

Viewing: **ASTR 122 : Stars and Galaxies**

Last approved: 02/02/23 3:50 am

Last edit: 02/01/23 4:09 pm

Catalog Pages
referencing this course

[ASTR - Astronomy](#)

Programs referencing
this course

[0333: Astronomy Minor](#)

[10KL0040BS: Food Science & Human Nutrition: Human Nutrition, BS](#)

[10KP0112BS: Computer Science, BS](#)

[10KV0333BSLA: Astronomy, BSLAS](#)

[10KV3879BSLA: Geology: Teaching of Earth Science, BSLAS](#)

History

1. May 29, 2015 by Amy Elli (amyelli)
2. Jun 10, 2016 by Amy Elli (amyelli)
3. Feb 2, 2023 by Teresa Spence (tcspence)

General Information

Effective Term:

College: Liberal Arts & Sciences

Department/Unit: Astronomy (1430)

Name (ORG Code):

Course Subject: Astronomy (ASTR)

Course Number: 122

Course Title:

Abbreviated Title: Stars and Galaxies

Course

Description:

Introduction to celestial objects and phenomena beyond the Solar System, and their governing basic physical principles; galaxies, quasars, and structure of the universe; dark matter and dark energy; the Big Bang and the fate of the universe; the Milky Way; the interstellar medium and the birth of stars; stellar distances, motions, radiation, structure, evolution, and remnants, including neutron stars and black holes. Emphasis will be placed on problem-solving and scientific methods.

Justification

Justification for change:

Please Note: a syllabus is
required for General
Education review:

Course Information

Course Credit

Course credit:

Undergraduate: 3

Graduate:

Professional:

Registrar Use

Only:

Banner Credit: 0 OR 3

Billable Hours: 0 OR 3

Grading Type

Grading type: Letter Grade

Alternate Grading
Type (optional):

Available for DFR: No

Repeatability

May this course
be repeated? No

Credit Restrictions

Credit

Restrictions:

Credit is not given for ASTR 122 if credit in either ASTR 100 or ASTR 210 has been

earned.

Advisory Statements

Prerequisites:

Concurrent
Enrollment
Statement:

Restricted
Audience
Statement:

Cross-listing

Cross Listed
Courses:

Class Schedule Information

Class Schedule
Information:

ASTR 121 and ASTR 122 cover the same topics as ASTR 100, but the material and topics are covered in much more depth over two semesters instead of one. ASTR 121 and ASTR 122 are independent offerings and can be taken in any order. While ASTR 121 and ASTR 122 are for non-science majors, problems solving with basic algebra is required. Science and astronomy majors should take ASTR 210.

Fees

Is a fee requested No
for this course?

Course Description in the Catalog Entry

This is how the above information will be represented in the Catalog:

Introduction to celestial objects and phenomena beyond the Solar System, and their governing basic physical principles; galaxies, quasars, and structure of the universe; dark matter and dark energy; the Big Bang and the fate of the universe; the Milky Way; the interstellar medium and the birth of stars; stellar distances, motions, radiation, structure, evolution, and remnants, including neutron stars and black holes. Emphasis will be placed on problem-solving and scientific methods.

Course Information: Credit is not given for ASTR 122 if credit in either ASTR 100 or ASTR 210 has been earned. Students with credit in PHYS 211 are encouraged to take ASTR 210.

Additional Course Notes

Enter any other course information details to be included in the catalog:

Students with credit in PHYS 211 are encouraged to take ASTR 210.

Course Detail

Frequency of course:

Every Fall

Every Spring

Duration of the course Full

Anticipated Enrollment: 180

Expected distribution of student registration:	Freshman:	Sophomore:	Junior:	Senior:
	N/A %	N/A %	N/A %	N/A %

General Education

General Education Category Quantitative Reasoning II
Physical Sciences

General Information

Is the course required for a major concentration? No

Is the course part of a sequence? No

What is the frequency with which the course will be offered?:
(For Example: every semester, once a year)

Every semester.

