BERGEN COMMUNITY COLLEGE

Assessment Report for (Department and/or Program): Physical Sciences

Academic Chair: Dr. Joan Tscherne

Assessment Period: 2010 - 2012

Submitted by: Prof. Marie McCrary

1. Intended Outcome (Goal):
To measure students' understanding of the scientific method by analyzing laboratory reports from four sections of Introduction to Physics (PHY185) and three sections of General Chemistry 1 (CHM141).

2. General Education Requirement(s) to which the intended outcome relates:
Scientific Knowledge and Reasoning: Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

3. Section(s) of the Strategic Plan to which the intended outcomes relates:
1.1 Take steps to increase student retention and student progression through academic programs.
1.2 Take steps to increase the number of students who graduate or transfer in a timely fashion.

4. Means of assessment, sources of data, and desired result:
During Spring 2011, we collected and analyzed data obtained from student laboratory reports, with the goal of demonstrating student understanding of the scientific method in relation to the General Education Requirement on Scientific Knowledge and Reasoning.

In both PHY185 and CHM141, students were required to write a laboratory report, which included a succinct objective, a section on data collection and analysis, and a conclusion discussing background theory and results. In CHM141, the laboratory report was about the Heat of Neutralization, while in PHY185 the report was about Ohm's Law. The laboratory reports were graded using two faculty-developed rubrics for the purpose of assessment, one for Introduction to Physics, and one for General Chemistry 1.

Introduction to Physics (PHY185)
Laboratory Report Grading Rubric
Lab # 10 – Ohm's Law

Rubric evaluates understanding of the scientific method in laboratory experiments

Report Section	**Meets (Full credit)**	**Partially Meets (50% - 75%)**	**Does Not Meet (<50%)**
Objective – 10 points	Full credit is given when original effort is shown in clearly stating the objective of the experiment.	Partial credit is given if student restates the objective from the Laboratory Manual.	No credit is given if student gives poorly worded or incomplete statement of objective (no clear sense of the experiment objective).
Data Collection/Analysis – 50 points	Original, completed data sheets from laboratory manual plus notes about the data collection are included. Calculations are done properly. Data is plotted correctly and graphs are correctly labeled.	Original, completed data sheets from lab manual are included. Calculations are completed with few errors. Slight errors on graph	No original data or incomplete sheets from lab manual. Incorrect or no calculations. Incorrect or missing graph
Conclusion – 40 points	Original effort must be shown in stating a conclusion drawing material from the data and analysis sections. Student must demonstrate advanced understanding of the experiment by including: • A discussion of the theory behind the experiment. • a list of equations and why they were required for the experiment. • Original and well thought out statements of what the major sources of error are; could they be reduced? • % error or % difference as required by experiment directions.	A conclusion that meets expectations will include: • Simple conclusions and statement of errors. • Simple list of equations and variables. Rudimentary explanation of experiment theory. • % error or % difference as required by experiment directions.	A conclusion that does not meet expectations will exhibit: • No conclusion. • Missing section or incomplete list of equations and variables. • No statement of theory.

General Chemistry I Laboratory (CHM-141)
Laboratory Report Grading Rubric
Rubric evaluates understanding of the scientific method in laboratory experiments
Spring 2011 - Heat of Neutralization

Report Section	**Meets (full credit)**	**Partially Meets (50% - 75%)**	**Does Not Meet (<=50%)**
Objective – 10 points	Full credit is given when original effort is shown in clearly stating the objective of the experiment.	Partial credit is given if student restates the objective from the Laboratory Manual.	No credit is given if student gives poorly worded or incomplete statement of objective (no clear sense of the experiment objective).
Data Collection and Processing – 50 points	Original, completed data sheets from laboratory manual. Calculations are done properly. Data is plotted correctly and graphs are correctly labeled.	Original, completed data sheets from lab manual are included. Calculations are completed with a few errors. Slight errors on graph	Incomplete data sheets from lab manual. Incorrect or no calculations. Incorrect or missing graph
Analysis and Conclusion – 40 points	Original effort must be shown in stating a conclusion drawing material from the data and analysis sections. Student must demonstrate advanced understanding of the experiment by including: • A discussion of the theory behind the experiment. • a list of chemical and mathematical equations and identifying variables and why they were required for the experiment. • Original and well thought out statements of what the major sources of error are; could they be reduced? • % error or % difference as required by experiment directions. • Postlab questions correctly answered	A conclusion that meets expectations will include: • Simple conclusions and statement of errors. • Simple list of chemical and mathematical equations and identifying variables. Rudimentary explanation of experiment theory. • Rudimentary error analysis • % error or % difference as required by experiment directions. • Postlab questions answered with only a few errors	A conclusion that does not meet expectations will exhibit: • No conclusion. • Missing section or incomplete list of chemical and mathematical equations and identifying variables. • No statement of theory. • No error analysis • Postlab questions omitted or incorrectly answered

The following sections were assessed: PHY185-001, PHY185-002, PHY185-003, PHY185-005, CHM141-001, CHM141-003, CHM141-601. A full-time faculty member was the instructor for each section.

