

# Annual Report for Assessment of Outcomes

SACC: PHY (Physics)

Submitted June 2011

Outcomes Assessed this year: **Communication** and **Professional Competence**

1. Describe changes that have been implemented towards improving students' attainment of outcomes that resulted from outcome assessments carried out in the previous academic year.

During the last academic year (2009/2010) The Physics SACC reported on the Critical Thinking Core Outcome. We designed and administered a simple test consisting of six questions that covered the key topics taught during the first course in all of the 3-term Physics sequences. Three of the questions were conceptual in nature, and three required very basic calculations. The tests were administered at the beginning of the quarter (pre-test) to 315 students across the district in PHY 101, PHY 201, and PHY 211. The same test was administered at the end of the quarter (post-test). The results were significant, the average score improving by over 60%. However, several points required further consideration:

- The PHY 101 students displayed the most improvement of any group on the conceptual questions. This was encouraging since PHY 101 is basically a conceptual Physics course. However, it brought to our attention the need to place greater emphasis on concepts in the other two, more mathematical Physics series (algebra-based and calculus-based).
- The conceptual question on rotation was the most frequently missed in the post-test. This led us to make improvements in the manner we approach the subject of rotation with our classes.
- The PHY 201 post-test scores were the weakest of any group - 20% of students still answered less than half of the questions correctly. This could be partially accounted for by the fact that the PHY 201 pre-test scores were also the lowest (63% of students answered less than half of the questions correctly). However, this finding resulted in several changes to instructional strategies, and when the post-tests were applied this year, only 9% of students tested in those courses answered less than half of the questions correctly. This is an issue that is still being addressed, and we look forward to even more improvement in the future.

2. Identify the outcomes assessed this year, and describe the methods used.

What were the results of the assessment (i.e., what did you learn about how well students are meeting the outcomes)?

## **2.1 Communication**

In any scientific endeavor, the ability to properly communicate results is of the utmost importance. After completing any Physics course, students should be able to clearly describe physical phenomena, identifying the laws and principles behind them. All Physics courses at PCC share two central course outcomes, which are as follows: "*After completion of this course, students will*

- *Apply knowledge of physics to **explain** natural physical processes and related technological advances.*
- *Design experiments and acquire data in order to explore physical principles, effectively **communicate** results, and critically evaluate related scientific studies."*

The Physics SACC chose to assess Communication skills by collecting samples of students' writing at both the beginning and end of a term and compare them for quality.

### **2.1.a. Describe the method(s) you used.**

- Two instructors evaluated five separate classes (PHY 201, PHY 202, PHY 203, and two PHY 101 classes).
- The 200 level courses were evaluated by collecting written lab reports. The 100 level courses were evaluated by collecting answers to conceptual homework problems.
- In each case, the assessment was evaluated using an appropriate rubric:

#### **Lab Report Rubric**

The report clearly describes the purpose of the lab; what it is that accomplishing the objectives will help convey about the scientific concept of the lab.	+1
The report effectively describes the procedures carried out in a way that is easy to understand and detailed enough to be repeated.	+1
The report contains a clear presentation of data, subsequent calculations, and results.	+1
The report contains a conclusion summarizing the basic principles studied, and making a clear statement of what was learned.	+1

Lab reports will receive a score between 0 and 4 points accordingly.

#### **Conceptual Homework Question Rubric**

The answer cites the underlying physical principle(s) involved.	+1
The answer relates the facts presented in the question to the underlying physical principle(s).	+1
The answer clearly shows the student's reasoning in applying the principle(s) to arrive at an answer.	+1
The answer is complete and correct.	+1

Answers to homework questions will receive a score between 0 and 4 points accordingly.

### 2.1.b. What did you learn?

The results for Lab Reports that were collected:

Lab Report Score	Beginning of Term	End of Term
4	44%	73%
3	24%	20%
2	17%	5%
1	10%	2%
0	5%	0%

- The improvement was significant, with 73% of students receiving perfect scores by the end of the term.
- Perhaps the most notable improvement was the decrease in students who went from scores of 2 or below at the beginning of the term (32%) to those receiving scores of 2 or below at the end of the term (7%).
- As far as scoring the individual lab components, the most improvement was seen in the writing of conclusions, and the least improvement was seen in describing experimental procedures.

The results for Conceptual Homework Questions that were collected:

Homework Question Score	Beginning of Term	End of Term
4	31%	52%
3	25%	31%
2	27%	10%
1	8%	6%
0	8%	0%

- The improvement was significant. However, only about half of the students were achieving perfect scores by the end of the term.
- A notable improvement was the decrease in students who went from scores of 2 or below at the beginning of the term (43%) to those receiving scores of 2 or below at the end of the term (16%).
- As far as scoring individual components, the most improvement was seen in students' presentation of the reasoning they used in arriving at an answer, and the least improvement was seen in providing correct and complete answers.

### 2.1.c. Identify any changes that should, as a result of this assessment, be implemented toward improving students' attainment of outcomes.

