

# Physics & Astronomy 108 – Astronomy Laboratory - S

## Spring Semester 2024 – 1 Credit Hour

### Online Learning

#### Instructor

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This class is entirely online. It uses content we provide from our own servers, a free supplementary textbook, and the University's Blackboard system for submitting your assignments and managing grades. Your work will be at your own pace whenever you want to do it. 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 class has teaching assistants who help me with grading and who will also will help you if you need assistance with the activities. When the contact information for them 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 individual assistance try University email rather than a phone call, and always put the course name "108-50" 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 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 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 dis-*

*cipline.*

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, 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 link to the class website, and to submit the weekly work.

**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** is where you submit your work for the week by answering the questions asked there. It is due before Monday midnight of the following week.

**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 all labs. You must participate in the class content before answering the questions that determine your score, and also contribute to discussions about the work. Be sure to stay active in the class by participating in the class website and submitting your work on time for assessment weekly.

**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 “abwxyz01”) which you use for access to university online resources. The list we use is based on Blackboard enrollment and it may lag your new enrollment in the class by a day. You may 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 does not store grades, but it 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 taking another online Physics & Astronomy class using this server this semester you will only need to create a new password once. Once you log in, our site will offer to you the content for classes that we know you are taking. Send an email if you think something is amiss.

## Textbook

The content will be provided online through the class website. There is no specific textbook for this lab class. 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.

Information on useful software and other materials will be provided online. Access to a desktop, laptop, tablet, or Chromebook rather cellphone may be necessary for some of the required work. If you have problems with class content or software, please use our class website and post your question to the discussion forum. Often other students have seen the same issue and will know the answer, or if not, we can work together to a solution. For supplemental help, try comprehensive free text

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

## 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.

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 occasionally. Given that, we will average all of your work and assign letter grades using the plus/minus system with 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 the cuts for the letter grades. For example, 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.

## **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/>



# Getting Started

## What to do Weekly

- 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 the class website when you need help or can offer advice to others. We encourage collaboration so learn from one another.
- 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.

**January 8 - January 14**    Observe the sky

**January 15 - January 21**    Identify constellations

**January 22 - January 28**    The Earth rotates

**January 29 - February 4**    Our dynamic Sun

**February 5 - February 11**    Earth’s Moon

**February 12 - February 18**    Explore Mars

**February 19 - February 25**    Light, vision, and telescopes

**February 26 - March 3**    Use an astronomer’s camera

**March 4 - March 10**    Jupiter and its satellites

**March 11 - March 17**    Spring break

**March 18 - March 24**    View the universe with astronomical telescopes

**March 25 - March 31**    Proxima Centauri: Our nearest neighbor with planets

**April 1 - April 7**    Virgo’s galaxies

**April 8 - April 14**    Solar eclipses (April 8, 2024 !!)

**April 15 - April 21**    Under the southern sky in Namibia

**April 22**    Last day of classes

    All course work is due today

    The course does not have a comprehensive final