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 111 (4 credits): OVERVIEW OF MODERN ASTRONOMY
Roots of modern astronomy; the scientific method; fundamental physical laws; the formation of planets, stars, and galaxies; introduction to cosmology; includes an integrated laboratory that reinforces the lecture topics, including hands-on experience with telescopes and imaging of celestial objects; not open to students who have taken ASTR 101 or ASTR 314.

The science of astronomy involves centuries of discovery and analysis, along with the (sometimes radical) revision of our understanding of the entire universe. As such, it casts its net over the widest possible array of topics, from the interaction of light with matter at the atomic level to the gravitational interaction of clusters of galaxies. Astronomical discoveries from the Greeks to the present provide many illustrative examples of the scientific method whereby observations are analyzed, hypotheses are formulated, predictions are made, and hypotheses are confirmed, revised, or rejected. ASTR 111 provides a solid foundation for students to understand what science is and what science is not. The lectures introduce students to nearly all fundamental topics of modern science including basic natural forces (Gravity, Electromagnetism, and the Strong and Weak forces), thermodynamics, Special and General relativity, quantum mechanics, modern particle physics, and cosmology. By applying scientific thinking to the natural world, students learn, e.g. why nights are shorter in summer and longer in winter, what powers the sun, how stars die, why galaxies differ in shape, and how the universe began. The integrated laboratory component of the course consists of scientific experiments that test hypotheses and reinforce class material. These experiments give the students hands-on experience with small commercial telescopes, the analysis of data obtained with those telescopes, and access to recent digital data obtained with professional-caliber facilities.

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

Critical Thinking (to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information):

Astronomy 111 is structured around general questions about science and its place in our world. We stress the use of the scientific method in answering questions. We give instruction in astronomy specifically, but give an appreciation of the broader context of that knowledge. In particular, we will show that gaining a scientific body of knowledge involves mastery of concepts and specific viewpoints, much more than simply learning a set of facts. We show what types of questions can be posed and how they are answered in a scientific context; this necessarily involves explanation of how scientific theories are developed and tested and the nature of science and limits of empirical knowledge. Astronomy is well tuned to this sort of instruction; both due to its intrinsic interest, but also because the span of time and spatial scales involved are so much greater than human experience.

Astronomy 111 includes instruction in issues that connect astronomical knowledge and associated scientific methodology more generally to concepts that unify the natural sciences and that are related to a broader cultural context. We show the importance of cause and effect reasoning in the scientific world view, demonstrate the characteristic scales and proportions of natural phenomena, explain the ways in which the Universe and local environment change and evolve, reveal the general applicability of natural laws, illustrate the role of mathematics in science, and discuss the historical development of science and impact on culture and general intellectual progress. Individual student progress is assessed regularly throughout the semester using metrics that include homework, in-class participation via polling, exams, and lab quizzes.

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

Communication is key to science and the students develop communication skills on multiple levels including analytic and written skills as part of the assignments as well as verbal skills during lectures and lab. Astronomy also is particularly attuned to teaching students visual interpretation and understanding, specifically by using figures and images of astronomical objects to infer empirical relations and thus learn universal physical concepts as well as to navigate the sky using celestial coordinates. The course components are designed to teach students how to explain the scientific process, describe basic physical concepts and general characteristics of astronomical objects, apply scientific thinking to the natural world, and formulate a scientific hypothesis. Individual student progress is assessed regularly throughout the semester using metrics that include homework, exams, and lab quizzes.
Empirical and Quantitative Skills (to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions):

In addition to regular homework and exams that help develop empirical and quantitative skills, ASTR 111 includes a laboratory component that supplements and reinforces the lecture material by guiding the students through a series of experiments to test hypotheses and thus learn the scientific process. The students apply the scientific method by acquiring data from existing archives, and they learn skills involving data reduction, analyzing their experimental results, and interpreting their scientific conclusions. The lab includes collecting digital night-time astronomical data as well as learning fundamentals of statistical and random errors, simple statistics, analysis of results oriented towards topics related to concurrent lecture material (i.e., the properties of light, atomic structure, the surface temperature and spectrum of stars, distances to the nearest stars), and connections between theory and data.

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

As part of the integrated lab for ASTR 111, students learn to work effectively in teams and as part of a larger group to take astronomical observations, obtain and analyze data, interpret their results, and possibly reconcile differing interpretations. The students work in pairs on the lab experiments which include building individual telescopes, measuring light from celestial objects, plotting measurements and assessing errors, determining relations between variables, and applying scientific theory to understand the underlying physical explanation. The students must be able to work as a team to understand the basic scientific concepts, test their understanding, apply their knowledge, and determine the correct outcome.

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