- Students would benefit from having these grading rubrics provided to them early in the term. The guidelines used here for scoring lab reports and homework would benefit students in all science classes, as well as in writing assignments in general.
- More emphasis should be placed on writing proper procedural descriptions in lab reports.
- In order to help students answer homework questions correctly, more in-class examples should be presented and thoroughly explained. A significant number of these examples should not simply be solved for the class by the instructor, but instead first be attempted by students in class in order to engage them in the process.

The second college core outcome that the Physics SACC chose to assess this year was Professional Competence.

## **2.2 Professional Competence**

Physics is a part of the curriculum for many professional and technical programs at PCC. A large part of our responsibility in teaching Physics is to help prepare students for success in their many and varied fields. A course outcome common to all of our Physics courses is:

*"After completion of this course, students will use an understanding of mathematics along with physical principles to effectively solve problems encountered in everyday life, further study in science, and **in the professional world.**"*

We chose to assess Professional Competence by polling our students to see what they had learned in their Physics courses that would be useful in their profession.

### **2.2.a. Describe the method(s) you used.**

- Three instructors evaluated five separate classes (PHY 101, PHY 201, PHY 202, PHY 211, and PHY 212).
- These courses were evaluated by asking students for written answers to the following question at the beginning of the term, and then again at the end of the term:

**"How do you think studying physics will help you in your professional life?"**

- The end-of-term answers were compared and contrasted with the beginning-of-term answers for detail and breadth.
- Ideally, it was hoped that students would go from perceiving the course as simply a requirement for their degree, to seeing it as containing valuable and relevant information directly related to their profession.
- The results were quantitatively judged by comparing the number of responses citing the course as a requirement vs. the number of responses citing specific course topics that related to a student's particular field.

## 2.2.b. What did you learn?

For the 128 students polled, the results are summarized in the following table:

	<b>Beginning of Term</b>	<b>End of Term</b>
Percentage of students citing their Physics course as a requirement*	78%	51%
Percentage of students citing specific topics within the course related to their field*	33%	69%

\*Note that percentages do not necessarily total 100% since some students mentioned both or neither aspects.

- The results were pleasantly surprising, considering that more than twice as many students mentioned specific course topics in their end-of-term answers.
- Although many students still referred to the course as a requirement, they were far more likely to include information on specific course topics in their responses.
- The results of this type of survey cannot fully be expressed by numbers alone. Several examples of student comments are shown below.

### Examples of student responses from the **Beginning** of the term:

- "This class is a requirement for the engineering program."
- "Physics is going to help me fulfill a prerequisite requirement for medical school."
- "I need it to enter and apparently understand pharmacy school - I'm not sure in what way."
- "Physics is part of my requirement for radiation medicine for OHSU"
- "I need to take physics to earn my degree in Mechanical Engineering"
- "Right now I honestly don't know how it will help me in my professional life other than helping me obtain my degree."

### Examples of student responses from the **End** of the term:

- "As a pilot, I will use Physics every day, such as the laws of motion, aerodynamics, and vectors. Physics will also be necessary to determine the center of gravity for take-off, predicting weather, and how much runway is needed to completely stop or take-off."
- "I plan to work in the medical field. Being able to understand pressure is extremely important when it comes to the respiratory system and the exchange of gases as well as the cardio vascular system and cardiac output."
- "Physics will greatly help me in my professional life. As an environmental consultant I will need to understand how everything in our world relates. To start with, I need to understand energy and power to help with the installation and sales of renewable energy such as solar panels and wind power."
- "In my professional life as a photographer, I know how light works with lenses much better now, and why colors bend the way they do. I know why light has certain properties based on the material it travels through."

- "As a pre-medical student, I expect that many aspects of physics will increase my grasp of how body systems work, particularly with respect to pressure, gas laws, and electromagnetism. Additionally, I find the mathematical approach of physics more challenging than classes such as biology, and working through these challenges will better prepare me for the rigors of medical school."
- "I plan on becoming a Geologist. I figure that understanding the forces at work in the universe will help me better understand the Earth as a whole."
- "It will help me figure out how much force is needed and which fulcrum point to use when hoisting an engine. It can help me figure out how much force to use when torquing down a bolt. It can also help me figure out how much distance I need when braking."
- "Physics is the science of movements. I hope someday to help those that have lost limbs to live normal lives. Physics helps me to understand the mechanics of the human body and to translate that motion into a prosthetic. I am able to understand the properties of torque needed to replicate running legs, or the range of motion needed to turn a steering wheel. Physics will forever help me help others."

### **2.2.c. Identify any changes that should, as a result of this assessment, be implemented toward improving students' attainment of outcomes.**

The results of this study were so encouraging that it is hard to recommend any changes. However, there is always room for improvement, so the following suggestions are offered:

- Physics instructors should continue to integrate more examples involving applications to specific professions since the students find these so helpful, and since this shows how relevant Physics is to our everyday lives.
- In addition to offering interdisciplinary examples, instructors should also stay informed as to which PCC degree programs require Physics courses so that we can offer pertinent information and examples in our courses. Currently, according to the PCC catalog, these programs include Mechanical Maintenance, Aviation Science, Bioscience, Electronic Engineering, Facilities Maintenance, and Microelectronics