Assessment report 2007:

Learning Objectives

Students who complete a Physics major should have an understanding of the principles of mechanics, optics, electromagnetism, quantum mechanics, and relativity. They will be experienced problem solvers, adept at translating a physical situation into a mathematical problem. They will have experienced the satisfaction and frustration of experimental work. They will be able to learn from books.

Specifically the department will evaluate for

a. mastery of content
b. development of laboratory skills
c. effective communication of scientific ideas and results.

Steps

The Department is committed to a flexible assessment plan to accommodate changes to the program and to permit targeting particular areas of concern.

The department uses the Force Concept Inventory to measure the students' improvement in understanding fundamental concepts in mechanics, in the introductory course (Physics 121) and the GRE subject exam taken by seniors to measure the effect of the program on the student's command of physical concepts and content (goal a).

The Force Concepts Inventory is a widely used tool to measure student understanding of forces and accelerations. We administer it early in the first semester of our introductory courses, and again later in the semester after the material has been discussed in class. This year, for example, the average score for one class improved from 45% correct on the pre-instruction test, to 61% on the post-instruction test. A figure of merit for this test is to compare the actual
improvement in scores to the greatest possible improvement. The actual improvement was 61-45% while the maximum possible was 100-45%, so the figure of merit was $\frac{16}{55}=29\%$. Apparently, instruction eliminated 29% of the student misconceptions in this area of physics.

Instructors choose one laboratory experiment from Modern Physics (Physics 221) to measure student ability both to conduct laboratory experiments and to communicate results clearly and accurately (goals b and c). Professor Weber taught the Modern Physics course this year. He emphasized the importance of laboratory work in that course, and set a high standard for the experimental work itself and the written reports that accompany it. He summarizes the results this way: “In the modern physics labs students were given only a basic set of guidelines for executing labs, leaving them to figure out all the “in between” steps. This was effective in getting them to learn the apparatuses themselves, and for instilling the habit of doing one, or several “practice runs” to get everything right for the principal data run. Common laboratory and data analysis techniques were emphasized by repetition among the labs, and the reports required them to understand error analysis and propagation, including the distinctions between statistical and systematic errors.

The final reports required them to produce a cogent lab writeup similar to a scientific paper in format with an abstract, introduction, discussion of data taking and analysis and confrontation with expected values and discussion. Here, especially I got the impression I was pushing them harder than previous years might have done. Typically I would go through a couple of iterations with each group, starting with a very heavily-commented initial paper (and low score) and allowing them two tries to “polish it.” I believe that most students got a good impression of what’s required for an effective writeup and a few of them made tremendous leaps, such that they got nearly perfect scores on the last couple of labs.”

In an effort to develop students’ presentation skills, Professor Spivey assigned her Physics 122 students research topics to be presented to the class toward the end of the semester. I attended some of the presentations and was impressed with the efforts the students had made to learn some physics on their own. The assignment successfully brought students face to face with the difficulties in mastering new ideas in physics and communicating them to others.
We were without most of our lab facilities this year because Thompson Hall was closed for renovation. The only student laboratory work was Jonathon Tollerud’s work with Professor Worland. Together they succeeded in developing a system that used speckle interferometry to measure the normal modes of vibration of a drum head. It represents significant progress in Worland’s research, especially impressive because of the difficult circumstances.

If any of our students took the physics GRE this year, they didn’t tell me about it. We try to prepare students for graduate school work in physics or related fields. And we assess our program, in part, by the experiences our students have in graduate school. None of this year’s students will be going to a physics graduate program next fall. Several are already in or will be entering engineering programs, and a couple are holding out for a year before graduate school. A list of recent graduates currently pursuing advanced degrees in physics or a related field follows:

- O’Leary   (Oregon)
- Jorgenson  (UC San Diego)
- Jensen    (Washington)
- Leary     (Oregon)
- Early     (Oregon State)
- Messal    (Northwestern)
- Clarke    (Oregon)
- Bertrand  (Maryland)
- Clausen   (Oregon)
- LaForge   (UC San Diego)
- Nuygen    (Scripps Inst. Oceanography)
- Treis     (Wisconsin)
- Slee      (Washington)
- Dahl      (Washington)
- Tollerud  (UC Irvine)

**Feedback**

Each year, the faculty meet to discuss student performance as related to each goal and to consider appropriate modifications to the curriculum and program. As a result of these discussions, we have revised our curriculum slightly. We will discontinue the waves and optics course 212, and to combine its content with Modern Physics I, physics 221. The current requirement for the major is 212, and 221, with Modern II, physics 222, an elective. Physics 212 is offered in the spring. However some of the
concepts in 212 are needed in 221 which is offered in the fall. A more natural ordering of ideas would have the study of waves, physical optics, and relativity in the fall of the sophomore year, followed by the study of the structure and properties of matter in the spring.

We will continue with the same assessment procedures next year.