

# Physics & Astronomy 107 – Elementary Astronomy – S

## Spring Semester 2023 – 3 Credit Hours

### Online Learning

#### Instructor

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Video Conference: by Zoom or Blackboard Collaborate on request

This class is entirely online. It uses content that we provide from our own servers, a free textbook, and the University's Blackboard system for testing and grades. Your work will be at your own pace whenever you want to do it each week. There are no scheduled class times. However, the course has weekly assignments which are required. See the section below about how to begin your class.

The astronomy class has a teaching assistant who helps me with grading and who will also will help you if you need assistance. When the contact information for your assistant is available it will be added to the Blackboard site as well.

There is a discussion forum on our class website where questions that others may have should be asked and answered. When you need assistance try University email rather than a phone call, and always put the course name "107-50" on the subject line. While phone calls and video conferences are other options, email is the best one for us if it works for you.

#### Objectives

This course examines the entire universe, as observed today with the instruments of modern technology, and as explained with the ideas of physicists and astronomers. It meets the University's Cardinal Core Requirements for a three hour Natural Science course. There is a separate optional Physics 108 laboratory, also offered online.

As with other Cardinal Core Natural Science classes, the objective of this course is to incorporate astronomy into your critical thinking skills, and to understand how the methods of science work. We will do that by exploring how physics and astronomy help us unravel the underlying mysteries of the Universe, and to

1. Help you understand (and cope with) astronomy encountered in everyday life: seasons, solar energy, and the GPS in your cell phone.
2. Provide a basis for understanding the latest developments about astronomy you will hear in the news.
3. Recognize that while physics does not fully explain the universe, it does predict the effects of intangible invisible things, even though nobody knows what they really are

... yet. (That is, not to fret when something seems incomprehensible, since science still does not explain everything, has to rely on predictable behavior of invisible things such as gravity, and depends on the properties of space, time, and fundamental particles which nobody completely understands.)

4. Present you with mysteries not yet solved, or with contradictory or untested theories, so that you may solve them in the future and win a Nobel Prize or have fun trying. (There is plenty of astronomy, not to mention physics, that we do not yet know.)
5. Teach physics and astronomy that you may apply to make life better for yourself and others now, and in the future.
6. Open your mind to new discovery by knowing that the universe should be understandable.

## Cardinal Core Outcomes and Assessments

Natural Sciences are concerned with understanding the laws of nature and the physical world. Students who satisfy the Cardinal Core requirement for Natural Sciences will be able to do all of the following:

1. Demonstrate an understanding of the nature and methods of science inquiry.
2. Apply scientific principles: to interpret evidence, to make predictions, and/or to explain cross-cutting concepts in one or more of the sciences.
3. Explain how scientific principles relate to issues of personal and/or societal importance.
4. Communicate effectively an understanding of scientific concepts and experimental outcomes in speech or writing, using sound scientific terminology and citation appropriate to the discipline.

In this course these outcomes will be assessed through weekly quizzes and two longer tests. A monitored online forum for class discussion of topics posed both by students and by the instructor will encourage students to develop their knowledge, deeper understanding of the science, and the skills to communicate effectively with others.

### Outcome 1

*Demonstrate an understanding of the nature and methods of science inquiry.*

The course covers how we have come to understand the entire universe and its evolution. This embodies many of the key discoveries of physical science from prehistoric measurements of seasons and eclipses through the most recent observations of gravitational waves. Understanding the roles of individual scientists and their contemporaries, the methods enabling their discoveries, how their knowledge was communicated, and the current process of scientific enterprise, is part of the course content and is tested in quizzes and exams. Additionally, thoughtful questions posed to others in the class are encouraged to engage one another in analysis of the topics at hand, and to develop communication skills.

## Outcome 2

*Apply scientific principles: to interpret evidence, to make predictions, and/or to explain cross-cutting concepts in one or more of the sciences.*

While astronomy is based on observation and measurement, the analysis of the observations depends on physics. The emphasis in this course is not as much on fact as it is on understanding what those facts tell us about the universe, how we come to those conclusions, and what the uncertainties are in that process. The requisite simple but essential physics is incorporated into the course content. The fundamental ideas of physics and other sciences unify our understanding of the current state of the universe, and allow us to predict or model its future. Examples include the motions of the Earth and other planets in our solar system, the formation of stars and planets, the evolution of the universe from its beginning to the appearance of matter as we know it today, the future of our Sun, and indeed of the entire universe. This content is included on the weekly quizzes and exams as appropriate for the topics at hand.

