

**Physics & Astronomy 108 – Astronomy Laboratory - S**  
**Spring Semester 2025 – 1 Credit Hour**  
**Online Learning**

## **Instructors**

### **Faculty**

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### **Teaching assistants**

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## **Quick read**

This class is entirely online. Your work will be at your own pace whenever you want to do it since there are no scheduled class times. However the course has weekly assignments which are required. See the sections below about how to begin your class.

The astronomy lab class has teaching assistants who help me with grading and who will also will help you if you need assistance. There is a discussion forum on Blackboard where questions should be asked and answered. When you need individual assistance try University email rather than a phone call, and always put the course name “108-51” 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.

Go to Blackboard and check out “Start Here” to have access to class content online. There is a lab activity each week based on this content, and work to do and submit on Blackboard. You will receive email reminders when it is due. For the rest, skip to the **Requirements** at the end, or read on for the details.

## **Objectives**

This course offers a “hands-on” opportunity to learn by exploration and discovery how physicists and astronomers have arrived at their current understanding of the universe. There will be experiments you will do on your own at home, guided exercises with web-based resources, and use of images and data from the university’s telescopes in Kentucky, Arizona, and Australia. Our overall objective is for you to learn how thoughtful reasoning about experiments and observations is the foundation of physics and astronomy. It meets the University’s Cardinal Core Requirements for a Natural Science laboratory. There is a separate Physics &

Astronomy 107 “Elementary Astronomy” course which should be taken concurrently or before taking this lab. In some semesters it may also be offered in a fully online format, but this lab and the course are separate.

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 itself still does not explain everything, and has to rely on predictable behaviors of invisible things such as gravity and the properties of the 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 activities that require written responses to questions, and analysis of observations and measurements. A monitored online forum for class discussion of topics posed both by students and by the instructor will encourage you to develop your knowledge, a 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 many interactive examples of how we have come to understand the entire universe and its evolution. From the simplest visual observations of the sky, to working with real scientific data representative of that leading to paradigm shifting discoveries, you will come to understand the contributions of individual scientists and their contemporaries, and the current process of scientific enterprise. Thoughtful questions posed to others in the class are encouraged to engage one another in analysis of the weekly activities of the lab, and to develop communication skills. Each week you complete your work by submitting answers to questions we have asked, and explaining what you understand about the methods and results of that week's study.

## **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 these observations depends on physics. The emphasis in this course is not as much on fact or measurement of a specific quantity, 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 activities as needed, along with predictions based on knowledge of the current and past universe that result from applying science and reasoning to a realm of time and space far from the present day on Earth. Many of the experiments are designed to develop an understanding of how we came to the knowledge we have, and to use that process as a tool. An example would be determining the mass of Jupiter from the motions of its satellites while using those observed motions to predict where the satellites would be in the future. Another would be using measurements of supernova to find the behavior of exploding dying stars, and in turn applying that knowledge to infer the distance to other galaxies in which such supernovae are found. Each week the activity involves gathering data, interpreting it, and explaining it with the foundational science that is incorporated into that work.

## **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 from the relevance of the Sun, Earth and seasonal cycles to our life, and the environment of our planet in the solar system. Our calendar and precision time keeping has been a core component of astronomy since prehistoric times, and in the first activities of this laboratory class you will learn how the daily and annual changes you can see in the sky enable predictions of climate useful for agriculture. You will see how telescopes determine where we are in the universe, the age of the Sun, and ultimately the fate of the Earth. In exploring Mars through robotic spacecraft, you will find how the society's investment in large scale science returns deeper understanding of the origins of life here and potentially elsewhere. Your understanding of these concepts is assessed by questions you answer weekly. While some reflect a measurement or analysis result, many require a written thoughtful response explaining the principles and methods. Additionally, your comments on the class forum will

engage others in discussing the relevance of the things you are learning to your life and to society.

#### **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 every week to the scheduled work. You are expected to convey your understanding of the concepts underpinning the work, and how the experimental or observational results are interpreted and analyzed. Of course this includes also explaining problems you encountered, and resolving difficulties in the same way that science is done today on the most cutting edge topics. The written responses are assessed and become part of the course grade. There is a mentored 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.

A part of this class is to use data from our telescopes and from observatories in space to explore an idea or object that interests you. You will be asked to explain what caught your interest, what you expect to learn, and then to use that data to arrive at an explanation that places it in the context of what you knew before.

In addition to real-world experiences and measurements that are dependent on astronomy, we will guide you through the use of astronomical instruments to understand how we acquire scientific knowledge, even taking a close up look at Proxima Centauri, the Sun's nearest neighbor with a planet that is potentially habitable.

#### **Requirements**

The class website will guide you through experiments or observations on different weekly topics over the semester, and will pose specific questions to answer. While you may work on these on- or off-line, your responses will be entered online interactively on Blackboard and will be graded. We reserve the right not to accept work that is late, but please let us know when you need extra time.

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 participate in the activities to gain an understanding of the science, and 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 on Blackboard, 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 solve problems. Individual and group assistance through email, video conferencing, or telephone is available on request.

## Blackboard

The University's Blackboard system is the University's gateway to Distance Education programs:

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

Use your University *User ID* and *Password* to log into Blackboard. Select the course (Elementary Astronomy Laboratory) for the latest announcements, a discussion forum, find links to the class website, and to submit the weekly work.

**Start Here** under Course Content provides guidance the first time and will help if you are new to online classes. It includes the syllabus, information about the faculty, and a guide on what to do weekly.

