Form E-1-A for Boston College Core Curriculum

Department/Program __Physics_____ **July 2018**

1) **Have formal learning outcomes for the department's Core courses been developed? What are they?** (What specific sets of skills and knowledge does the department expect students completing its Core courses to have acquired?)

   The Department of Physics Core courses share with the university's Natural Science Core the same desired outcomes, namely that at the completion of a Core course students will have:

   a) expanded their understanding of the principles, body of knowledge, and investigative strategies that comprise physics and its technological applications;
   b) developed a scientific literacy that will promote curiosity, respect for the scientific method, and general awareness of the limitations of scientific conclusions;
   c) recognized the role of scientific discovery, past, present, and future, in interrelated concerns such as human health, societal well-being, and planetary sustainability; and
   d) appreciated the role of physics in defining their relationship with the natural world and their position within the cosmos.

2) **Where are these learning outcomes published? Be specific.** (Where are the department's expected learning outcomes for its Core courses accessible: on the web, in the catalog, or in your department handouts?)

   The complete list of outcomes is published on the Department of Physics "Undergraduate Program" webpage, and various aspects are included on Core course syllabi.

3) **Other than GPA, what data/evidence is used to determine whether students have achieved the stated outcomes for the Core requirement?** (What evidence and analytical approaches do you use to assess which of the student learning outcomes have been achieved more or less well?)

   The data differs to some extent depending on the nature of the core course with respect to amount of rigor and mathematical detail. For example, in the Core courses that cover classical mechanics, at the beginning of the course the department administers to students the "Force Concept Inventory"/Mechanics Baseline test. At the end of the semester the test is administered again in order to assess student learning. Additionally, student evaluations are reviewed by the Department Chairperson, who discusses this information with the Undergraduate Affairs Committee (UAC).

4) **Who interprets the evidence? What is the process?** (Who in the department is responsible for interpreting the data and making recommendations for curriculum or assignment changes if appropriate? When does this occur?)

   All physics faculty members who teach Core courses participate in interpreting the evidence, for example, by administering the Force Concept Inventory. However, it is the responsibility of the Undergraduate Affairs Committee to coordinate the process, evaluating and analyzing departmental data. That committee reports to the physics faculty as a whole and receives their input. Based on this, and in cooperation with the department's Teaching Committee, the UAC will work with instructors to

develop specific ways to better meet program goals, including changes in the curriculum to address deficiencies.

5) **What were the assessment results and what changes have been made as a result of using this data/evidence?** (What were the major assessment findings? Have there been any recent changes to your curriculum or program? How did the assessment data contribute to those changes?)

Currently the department offers four Core courses. Three are traditional problem-solving courses, one is algebra-based, and the other two are calculus-based (a smaller course for physical science majors, and a larger course for Biology majors and students in the Pre-Health Program). The three of them comprise the basic areas of physics at the introductory level, but differ in the level of rigor and mathematical detail. The results of the Force Concept Inventory and student evaluations are continually reviewed to improve those courses. Our students typically score well above the national average on the FCI, and seem satisfied that the curriculum meets their particular needs, and so the basic structure of these courses has remained unchanged.

Long ago, more Core courses had been offered through the Department of Physics with emphasis on the history and philosophy of science, and societal issues *e.g*. the environment or proliferation of nuclear weapons. However in recent years our department has not been active in developing these concept-based courses for non-science majors. To address this lack of diversity Prof. Herczynski recently developed a Core course offered during the summer at our partner institution the University of Parma (Italy). The course, titled *The Art of Physics*, is described as a 'somewhat subjective selection of topics meant to serve as an invitation to consider the power and beauty of physics and its place among the liberal arts', and takes an integrated approach to the philosophy, history, and quantitative reasoning inherent in the field of physics. We have not yet conducted an evaluation of this course.

As our department grows we will be offering incentives for the further development of such courses. During the 2018-2019 academic year, Prof. Naughton will be co-instructing the first *Complex Problems & Enduring Questions* course with a physics component (co-taught with Prof. Nugent in English) entitled *Inspiration in Imagination/Reading the Impossible Universe*. He has received full course teaching release from our department to encourage this effort.

6) **Date of the most recent program review.** (Your latest comprehensive departmental self-study and external review)

External review: December 2009