## Outcome 3

*Explain how scientific principles relate to issues of personal and/or societal importance.*

The role of science in modern society is a topic that recurs throughout this class, especially in the context of space exploration and the costs of large scale scientific instrumentation and research. Other topics of pressing concern are the energy balance of the Earth, including the effects of planetary atmospheres on surface temperatures, the habitable zone around the Sun and other stars, our search for planets and life elsewhere in our Galaxy, and the eventual demise of the Sun and our planet. Special attention is drawn to sunlight as a source of useful power for personal as well as larger grid-scale applications. This content is included on the weekly quizzes and exams, and because it is a culminating application that draws on the entire course content as a foundation, it is emphasized in the exams.

## Outcome 4

*Communicate effectively an understanding of scientific concepts and experimental outcomes in speech or writing, using sound scientific terminology and citation appropriate to the discipline.*

There are required written responses to posed questions on the exams. The topics for these questions are developed in a discussion forum for the class that invites participation by everyone, so that skills to communicate scientific concepts develop during the course when students explain those concepts to one another, and pose questions to their peers. The forum is mentored, and the written responses on quizzes and tests become part of the class grade.

## Requirements

Blackboard and the class website will guide you through weekly topics over the semester, and will pose specific ideas and questions to consider. While you study, you are expected to use the discussion forum with other students in the same way that you would work with one another for any class. This is a very important part of the class and we monitor the forum to see where you are having difficulty. We encourage collaboration and peer instruction because our goal is to have you learn by whatever means you find most helpful, but of course you

must do your own work. We will try to resolve questions you may have for the class as a whole through the discussion forum whenever we can, and to respond to email individually as needed.

Use the discussion forum, take your time to understand, ask questions when you need help, and remember the objective is to learn how to observe, reason, and use your growing knowledge and skill to understand our universe. Individual and group assistance through email, video conferencing, or telephone is available on request.

Each week you should use the class website (see below) to work with new web-based interactive content and suggested readings from the textbook. Take a graded quiz on Blackboard over the week's content any time from Saturday morning through Monday midnight (US Eastern Time) at the end of each week. There will be two longer tests, one at midterm, and one at the end of the course. We will send email reminders weekly about the quizzes and exams.

## Blackboard

The University's Blackboard system is its gateway to support for all of its classes:

<https://blackboard.louisville.edu/>

Use your University *User ID* and *Password* to log into Blackboard. Select the course PHYS-107-50-4232 (Elementary Astronomy - S-Fall 2022) for the latest announcements, the weekly quizzes, and the two exams.

**Start Here** provides guidance the first time and will help if you are new to online classes.

**Announcements** are updated at least weekly with the topic and any new instructions. These are also sent to you by email.

**Assignments** will have your weekly quizzes and exams, available Saturday morning through Monday midnight.

**Content** has the link to our class web server. It is different from Blackboard and requires its own password (see below).

**Tools** is a link provided by the University to many different features of Blackboard and its commercial partners. If we need these (for example Collaborate Ultra) we will also link to them from Content. This tab is overflowing with options, most of which you do not need.

**My Grades** will be updated with recent work when it is evaluated. Your course grade is the average of 3 parts, of which the quizzes are 60% and each test is 20%. You must participate in the class content and discussions as well, so be sure to stay active in the class each week.

**Help** will take you to Blackboard support. Please note that this does not provide help with our class website which we run ourselves. If you need help with it, send an email and we will work with you individually.

## Class website

Content for this course is provided through our server at

<https://prancer.physics.louisville.edu/moodle>

which you may bookmark for direct access during the week, or click on the link in Blackboard for the course under Content.

This resource requires a login with a user ID and password. We create these accounts for you using your U of L ID (something like “ablast01”) which you use for access to university online resources. The list we use is based on Blackboard enrollment and it may lag your enrollment in the class by a day after Friday, January 6. You should send an email to remind us if the following does not work.

When you go to the class site the first time you will be asked to enter a user name and password. For the name use your U of L ID (in the form “ablast01”) For the password use the one we will provide on the Announcements page, and also on the Content link, of your Blackboard class. Once you do this the first time, the server will request that you enter a new password. You may then select your own. You may also edit your personal information on the server if you want to share it with others in the class. The next time you connect you will need to use the password you created. We advise not to use the same password you have on other university accounts for your own protection. Should you forget or need to change your password we will provide another one for you if you request one by email. This server provides records for us of your participation in the class, and we use it for the discussion forum for the course too.

If you are also in another online Physics & Astronomy class this semester you will only need to create a new password once. Once you log in, our site will offer the classes to you that we know you are taking.