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

**Assignments** under Course Content is where you submit your work for the week by answering the questions asked there. Each assignment is due before Monday midnight of the week following the topic.

**Week One to ...** entries are for each week of the semester with the topic and content for that week that will take you to our class content server outside Blackboard.

**Gradebook** will be updated by Blackboard with assessments of recent work as it is evaluated. Your course grade is the average of all labs. Be sure to stay active in the class by participating in the class website and submitting your work on time for assessment weekly.

**Discussions** is the Blackboard forum for this class.

**Messages** provides an online message service with an email copy to the instructors. We may reply directly by email.

## Class website

Content for this course is provided through our server that is independent of Blackboard. You should access the server through the weekly links for content on Blackboard. You may notice that you are a guest user, and that no login is required. However, Blackboard tracks your access to the content so that we will be alerted if you do not work on the assignments weekly. To avoid issues with your activity in the class, be sure to use your own Blackboard account when working on the course and its assignments.

## Textbook and resources

The content will be provided entirely online through the class website. There is no specific textbook for this lab class. For supplemental help, try comprehensive free Astronomy text online

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

In many cases, simply by using a Google search and looking for an appropriate entry in the Wikipedia you can find an answer to basic physics and astronomy 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, or ESO, and the selected links we offer. Artificial intelligence services (e.g. ChatGPT or Google Gemini) may also be useful, but be wary because their responses may be too creative. When in doubt, seek out and compare the most authoritative sources.

Information on useful software and other materials will be provided online. Access to a desktop, laptop, tablet, or Chromebook rather than a cellphone may be necessary for some of the required work.

## Help and discussions

When you have questions or need help, please use our Discussion forum on Blackboard. Often other students have seen the same issue and will know the answer. If not, we can work together to find one. Of course you may also send us questions or comments by email. If you participate in a forum or group outside of Blackboard, then we will not be aware of issues or be able to respond to them. Our Department of Physics & Astronomy operates a “Physics Learning Center” with daily hours for those on campus who need help in-person. See the Announcements on Blackboard.

## Evaluation and grading

While you will receive email reminders, the course is self-paced. You should plan to complete one experiment each week, and to respond to the weekly lab assignment about that experiment on Blackboard. You may do the work at any time during the week, and you may return to Blackboard’s Assignment section to modify your answers until it is finally submitted for our review. Weekly work is always due by Monday midnight of the following week since you have all week to complete it.

Although the initial scoring of most questions is done in part automatically, there are some that require you to write an answer which we will read and evaluate. Consequently, there will be a delay after you submit your work before we can provide an assessment. If we see an issue about what you have submitted, we may advise changes that would improve your score. Our purpose is to help you learn and understand by observation and reason, not to hear an echo of a precisely “correct” textbook answer. You will have an opportunity during the week after the score is posted to submit a revision. Current assignments and those which remain open for followup work will appear on Blackboard under “Assignments”.

There are 14 activities this semester and your completion of each one contributes equally to the course grade. **This is very important** – you must fully participate in this course, that is, read and work on the labs weekly and contribute to the discussion forum to have help and interact with other students. Given your weekly participation, we will average all of your work and assign letter grades using the plus/minus system. Because work not submitted is scored as "0", keep up with the weekly cadence. Anticipate that the grading scale is A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69), and that we use +/- grades within 2 points of the cuts for the letter grades. For example, on this scale 85 would be "B", while 82 would be "B-" and 88 would be "B+". A missed assignment counts as zero and would have a significant effect on your course grade.

## Getting started

To begin your class, go to Blackboard and check out the latest announcements, then click on *Getting Started*. Follow the directions to the class website for the week's assignment with an activity, step-by-step guide, and questions to consider. Complete the work, taking notes as you go, and then return to Blackboard. For each week take a quiz about the activity. There is no time limit on the quiz, so submit it only when you are satisfied with your answers. The quiz is due before the end of the day the following Monday, even when the week has a break or holiday.

## 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/sexualharassment/procedures/>

## What to do weekly in your online astronomy lab class

- Each Monday begins a new activity for that week with content linked from Blackboard.
- Follow the instructions on the class website for the work at your own pace.
- Ask and answer questions in the discussion forum on Blackboard when you need help or can offer advice to others. We encourage collaboration, so learn from one another, and then submit your own work on Blackboard.
- Before end of day the following Monday, complete the “Assignment” by responding to the questions on Blackboard for that week.
- After we have evaluated your work, you may optionally return to it again during the following week to revise and resubmit it. Labs will be open to revision for at least two weeks after the initial due date.

**6 January - 12 January** Observe the sky

**13 January - 19 January** Identify constellations

**20 January - 26 January** The Earth rotates

**27 January - 2 February** Artificial satellites and near-Earth objects

**3 February - 9 February** Our dynamic Sun

**10 February - 16 February** Earth’s Moon and eclipses

**17 February - 23 February** Explore Mars

**24 February - 2 March** Your eyes and vision

**3 March - 9 March** Light and telescopes

**10 March - 16 March** *Spring Break*

**17 March - 23 March** Use an astronomer’s camera

**24 March - 30 March** Planets and their satellites

**31 March - 6 April** Proxima Centauri: Our nearest neighbor with planets

**7 April - 13 April** Virgo’s galaxies

**14 April - 20 April** Under the southern sky in Namibia

**21 April - 27 April** Last day of classes April 23

All course work is due on Wednesday

The lab course does not have a comprehensive final