problem sets. **The deadline to submit your homework problem set folder is Tuesday, May 3rd, in class. No homework problem sets will be accepted after May 3rd.**

There will be several short quizzes given during the semester, and one cumulative Final Exam given at the end of the semester. All information about the schedule and topics of the in-class quizzes will be communicated through lecture, in the course Powerpoint slides (available on D2L), and through announcements posted on the course D2L webpage. We will finalize the times of each quiz as early as possible. Please do not make any plans that interfere with quiz times once they have been scheduled, as there are no late or make-up quizzes given. **If you need to miss a quiz, you will not be allowed to make up this quiz unless you have a prior approved Dean's excuse or appropriate medical excuse. You cannot be excused from the final exam, and there are no opportunities to take it at a different time.** The University has scheduled the time for the class final exam and this is the only time it is to be offered. During quizzes/exams you must bring a photo ID, you are not allowed to wear headphones, and you are not allowed to communicate with anyone in the classroom except for the course instructors and exam proctors. You must turn in your quiz or exam question booklet and answer sheet immediately upon completing it. Possession of course quizzes or exams booklets outside of class will result in being failed from the course. If you have been certified as needing to take an exam under special circumstances, please make the necessary arrangements with the Disabilities Resource Services Center well in advance of the exam date (at least 10 days).

<u>Dates</u>	<u>Tentative In-Class Activity Schedule</u>
1/13	Introduction, Syllabus
1/18 – 1/20	Newton's Laws and Gravity (LT) Telescopes and Light
1/25 – 1/27	Formation of the Solar System (LT)
2/1 – 2/3	Sizing Up the Planets (LT) Small Objects of the Solar System (Lab) Quiz #1 (tentatively)
2/8 – 2/10	Greenhouse Effect (LT) Luminosity, Temperature and Size (LT)
2/15 – 2/17	Blackbody Radiation (LT) Types of Spectra (LT) Quiz #2 (tentatively)
2/22 – 2/24	Doppler Effect Apparent and Absolute Magnitudes (LT)
3/1 – 3/3	Stars and the H-R Diagram (LT) Stellar Evolution (LT) Quiz #3 (tentatively)
3/8 – 3/10	No Classes: Spring Break
3/15 – 3/17	Extrasolar Planets Transit (LT) Milky Way Scales (LT)
3/22 – 3/24	Galaxy Classification (LT) Dark Matter (LT)
3/29 – 3/31	Looking at Distant Objects (LT) Size and Scale (handout RT) Quiz #4 (tentatively)
4/5 – 4/7	Introduction to Cosmology and Hubble's Law (LT)
4/12 – 4/14	Expansion of the Universe (Lab) Making Sense of the Universe (LT)
4/19 – 4/21	Exploring the observable Universe (Lab) Detecting Extrasolar Planets with Gravitational Lensing (LT)
4/21 – 4/23	Cosmology and Big Bang (LTs) Quiz #5 (tentatively)
4/26 – 4/28	Cosmology and Final Writing
5/3 (Tuesday)	Last lecture day - Wrap up & Review Observing Logs Due Tuesday May 3rd (In Class) Homework Folder Due Tuesday May 3rd (In Class)
5/10	FINAL EXAM Tuesday May 10th, 10:30am – 12:30pm in Room N210

Final Examination

The course cumulative final examination will consist of approximately 50 multiple choice questions that assess content from the entire semester of topics. The date of the final exam is set by the university and no alternative times will be provided to take the exam. The final exam is scheduled for Tuesday May 10th, 10:30am – 12:30pm and will be held in Room N210 of Steward Observatory.

Grading Scale and Policies

Absolute grading (no curves, no competition, and absolutely no extra credit - it is in your best interest to help each other learn astronomy)

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|--------------------------------------|-----|
| 1. In-term Quizzes | 35% |
| 2. Final Exam (<i>cannot drop</i>) | 15% |
| 3. Homework | 20% |
| 4. Participation, Labs and Writing | 25% |
| 5. Observatory Visit/Log | 5% |

90% – 100%	A
80% – 89.9%	B
70% – 79.9%	C
60% – 69.9%	D
≤59.9%	E

No plus or minus grades

Your course grades can be accessed via D2L. There will be absolutely no extra credit. No late work is accepted (unless its for a circumstance that satisfies one of the reasons outlined in the *Absence and Class Participation Policy* section). If you find a mistake with your posted scores, please contact your course TA as soon as possible. It is your responsibility to discover and notify your TA of any grading errors on D2L. All scores to your work in the class are final 72 hours after they have been posted. Please make sure if you have any grading dispute that you contact your TA BEFORE this 72 hour period is over.

