

The Liberal Arts and Sciences (LAS) program learning outcomes are under review but no changes have been approved at this time. Please refer to the section on the LAS degrees for more information on the review process.

The program learning outcomes for Liberal Arts and Sciences that are applicable to the Astronomy sequence (AST 111-112-113) are:

- Communicate the significance of facts, concepts, and ideas in spoken and written English which is clear, precise and logical.
- Demonstrate a problem-solving capability through analysis/synthesis.
- Recognize the ways in which a scientific approach can be used to formulate an understanding of the observable world.
- Demonstrate an academic proficiency comparable to students completing the second year of a baccalaureate degree program.

b. End-of-sequence learning outcomes for Astronomy

In order to complete the sequence successfully the student should be able to do:

- Describe the major patterns and movements of the Sun, Moon, Planets and stars.
- Discuss the formation of the solar system and describe the major physical characteristics of each planet.
- Describe the minor bodies of the solar system (moons, asteroids, comets and meteoroids).
- Discuss the physical characteristics of the stars and the Sun (mass, temperature, radius, luminosity) and the relationships among these variables.
- Discuss the stages of evolution for stars of various masses and describe the properties of stellar remnants (white dwarfs, neutron stars and black holes).
- Discuss the properties of galaxies including the Milky Way.
- Discuss the history and possible futures of the universe.
- Discuss the history of astronomy including historical beliefs and major contributions to the field of astronomy.
- Discuss the night sky, how it appears from earth, and how constellations and coordinate systems are used to locate objects in the sky.
- Discuss the nature of gravity and electromagnetic radiation (including visible light).
- Describe the major types of telescopes and discuss how astronomers use them along with various detecting instruments to study celestial objects.

The study of any branch of mathematical sciences, including astronomy, should help students to develop certain skills, including problem solving and critical thinking. Some of the competencies students who finish the three-quarter astronomy sequence should be able to demonstrate include the following:

- The ability to grasp very large and very small numbers, to display these numbers in proper scientific format, and to manipulate them with the aid of a scientific calculator.
- The ability to solve for unknown quantities, given the values of other related quantities and the relationships between them

- The ability to analyze scientific data, both measurements and descriptions, and arrive at valid conclusions.
- The ability to think critically about scientific evidence presented to them and to make decisions based on that evidence.

III. Assessment Method(s): A measurable indicator of success in attaining the stated learning outcome(s). The methodology should be both reliable and valid. Please describe in detail.

- a. **Formative Assessment Method(s) and Description:** a measurable indicator of student in-progress success in attaining the stated learning outcome(s).

Students in the astronomy sequence complete an individual project as part of each course. The emphasis changes as students progress throughout the sequence: basic astronomy, the solar system, constellations. Students make an individual choice for their project: in AST 111, the student chooses a topic related to astronomy; in AST 112, the student chooses a solar system; and in AST 113, the student chooses a constellation. The projects require observation, research and problem analysis as well as writing a four-page paper with a bibliography.

Students in AST 113 also complete a multiple choice test to assess their general knowledge of the astronomy sequence learning outcomes. The test consists of 150 questions derived from the astronomy test bank used by the department and measures astronomy vocabulary and thinking. The test is administered during lab class the last week of the quarter. Participation in testing is optional for the student; those that complete the test receive extra credit. This test is a replacement for the CLEP (College-Level Examination Program) that was previously used.

- b. **Summative Assessment Method(s) and Description:** a measurable indicator of end-of-program success in attaining the stated program learning outcome(s).

Not applicable to end-of-sequence assessment.

Refer to the report at the beginning of the Liberal Arts and Sciences for information on summative assessment of the program learning outcomes for Liberal Arts and Sciences.

IV. Results: A description of the actual results of overall student performance gathered from the assessment(s). (see III.a.)

The individual class projects that are done in AST 111-112-113 show evidence of thinking skills.

The astronomy test recently used for assessment in AST 113 has been administered once to two groups of students. The results are based on small sample sizes of 14 and 7. The average test score for the small sample was 73%. The instructor observed that these test results are consistent with the course grades that were assigned.

A few students continue on to four-year colleges for further study in Astronomy after completing the AST sequence. One student has entered graduate school to study astronomy. Some students pursue additional course work in science at four-year schools after completing the AST sequence. The AST sequence also attracts students interested in becoming science educators, particularly at the elementary education level.

- V. **Analysis/Actions:** From analysis of your summative assessment results, do you plan to or have you made any adjustments to your program learning outcomes, methodologies, curriculum, etc.? If yes, describe. If no, explain.

The new test administered in AST 113 is a replacement for the CLEP test that was tried in the past. The replacement was based on several problems: the CLEP test encompassed other areas besides astronomy; the CLEP was expensive to administer; and the scoring service from ETS took too long to adequately use the information for meaningful purposes.

The new test developed for AST 113 will be administered again next year in order to increase the sample size and allow analysis of results from year to year.

- VI. **General Education:** Are you using any tool(s) to assess any of the three primary general education outcomes* (communication, thinking, values/citizenship)? If so, describe.

- a. Where within the major do you assess written communication? Describe the assessment method(s) used. Describe assessment results if available.

The individual projects completed in all three courses of the AST sequence require students to write a four-page paper. Some students in AST 111 choose the creative writing option to meet the assignment requirement.

Writing is also part of astronomy lab reports and log sheets of observations.

- b. Where within the major do you assess oral communication? Describe the assessment method(s) used. Describe assessment results if available.

Oral communication skills are used during class discussions and through examination of controversial issues. Students also communicate when they work together as lab partners or when working together in groups.

- c. Where within the major do you assess thinking? Thinking might include inventing new problems, seeing relationships and/or implications, respecting other approaches, demonstrating clarity and/or integrity, or recognizing assumptions. Describe the assessment method(s) used. Describe assessment results if available.

Thinking skills are required in astronomy for conceptualizing distance in space and “time travel.” Thinking is also required for students to understand the properties in astronomy of sizes, speed and time frames. Students must also use thinking skills to distinguish scientific facts and recognize assumptions. The essay questions used on course tests assess thinking skills.

- d. Where within the major do you assess values/citizenship/community? These activities might include behaviors, perspective, awareness, responsibility, teamwork, ethical/professional standards, service learning or community participation. Describe the assessment method(s) used. Describe assessment results if available.

Global values and environmental issues are addressed in AST courses. Students acquire knowledge of cultural differences in views of astronomy, especially in naming practices used commonly throughout Western civilization and the Northern hemisphere.

Students learn to see the Earth as a single planet with a common global environment. Discussions on how people effect this environment include various topics such as pollution, overpopulation, the clearing of land for farming and building, and light pollution which makes it harder for today’s students to see the night sky.

- * Note: The oral communication checklist and the written communication checklist developed by the General Education Committee were adopted for college-wide use during the 1997-98 academic year by Academic Council. Thinking Guidelines developed by the General Education Committee are being piloted by faculty during the 1998-99 academic year.