## Textbook

While the content will be provided online through the class website, for supplemental help the comprehensive free text for the course is

*Astronomy*, Openstax, 2022, by Andrew Fraknoi, David Morrison, Sydney C. Wolff  
<https://openstax.org/details/books/astronomy-2e>

It is online with current content, interactive features, and also has a downloadable PDF through the above link (“Download a PDF”). A print version is available through the Openstax site links. We have noted recommended chapters in the text for reading but the best approach is to browse the content that seems relevant and try some of the questions there too as a way to see how you are doing.

In many cases, simply by using Google and looking for an appropriate entry in the Wikipedia you can find an answer to basic astronomy and physics questions, and links to far more detail than most textbooks provide. If you follow this suggestion, be selective in accepting answers from Internet resources. Wikipedia has proven to be very reliable, as are the sites supported by NASA, ESA, and ESO. Post your questions to the Discussion Forum. Since often other students have seen the same issue we can work together to find answers and insights.

Information on useful software and other materials will be provided online. No matter what kind of computer you use, there will be tools available for you. Because the class is

entirely online, you will need Internet access and would benefit from a laptop or desktop computer for working with the content and taking quizzes and exams.

## Evaluation and Grading

Required quizzes and exams are administered online through Blackboard. They will evaluate your progress toward meeting the course and Cardinal Core objectives with a variety of question formats, and will include written responses to assess outcomes.

At the end of each week, quizzes will help you to stay current in the course and understand and retain the new material. These quizzes are focused on the material for the week, yet they may also include questions from previous weeks that were often incorrectly answered. The average of quizzes for the course, counting the missed ones as zero, is 60% of your grade.

After 7 weeks, in time for a midterm progress assessment, there is a longer exam over the first half of the course. At the end of the term before the last day of classes another longer exam covers the second half of the course while also reviewing content from the semester. Each of these two longer tests is 20% of your grade. There is no comprehensive final.

Consistent participation in this online class is a course requirement. We monitor your activity on the website that provides course content. You should log in and study the material there using your own ID during the week before you take the quiz, much as you would attend weekly classes in a traditional course. The content is self-paced, and may lead you to explore on your own. While you study it, contribute to the discussion when you have a question or can offer an answer or comment for the benefit of your peers. The course is not passive, and we expect that you will actively engage in it. The quizzes are based on the content we provide which is intended to focus on key ideas for you to understand and retain. The textbook and other online sources have supplementary detail to explore too.

You will receive weekly reminders by email about the quizzes and exams. Always expect one to be available from Saturday through Monday every week. These will appear on Blackboard under assignments during that time. You may check your submitted work by looking at your Grades on Blackboard where a weekly score will be posted after our teaching assistant reviews your work. A common error on Blackboard is to forget to submit your work after you have answered the questions we posed. We cannot read work unless it is submitted.

**This is very important** – you must fully participate in this course, that is, read and study the material, contribute to the discussion forum, take every weekly quiz, and take both longer exams. Given that, final course letter grades are approximately A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69). We use +/- grades within 2 points of these cuts. For example, 85 would be “B”, while 82 would be “B-” and 88 would be “B+”. If you follow your grades on Blackboard, please remember how quizzes and tests are weighted differently. We will provide a midterm grade assessment for you after the first test, and we may reach out to ask if you need help or to offer advice if we see an issue developing. To do well, read and study the content, participate in the discussions at least occasionally, and do not miss taking quizzes and tests when they are scheduled. The assignment of a letter grade based on averages of quizzes and exams is contingent on participation in the class. While we will

try to advise you if we see an issue with non-participation develop, it is your responsibility to study and engage in the course during the week and to be aware of the quiz and exam schedule.

## **Caveats**

We reserve the right to make changes in the syllabus when necessary to meet learning objectives, when new astronomical discoveries occur, or when there is a technical or software issue that requires a change in content or methodology. Any changes will be announced by email and posted in the current online syllabus and schedule.

## **Title IX/Clery Act Notification**

Sexual misconduct (including sexual harassment, sexual assault, and any other non-consensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain confidential support from the PEACC Program (502.852.2663), Counseling Center (502.852.6585), and Campus Health Services (502.852.6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (502-852-5787) or University of Louisville Police (502.852.6111).

Disclosure to University faculty or instructors of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is not confidential under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer.

For more information, see the Sexual Misconduct Guide.

<https://louisville.edu/hr/employeerelations/sexual-misconduct-brochure>

## Getting Started

### What to do Weekly

- Each Monday begins a new topic for that week organized through Blackboard's Content tab.
- You must study content on line, work through it at your own pace during the week.
- You may also read the chapters or sections that are suggested in the textbook.
- You should ask and answer questions on the discussion forum.
- Before the end of day the following Monday, complete the weekly quiz or test on Blackboard for credit.