Briefly describe how the course fulfills the General Education objectives:

The historical evolution of our knowledge of stars and galaxies from ancient times to the present, and where those objects fit in our understanding of the universe, is an integral part of the course. This affords the students the opportunity to learn how critical thinking and quantitative (deductive) reasoning is used to: (1) separate

scientific fact from conjecture or dogma; (2) test the applicability of physical laws, established or confirmed through laboratory experiments, to objects and phenomena in the cosmos far beyond our physical reach; and (3) apply the acquired critical thinking and quantitative reasoning in homework and other activities (e.g., discussion and observing sessions) to solve problems and discover the best possible (more often than not unique) answer to each. Although done in the context of acquiring knowledge about stars and galaxies, the rigorous thinking process and its application to the separation of fact from fiction go far beyond astronomy (or science in general). They provide students the means to use their minds creatively, but in a disciplined manner, to become informed and productive citizens.

Women have been making significant, often ground-breaking, astronomical discoveries for more than a century. This research and results, as well as those achieved by astronomers of color and members of underrepresented minorities, are incorporated in Astr122 through images, graphs, and past and present announcements of discoveries in the news.

Describe the instructional format and provide special justification, if necessary:

Two lectures/week by a professor, and one discussion session/week led by a TA (emphasizing problem solving through mathematics, quantitative reasoning, and both written and oral communication of the results).

Describe the means by which the Communication Skills goal will be achieved:

Written homework/exercises require either clear mathematical answers, or physical explanations of quantitative results, or both (see attached samples, labeled 02-Astr122_Homework_Example, and 03-Astr122_Discussion_Activity_Example). The discussion sessions also add an oral dimension to such communication. Moreover, students participate in moderated forums in which they collaboratively annotate the textbook and discuss the weekly course reading assignments. These assignments are used to improve students' science literacy and communication skills by encouraging them to engage with one another and the course material to create a collaborative learning experience (see attached sample labeled 05-Astr122_SP22_Moderated_Discussion_Example.pdf).

Describe how evaluation and adherence to General Education guidelines will be monitored:

Please indicate the timeline for such evaluations

Instructors submit course reports and documents at the end of each semester. These are monitored and reviewed periodically by the department chair and the curriculum committee. A recent Exam example, part of documents used to monitor the quantitative nature of the course, is attached (see 04-Astr122_Exam_Example.pdf).

Indicate those who will teach the course and describe procedures for training & supervising teaching assistants:

Bryan Dunne, a recognized excellent teacher of elementary astronomy courses, has been teaching the course for the last 6 years. Any other professor assigned to this course will have Dr. Dunne's detailed documents available, as well as his assistance as may be needed. The professor meets with the TAs once a week to discuss how to best run the discussion sessions and solution of assigned problems.

Quantitative Reasoning II

Which type of course is this?

Mathematics

If the course incorporates mathematics show how at least 25 percent of the course content and graded material incorporates either calculus, or mathematics for which calculus is a prerequisite, or college-level mathematics emphasizing logical thought processes as opposed to memorization or manipulation of mathematical formulas.

Astr122 incorporates mathematics that involves logical thought processes and insightful interpretation of mathematical concepts to analyze and understand fundamental observations of objects and phenomena in the Universe.

The Attachment 03-Astr122_Discussion_Activity_Example.pdf is a typical discussion worksheet. In the worksheet, students are using a property of the blackbody radiation from stars (i.e., that temperature is uniquely related to color) and the Hertzsprung–Russell diagram to (1) correlate the color with the luminosity of each star, (2) derive each star's physical properties, and (3) determine, for example, which of the observed stars are hotter, and which will burn hydrogen longer. Moreover, in the case of observed stellar clusters, the students can decide which clusters are older and which younger. Exercises that require such synthesis and application of multiple concepts to arrive at conclusions and understand the evolution of stars is an advanced concept, based on strong mathematical principles, which are approached differently than in Astr100, thereby differentiating the two courses.

