Changes Resulting from Assessment of General Education Science
"Closing the Loop"
March 2010

During the winter 2009 term, OIT conducted an assessment in general education science. The full report for this institutional student learning outcome (ISLO) is available at www.oit.edu/provost/islo/reports.

The Natural Sciences Department and the Executive Committee of the Assessment Commission identified two areas in student learning in PHY 221 that warranted focused efforts for improvement. These two areas were 1) prerequisite algebra/calculus skills, and 2) problem solving strategies.

Improvement Initiatives
The physics faculty implemented a number of strategies to improve student performance in certain math skills and problem-solving strategies, as described below.

- The physics faculty selected a new textbook for PHY 221 and implemented it in fall 2009. The text was selected because the problem examples had broader appeal to a variety of majors, not just engineering.
- The physics faculty met with the math faculty to discuss common instructional issues. It was learned that vectors were not included in prerequisite math courses as expected, but instead are included in a later course.
- At the beginning of the winter 2010 term, the PHY 221 instructor required a math homework assignment that provided a review of relevant math and also served as a diagnostic tool to determine where students were having problems. The instructor went over the problem areas in class. He also emphasized the underlying math while demonstrating physics problem solutions throughout the term.
- The PHY 221 instructor added a full lecture on vectors.
- The PHY 221 instructor implemented a structured, five-step problem-solving strategy and required students to use this with each homework problem. The steps were 1) define the problem and variables, 2) identify the concepts involved, 3) outline a plan to solve the problem, 4) execute the plan, and 5) check the answer in some alternate way to test for reasonableness.

In addition to the above instructional strategies, the Registrar's Office implemented computerized prerequisite checking on the Web for Student registration system during the winter 2010 term. Previously, the Registrar's Office provided physics faculty with a special report on the previous math courses taken by Physics students, but did not enforce prerequisites systematically. That report will continue, and in addition the new prerequisite system will bar students from registration in physics if they do not have the appropriate prerequisite math course.

Winter 2010 Re-Assessment
At the end of the winter 2010 term, the PHY 221 instructor re-assessed students using similar reasoning problems to those used in the original winter 2009 assessment, with a focus on the two math issues noted above. The results for this re-assessment are shown below in Table 1.

Term of Assessment	Percent of students performing at proficiency or higher
Winter 2009	42.5%
Winter 2010	48.5%

Table 1. Assessment of physics reasoning in PHY 221

The physics faculty felt that these results were good, but they had hoped for a greater change in view of the efforts made. The instructor did feel that there was a slightly better understanding of concepts such as vectors in the class. In addition, the instructor was pleased that at least half of the students demonstrated proficiency or better by successfully completing four out of six reasoning problems.

The physics instructor noted that many students did not spend sufficient time using the problem-solving strategy on homework problems. The instructor noted that only three weekly homework problems required using the problem-solving strategy, with additional problems suggested for further practice. Students often did not receive full credit because they did not follow the required steps fully. The problem-solving strategies were not required for exam problems due to time constraints.

One of the physics instructors recently attended a meeting of the American Physical Society in March 2010. At that meeting, it was apparent that two issues are common in physics instruction nationally—that students struggle with the prerequisite math skills and generally do not spend enough time studying for physics.

The instructor, who will continue to teach these same students in PHY 222 in the following term, will continue to require the same problem-solving strategies and will re-assess at the end of the spring 2010.

The Executive Committee of the Assessment Commission reviewed these results and supports the efforts that the physics faculty have made. The committee concurs with plans to continue with these efforts and re-assess at the end of spring term, with the idea that improvements in student learning may become more evident in the second term in the physics sequence.

The next full assessment of general education mathematics is scheduled for the 2011-12 academic year.