Requests for incompletes (I) and withdrawal (W) must be made in accordance with University policies, which are available at <https://catalog.arizona.edu/policy/grades-and-grading-system>

Classroom Behavior Policy

To foster an equitable learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel respected and comfortable with each other and where we can voice our ideas and challenge ourselves. To that end, our focus is on the tasks at hand and not on extraneous activities (i.e. texting, chatting, reading a newspaper, making phone calls, web surfing, etc). We ask that you come to class ready to fully engage and work collaboratively everyday! We also ask that you respect your fellow classmates and their learning.

You are expected to know and follow the University of Arizona Code of Academic Integrity.

See: <https://deanofstudents.arizona.edu/policies/code-academic-integrity>

Students are asked to refrain from disruptive conversations with people sitting around them during class. Your behavior in class must not disrupt the teaching of the class or the learning of other students in class. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will lose course participation points and may be reported to the Dean of Students.

Some learning styles are best served by using personal electronics, such as laptops, tablets, or iPads. These devices can be distracting to other learners and thus their use can degrade the learning environment. Therefore, students who prefer to use electronic devices for note-taking during lecture will be asked to sit in a designated area of the classroom. **Use of laptops, tablets and iPads for purposes that do not relate to the course will result in the loss of course participation points.**

Violation of the course conduct policy carries the following punitive actions: If you use your cell phone or it is visible, OR you choose to use your laptop/tablet for any reason other than for the purposes stated above, OR your behavior is determined by your professor or the course graduate teaching assistants to be disruptive to the learning of other students during class, you will be asked to provide your name and Student ID Number and you will lose one day of participation points. **If your behavior is in violation of this course conduct policy three times during the semester, you will FAIL THE CLASS.**

We consider academic dishonesty, including cheating, plagiarism, and fabrication, as defined in the UA Code of Academic Integrity, to be a serious offense and the maximum punishments allowed will be pursued in all

scenarios. This includes content on writing assignments, homework assignments, or scantron forms. If nearly (or totally) identical work is submitted by more than one student, all parties involved may receive the maximum punishment for plagiarism and/or cheating. Your work must be unique and original. Again, note that you should never take a quiz/exam booklet or Scantron outside of the classroom for any reason. Possession of course quizzes or exams outside of class will result in being failed from the course.

Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself.

See: <https://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>

Accessibility and Accommodations

Our goal in this classroom is that learning experiences be as accessible, equitable and as inclusive as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations. For additional information on Disability Resources and reasonable accommodations, please visit: <http://drc.arizona.edu/>

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination, <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a respectful, tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at:
<https://policy.arizona.edu/faculty-affairs-and-academics>

Student Assistance and Advocacy information is available at:
<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

The University of Arizona provides a wide variety of resources to help you feel more at home in the UA environment. Examples of student resource/cultural centers include:

- The African-American Student Center
- The Asian & Pacific American Student Center
- The Guerrero Student Center
- The Immigrant Student Resource Center
- The LGBTQ+ Student Center
- The Native American Student Center
- The Transfer Student Center
- The Veterans Education and Transition Services Center

- The Women & Gender Resource Center

We encourage you to take advantage of the community, support, and learning opportunities afforded by these centers, and to encourage your friends and colleagues to do the same.

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

ASTR 170 B1 Observing Log

Telescope Operator Stamp

Name: _____

Student ID: _____

Observing Date: _____

Drawing(s) of what you observed	

Use the space below AND the back of this page to provide a detailed description of the objects you viewed (as if you were describing what the objects looked like to a person who had his/her eyes closed). Include the time of your observation, the direction you were looking, important names and labels. Describe the appearance of the objects, including how they may have looked different than your expectations.

ASTR 170 B1 – The Physical Universe
STUDENT INFORMATION AND AGREEMENT SHEET

Name _____

Student ID Number _____

Local Telephone Number _____

Email Address (*if checked regularly*) _____

By signing below, I acknowledge I understand that:

- (a) The policies, rules, regulations, dates and deadlines outlined within this course syllabus apply in all ways directly to me and my conduct in the course.
- (b) This course has scheduled in class examinations and a final examination as shown in the syllabus and listed in the University course/examination schedule, and I will not make plans that interfere with these scheduled examinations. In addition, I will bring my photo-student ID and a pencil to each examination and show my photo-student ID to a test administrator if asked.

Signature

Date