Attachment 02-Astr122_Homework_Example.pdf is a typical homework assignment. In this exercise, the students learn how to decode electromagnetic radiation to arrive at conclusions concerning the physical nature of the objects that emitted it. (This is the main way astronomers learn about objects and phenomena in the universe, as well as about the universe as a whole.) In question 7 of this example, the students have to couple intuitive understanding and mathematical formulation in order to obtain the correct answer. Plugging numbers in any one equation would not work – not enough numbers are given for this approach. The result is a better intuitive as well as mathematical understanding of the relation between the energy emitted by an object and its temperature.

In problem 13 of the same homework assignment, the students are expected to bring

together multiple concepts (the basic structure of atoms, what causes emission or absorption of radiation, the mathematical understanding of what determines the energy of an emitted or absorbed photon, and interpretation of a diagram) in order to answer the question. This approach does not limit the students' knowledge to a qualitative, descriptive understanding of astronomical objects and phenomena. It gives them a deeper and longer-lasting understanding of astronomy.

Finally, we give another example from Attachment 04-Astr122_Exam_Example.pdf, an exam. To provide the answer to problem 6, students have to bring together multiple mathematical equations that explain (through a simplified description of Einstein's theory of general relativity) gravitational time dilation. The last concept is important for placing GPS in context, as well as for understanding gravitational redshift, which is critical for interpreting observations of distant galaxies.

Altogether, mathematical based content, such as the examples listed above (and a significant fraction of the homework, lab, discussions, in-class questions, and exams) makes up more than 25% of the graded material.

Natural Science & Technology - Physical Sciences

Show that the course presents the fundamentals of the science, or has as a prerequisite a college course in the fundamentals of the science.

Astr122, being an introduction and survey of the Universe beyond the solar system, covers the fundamentals of science directly. As can be seen in the attached Syllabi, Weekly Schedules (for Fall 2021 and Spring 2022), and examples, the topics covered range from motions of the night sky, fundamental physics necessary to infer astronomical properties (i.e. gravity, light, and motion), properties, structure, and evolution of stars, properties of galaxies (including our Milky Way), the expansion, and acceleration of the expansion, of the Universe, the Big Bang, and the end of the Universe. In most cases, we also provide the historical context of the discoveries, which exemplifies the process of science (from the Copernican revolution to the discovery of Dark Energy).

Show that the course emphasizes the scientific method, including making observations, evaluating data, and solving problems.

Throughout the course, the students learn how we acquire our knowledge about stars, galaxies, and other objects in the universe, not merely what those objects are. Moreover, the students learn how a combination of observations and theoretical calculations allows us to understand how those objects behaved in the past as well as to predict how they will evolve in the future. The course emphasizes the scientific method through examples (e.g., why the most massive stars are called O stars, instead of A stars, which is due to classification before we understood the science behind the

classification). In addition, computer-lab exercises illustrate modern astronomical techniques, which, coupled with the hands-on night observing (e.g., see attached 06-Astr122_Night_Observing_Worksheet_2.pdf), allow students to obtain, analyze, evaluate data, and solve problems. Lectures and discussion sessions allow students to acquire knowledge of the scientific principles and methods of astronomy and, then, apply that knowledge to solve problems in homework and other exercises, as well as with actual observations.

Additional Course Information

Does this course replace an existing course? No

Does this course impact other courses? No

Does the addition of this course impact the departmental curriculum? No

Has this course been offered as a special topics or other type of experimental course? No

Will this course be offered on-line?
Online and Face-to-Face

Faculty members who will teach this course:

Bryan Dunne, a recognized excellent teacher of elementary astronomy courses, has been teaching the course for the last 6 years. Any other professor assigned to this course will have Dr. Dunne's detailed documents available, as well as his assistance as may be needed. The professor meets with the TAs once a week to discuss how to best run the discussion sessions and solution of assigned problems.

Course ID: 1001100

Comments to Reviewers:

Course Edits
Proposed by:

Key: 1356