Texas A&M University
Core Curriculum
Initial Request for a Course Addition to the Fall 2014 Core Curriculum

Foundational Component Area: Life and Physical Sciences

In the box below, describe how this course meets the Foundational Component Area description for Life and Physical Sciences. Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method. Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.

The proposed course must contain all elements of the Foundational Component Area. How does the proposed course specifically address the Foundational Component Area definition above?

**ASTRONOMY 102 (1 credit): OBSERVATIONAL ASTRONOMY**
Observational and laboratory course which may be taken in conjunction with ASTR 101 or ASTR 314. Use of techniques and instruments of classical and modern astronomy. Prerequisite: ASTR 101 or ASTR 314, or registration therein.

ASTR 102 is an autonomous laboratory course that teaches students how to understand and apply appropriate technology to the study of the natural sciences. Students obtain hands-on experience by learning and applying astronomical observational techniques on small commercial telescopes at the campus observatory and analyzing data obtained with those telescopes. Full development of scientific methods and thought are shown using direct observations of, e.g. the surface of the Moon (craters, mountains, valleys), phases of Venus and the Moon, and the motion of the moons around Jupiter, and how these early astronomical discoveries culminated in the development of Newtonian gravity and dynamics. A linked discussion of planetary systems around other stars also illustrates the limitations of the standard formation model of the Solar System. Throughout the course mathematical techniques are used to illustrate concepts, derive physical relations, and show the manner in which the need to explain natural phenomena led to the development of higher mathematical tools. For example, the need to have a mathematical framework to explain the movement of planets around the Sun led directly to the invention of calculus by Isaac Newton.

Texas A&M is one of only a few schools that offer such an observational astronomy course and it is extremely popular among our students. When students complete the 102 course, they have the skills and knowledge to be competent amateur astronomers.

For more information, please contact the Undergraduate Astronomy Coordinator Dr. Kim-Vy Tran (vy@physics.tamu.edu) and visit the website astronomy.tamu.edu

**Core Objectives**

Describe how the proposed course develops the required core objectives below by indicating how each learning objective will be addressed, what specific strategies will be used for each objective and how student learning of each objective will be evaluated.

The proposed course is required to contain each element of the Core Objective.
Critical Thinking (to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information):

Astronomy 102 is focused on applying the scientific method by acquiring astrophysical observations and analyzing the resulting data to test hypotheses. We engage the students in understanding experimental design and troubleshooting through laboratory exercises that are designed to enhance understanding and comprehension of the physical phenomena observed in the night sky. Students learn to navigate the night sky using a celestial coordinate system to determine when objects rise and set and how to locate objects on a given date and time. Night sky targets include stars, the Moon, and objects from the Messier catalog and New General Catalog; the latter include galaxies, star clusters, planetary nebulae, etc. By observing objects in the night sky, students analyze how the night sky changes and develop a deeper appreciation of the underlying physical concepts.

Communication (to include effective development, interpretation and expression of ideas through written, oral and visual communication):

Astronomy 102 is based at our Physics Observatory and students learn general astronomy, coordinate systems, star charts and telescope design in a classroom environment while making observations using sophisticated telescopes in an outdoor environment. In this existing construct, three to four students share a telescope as a lab group and the students assist each other during their laboratory time. In learning to navigate the night sky, students must learn to read star charts and communicate to their peers about how to locate and observe night sky objects. Each student learns how to explain the concepts during one-on-one discussions with their teacher, specifically by showing where objects are in the night sky and how to locate them. The students also keep a lab manual where all of their observations are recorded; the lab manual is examined at the end of the semester and is included in the final course grade.
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Empirical and Quantitative Skills (to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions):

ASTR 102 teaches students how to navigate the night sky by learning about the celestial coordinate system (Right Ascension and Declination), reading star charts, and determining when objects rise and set. Several of these steps require manipulation of numerical data, e.g. target coordinates to determine position on a given date and time, and empirical knowledge to use the telescope. Several fundamental physical concepts are taught by observing night sky phenomena. For example, observing the Moon’s surface demonstrates that it must be spherical and has features including mountains, craters, and valleys. Observation of binary stars illustrates how gravity works on large scales and that stars have different temperatures (colors). Identifying galaxies beyond the Milky Way gives a sense of the vast physical and times scales in the Universe.

Student understanding is evaluated using regular quizzes, keeping a semester-long lab manual, and with one-on-one discussion with the teacher to identify objects in the night sky.

Teamwork (to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal):

ASTR 102 is arguably one of the best courses to develop cooperative learning skills for students spanning the range in personality because teamwork is an essential component of active learning in the course. Students learn to work effectively in small groups to take astronomical observations, obtain and analyze data, and interpret their results. The telescopes require at least two students to operate successfully, and students need to discuss which objects they will observe and how to locate the object in the night sky using star charts and celestial coordinates. While the students are evaluated individually, their participation and ability to learn with others is key to their success in ASTR 102.

Please be aware that instructors should be prepared to submit samples/examples of student work as part of the future course recertification process.