

Physics Department Undergraduate Assessment Report

30 March, 2009

The Physics Department assesses its progress toward learning goals for both undergraduate majors and non-majors. Non-majors make up the bulk of undergraduate students that we teach. In part A we outline learning goals for different undergraduate student populations. In part B we discuss assessment procedures. Part C gives a specific example of how goal-setting and assessment strategies were used to modify the Physics 207/208 service course sequence to better serve life science majors.

A. Learning Goals

These goals differ according to the student populations involved.

1. Learning Goals for students in introductory service courses (for non-majors. These goals are primarily for our “General Physics” courses: Physics 103/104, Physics 201/202, Physics 207/208, and Physics 205, 241, and 244):
 - a. to know basic physical principles (forces, conservation of energy, etc.)
 - b. to solve problems using both quantitative and qualitative applications of these physical principles
 - c. to overcome misconceptions about the behavior of the physical world
 - d. to understand the range of applicability of physical principles, particularly to the each student’s particular field of study
 - e. to apply physics to topics not explicitly covered by the courses
 - f. to appreciate the excitement of physics
 - g. to make quantitative measurements of physical phenomena and understand the statistical significance of observations made in the presence of statistical and systematic uncertainties.

2. Learning Goals for students majoring in Physics, AMEP, Astronomy-Physics:
 - a. same goals as “1”
 - b. to understand basic physical phenomena in depth
 - c. to be acquainted with a wide range of research areas in physics
 - d. to prepare students for graduate study or careers in physics and related fields.

3. Learning Goals for non-science majors. These goals are primarily for Physics 107 (“Ideas of Modern Physics”), Physics 109 (“Physics in the Arts”), Physics 115 (“Energy”), and Physics 371 (“Acoustics for Musicians”).
 - a. to know basic physical principles (forces, conservation of energy, etc.)
 - b. to overcome misconceptions about the behavior of the physical world
 - c. to appreciate the excitement of physics

B. Physics Undergraduate Program Assessment

1. Introductory service courses

- a. Academic Department Manager (ADM) monitors enrollment trends (annually) in student population of the introductory courses through surveys and on-line databases. By studying demographic information ADM assesses whether our courses are accessible to the full spectrum of the undergraduate population. This process needs to be automated. Assesses Learning Goal 1.
- b. Course evaluations of lecture, lab, discussions (in place). Assesses all of Learning Goal 1.
- c. Periodically administer Force Concept Inventory to students at beginning and end of each course. The FCI is a short, standardized test of students' understanding of physics. It is easy to administer and score. Our physics education visitors reported using it at the beginning and the end of a semester to assess their courses. Compare to scores at other institutions for similar courses and to historical trends in our own courses. Assesses Learning Goals 1a, 1b, and 1c.
- d. Periodically survey (with class questionnaires and interviews and interviews with students enrolled in the Peer Mentor Tutor program) students in introductory courses. Questions include: (i) relevance of course content to their course of study, (ii) reaction to course organization. Assesses Learning Goals 1d, 1e, and 1f.
- e. Periodically invite faculty from departments that require physics for their majors to visit introductory courses and fill out questionnaires about relevance to their programs. Assesses all of Learning Goal 1.
- f. Lab Director assesses discussion sections and laboratories through periodic visits.

2. Majors

- a. ILM conducts annual exit survey of graduating seniors by email and regular mail and maintains a data base of where they go after graduation. Assesses Learning Goal 2d. Topics include:
 - (i) the department environment,
 - (ii) enrichment experiences,
 - (iii) professional and employment preparation, and
 - (iv) review of academic program.
 - (v) effectiveness of new intro sequence: Physics 247/248/249
- b. ADM periodically surveys alumni to assess long-term relevance of program to real world. Assesses all of Learning Goal 2.
- c. Course evaluations. Assesses Learning Goal 2a.

3. Non-science Majors

- a. Academic Department Manager (ADM) monitors enrollment trends (annually) in student population of non-science majors courses through surveys and on-line databases. By studying demographic information ADM assesses whether our courses are accessible to the full spectrum of the undergraduate population. This process needs to be automated. Assesses Learning Goal 3.
- b. Course evaluations of lecture, lab, discussions (in place). Assesses all of Learning Goal 3.

C. “Physics for Biologists” course: a test-bed for new assessment procedures.

1. Overview

For several years the Department of Physics has worked with members of the biological sciences on campus to improve the way we teach introductory physics to students majoring in biology, biochemistry, genetics, etc. These efforts began with a program called “SyMBiosis.” SyMBiosis was a response to the realization that a large number of students that take introductory physics major in some field related to biology and that the level of physical understanding required in biological fields will continue to increase. We have modified the Physics 207/208 sequence to better serve life science majors. This has been a part of what we call “SyMBiosis II.” Our overarching goals are to:

- a. present physical principles in a manner that is especially useful to biology students (Learning Goal 1d)
- b. develop pedagogy that improves students’ understanding of physics (Learning Goal 1a,b,c,d,e)
- c. and its applicability to biology. (Learning Goal 1d)
- d. encourage students to take physics as freshmen and sophomores (Learning Goal 1d) so that biology departments can
- e. integrate physical principles into biology courses (Learning Goal 1d).

The curriculum changes immediately affect Physics 207, “General Physics”, and the second semester, Physics 208. These courses are offered each semester and have an enrollment of about 150 students each term.

Assessment in these courses has varied over the past several years. Below are listed several successful strategies.

- a. We invited faculty from biological science departments to sit in on course lectures, discussions, and laboratories during the semester and provide feedback on topics covered and how to integrate them better with biology. Through SyMBiosis-II we had established these contacts and have commitments from over 20 faculty members outside our department. At one forum, biology faculty and

staff worked side-by-side with physics faculty to write outlines of examples that we might use in Physics 207/208. (Assessment 1e)

- b. Surveyed students with questionnaires. The questionnaires asked about students' perceptions of the course content and structure and have been given at the middle and end of the course. (Assessment 1d)
- c. Surveyed the students with the Force Concept Inventory at the beginning and end of the semester (Physics 207 only). (Assessment 1c)
- d. Interviewed students to determine their views on the effectiveness of the changes. Interviews complement the questionnaires of part "b" by giving the opportunity to dig deeper on student responses and ask questions in a flexible way. These interviews occur throughout the semester to allow timely adjustments. (Assessment 1d)