

**Assessment Trends Report
Student Learning Outcomes in Physics and Astronomy**

November 2009

The goal of this report is to evaluate the assessment of student learning outcomes in Physics and Astronomy. The report addresses four key questions to evaluate the quality of our assessment processes.

(1) How have we sustained the assessment effort over a multi-year period of time?

How many years have you completed an annual assessment report?

2006 2007 2008 2009

The learning goals and assessment process were developed by Eric Martell, at that time the only member of the department. The assessment process is currently overseen by the Chair, but both faculty in the department collect and analyze data, and assessment has been deliberately integrated throughout the curriculum.

(2) How do we systematically and comprehensively collect and analyze data about student learning?

The learning goals for students in Physics and Astronomy are:

1. Students will solve complex problems that require integrating knowledge from a variety of subfields, including classical mechanics, classical electrodynamics, thermodynamics, atomic and nuclear physics, and quantum mechanics, as well as incorporating sophisticated mathematical techniques such as partial differential equations, tensor mathematics, calculus of vector fields, and linear algebra.
2. Students will follow the scientific method to design and carry out informative and professionally interesting experiments, utilizing laboratory techniques sufficiently advanced as to allow an easy transition to graduate school or industry.
3. Students will effectively communicate scientific knowledge to general audiences as well as colleagues in the field via oral presentations, formal journal articles, and writing for the layperson.

Data is collected for each goal as follows:

- Learning goal 1 is assessed through two quantitative measures, the Force Concept Inventory (FCI), given to all students in both College Physics I and University Physics I, and the Physics Major Field Test (MFT), given to all majors at the end of their sophomore, junior, and senior years. Both of these exams are administered nationally and provide norms within the discipline.
- Learning goal 2 is assessed via rubrics applied in courses offered in the sophomore, junior, and senior year, including the required senior research course.
- Learning goal 3 is assessed via rubrics designed by the department for both written and oral presentations.

Since the department is small, data is gathered for all majors throughout their tenure at Millikin, and as such is comprehensive.

	Student Learning Outcome 1	Student Learning Outcome 2	Student Learning Outcome 3
AY 2006-07	RED	YELLOW/GREEN	GREEN
AY 2007-08	RED/GREEN	YELLOW/GREEN	GREEN
AY 2008-09	YELLOW/RED	YELLOW/GREEN	GREEN

(3) How do we use the analysis to improve curriculum and pedagogy and to inform decisions about budgets and strategic priorities?

Each report is emailed to the other departmental faculty member, Casey Watson, and a (usually informal) departmental meeting is held to discuss issues that affect the department going forward, primarily areas identified as concerns and the initiatives developed to address those concerns. Both faculty members share responsibility for evaluating, modifying, and continuing to improve the assessment process, with Professor Martell taking the leadership role on overseeing and coordinating efforts.

To address its concern about the first student learning outcome, the department sent its junior faculty member, Casey Watson, to a workshop for new Physics faculty, where he had access to in-depth training in research-based pedagogies presented by the leading researchers in the field of Physics Education. The department also recognized that it needed to reform its pedagogy by including exams within upper-division courses which utilize multiple-choice

questions (taken from old GRE subject exams) to help students prepare for the types of questions on the Physics Major Field Test. The department has also reordered course sequencing and changed course content within the experimental physics sequence in order to more intentionally focus on goal 2. Unfortunately, medical problems prevented assessment of the consequences of these changes.

(4) How do we evaluate, modify, and continue to improve the student learning assessment process in this program?

The assessment process within the department has not significantly changed over time. The department continually reaffirms the validity of the learning goals, in part backed up by data collected across the country about the professional needs of physics majors.

Evaluation from Focus Visit Leadership Team (includes Academic Deans, Program Leaders, and Focus Visit Report Writers)

Rating: Green

Academic program	Goal 1 (multi-year)	Goal 2 (data collection)	Goal 3 (Use assessment to improve)	Goal 4 (improve assessment)	Total
Physics	3	3	3	3	12

Based on the four questions/criteria, the Focus Visit Leadership Team rates Physics and Astronomy as Green. The faculty have sustained the effort over a multi-year period of time, even during a medical leave; they have been systematically and comprehensively collecting and analyzing data about student learning in their program; they have been using their analyses to draw conclusions about improving curriculum and pedagogy and to inform decisions about budgets and priorities; and they continue to evaluate and modify their student learning assessment process.