### Longer Tests

- The first longer test on Blackboard covers the first half of the course at midterm from Saturday morning of that week through the end of day on the following Monday.
- The second longer test on Blackboard covers primarily the second half of the course, though it may draw on material from the first half. It is also from Saturday morning of that week through the end of day on the following Monday.
- The course ends on the last day of classes for the semester. There is no exam during finals week.

### Grades

You must participate in the online course content every week, ask and answer questions on the discussion group, take all the quizzes when they are available, and take the two longer exams. If you do, then the final course grade is based on the quizzes (60%) and the two exams (20%) each.

### Reminders

The class is organized to cover new material each week, so plan your study time with the online material and participate in the forums weekly. Weekly quizzes open on Saturday morning and remain available through Monday at midnight. These are intended to help you review and understand the material and to keep up with the pace of the class. If you go through the online material and read the textbook selections before taking the quizzes you should do well on them, and then you will be prepared for the longer tests and retain the key ideas of the class.

## Schedule and Content

The primary content will be through links on Blackboard under **Content** that will take you to our resources. The chapters here are selected supplemental reading from *Astronomy* by Fraknoi, Morrison, and Wolff. These suggestions may change. Please participate in the online discussions to see what other students find helpful and interesting. Weekly quizzes for credit are on Blackboard from Saturday morning through Monday midnight unless otherwise announced.

### **January 9 - January 15** Constellations

Chapter 2.1: The Sky Above

Star charts and other links online.

### **January 16 - January 22** Sun

Martin Luther King holiday on January 16 - quiz due Tuesday

Chapter 4.1: Earth and sky

Chapter 4.2: The seasons

Chapter 8.4: Life, chemical evolution, and climate change

Chapter 15.1: Sources of sunshine

### **January 23 - January 29** Telescopes & our solar system

Chapter 6.2: Telescopes today

Chapter 7.1: Overview of our planetary system

### **January 30 - February 5** Moon

Chapter 9.1: General properties of the Moon

Chapter 4.6: Ocean tides and the Moon

Chapter 4.7: Eclipses

### **February 6 - February 12** Mars, Jupiter & Saturn

Chapter 10.4: Geology of Mars

Chapter 10.5: Water and life on Mars

Chapter 11.2: Giant planets

### **February 13 - February 19** Asteroids, comets, and meteors

Chapter 13.3: Comets

Chapter 13.1: Asteroids

Chapter 14.1: Meteors

Chapter 14.2: Meteorites

### **February 20 - February 26** Atoms and elements in the universe

Chapter 5.4: Structure of the atom

Chapter 16.2: Mass and energy

Appendix K: The elements

Chapter 18.1: A stellar census

Chapter 18.4: Hertzsprung-Russell diagram

Chapter 20.5: Life cycle of cosmic material

Review for the first longer midterm exam from Saturday through Monday

**February 27 - March 5** Birth, life, and death of stars and their planets

Chapter 21.1: Star formation

Chapter 22.1: Evolution from the main sequence to red giants

Chapter 23.1: Death of low mass stars

Chapter 23.2: Evolution of massive stars: an explosive finish

Chapter 21.5: Planets everywhere

**March 6 - March 12** Beyond our understanding: The universe at large

Chapter 25.3: Mass of the galaxy

Chapter 28.4: Challenge of dark matter

Chapter 28.5: Structure of the universe

**March 13 - March 19** Spring break

There is no new content this week

**March 20 - March 26** Distances and time

Chapter 19.2: Surveying the stars

Chapter 19.4: H-R diagram and cosmic distances

Chapter 26.4: Extragalactic distance scale

**March 27 - April 2** Spacetime, relativity, and gravity

Chapter 24.1: Introducing General Relativity

Chapter 24.2: Spacetime and gravity

Chapter 24.5: Black holes

**April 3 - April 9** The beginning of an expanding universe

Chapter 26.5: Expanding universe

Chapter 29.1: The age of the universe

Chapter 29.2: A model of the universe

Chapter 29.3: The beginning of the universe

**April 10 - April 16** Galaxies

Chapter 26.1: Discovery of galaxies

Chapter 26.2: Types of galaxies

Chapter 29.4: The cosmic microwave background

**April 17 - April 23** The fate of the universe

Chapter 29.3: The beginning of the universe

Chapter 29.5: What is the universe really made of?

Chapter 29.6: The inflationary universe

Review and study for second test at the end of this week

Second longer exam is from Saturday through Monday

**April 24** Last day of classes

All course work is due today

The course does not have a comprehensive final