We consider the goal met if 80% of students in each section show competency in understanding the scientific method by achieving a 80/100 or greater on the laboratory report.

5. Summary of Results:

Introduction to Physics (PHY185) Assessment Data

PHY185 Section	Number of Students	Average Objective Score (10 points)	Average Data Score (50 points)	Average Conclusion Score (40 points)	Success (>80/100)	Success %
001	17	7.94	44.70	32.60	13	76%
002	18	7.22	35.00	24.33	11	61%
003	20	10	47.40	37.40	20	100%
005	19	8.81	37.14	34.19	14	74%
Totals:	**74**	**8.55 (weighted), 85.5%**	**41.13 (weighted), 82.26%**	**32.29 (weighted), 80.73%**	**58**	**78.4%**

General Chemistry 1 (CHM141) Assessment Data

PHY141 Section	Number of Students	Average Objective Score (10 points)	Average Data Score (50 points)	Average Conclusion Score (40 points)	Success (>80/100)	Success %
001	19	8.58	48.58	30.79	15	79%
003	11	7.45	47.45	27.82	8	73%
601	18	7.25	48.44	24.56	13	72%
Totals:	**48**	**7.82 (weighted), 78.20%**	**48.23 (weighted), 96.54%**	**27.77 (weighted), 69.43%**	**36**	**75%**

As a cohort of students, the criterion for success was not met in both PHY185 and CHM141. On a section-by-section basis, only PHY185-003 met the criterion for success.

6. Recommendations for modifications:

The success rates for PHY185 and CHM141 were 78.4% and 75% respectively, very close to the 80% goal.

In PHY185, the average scores in the objective, data, and conclusion sections were 85.5%, 82.26%, and 80.73% respectively. While it is difficult to draw definitive inferences from the results, the main reasons for points lost include merely copying the objective from the laboratory manual, slight calculation errors, improperly labeled graphs, and not sufficiently discussing background theory and predictions in the conclusions.

In CHM141, the average scores in the objective, data, and conclusion sections were 78.2%, 96.54%, and 69.43% respectively. Clearly, the students focused their attention on data collection and calculations. The main reason for the lower score in the conclusions section include insufficient discussion of background theory and the possible sources of error.

Although this is up to the prerogative of the instructor, in PHY185, written reports are typically required for all laboratory assignments, while in CHM141, the laboratory grade is based off of data collecting and answering the post-lab questions in the manual. This may be the reason for the average score in the conclusions section to be slightly higher for the PHY185 sections, and the average score in the data section to be higher in the CHM141 sections. Thus, in both PHY185 and CHM141, a focus on proper calculations and graphing, as well as the importance of understanding and reporting background theory in order to explain conclusions may show improvement.

In light of these assessment results, we have decided to have a department discussion regarding the breadth and depth of PHY185. This course begins with quantifying and converting units of measurement and ends with conceptual relativity. Every major topic in physics (mechanics, electromagnetism, thermodynamics, optics, nuclear and atomic physics) is covered in between. While it is beneficial to the student to see how the different fields of physics fit together to describe our universe, it may behoove the student to cover fewer topics in more depth. PHY185 is also a general education course, as well as a prerequisite for many other courses, including the courses in the health professions; therefore, changing the contents of the course will have implications beyond the physical science department. Thus, any changes in the structure of the course will be discussed within the physical science department, as well as the general education committee and outside departments for which this course is a prerequisite.

The assessment data for CHM-141 may indicate that use of the post-lab questions from the laboratory manual may not provide the students with sufficient training in error analysis. In addition the approach of using the questions in the manual exclusively does not encourage the use of background material to explain experimental conclusions or procedural errors. In order to address this issue, during the Spring semester the chemistry faculty will devote Department meeting time to discuss how best to improve the error analysis component of the CHM-141laboratory reports. Based on the conclusions from these meetings the department will adjust the format of the reports to be used during the Fall 2012 semester. Data collected using these reports will be used for the new assessment cycle during Spring and Fall 2013.

A few words of caution should be exercised before using the data to make concrete inferences. As the Spring 2011 semester was the first time PHY185 and CHM141 were used for assessment, the results may not be statistically significant. Another issue in trusting the data is that it was noted that many of the students who score high in other aspects of the course (exams, participation) may not have focused their attention into the criteria used for assessment in laboratory report, realizing that they did not need a good grade on the report to get a good grade for the course. This negatively skewed the assessment grading. For future assessment, the results may be more enlightening if more-encompassing criteria are used to define success.

7. Actions taken based on recommendations:

The physical science department convened to discuss student learning in light of these assessment results.

The physics instructors decided that individual strategies for improving student learning would be more effective than a blanket approach of changing the broad curriculum, which is considered a main strength of PHY185.

The physics instructors also identified some particular strategies to use to improve the quality of the lab reports. Looking at the results, we realized that we should stress the connections between the scientific method and the lab experiments during both lecture and lab. By emphasizing repetitions in taking measurements, students will see how the results of each trial vary, and this will help them differentiate between theory and experiment in the scientific method. We discussed having pre-lab quizzes to insure that students come to lab on time and prepared, as well as having students utilize graphing software as well as making graphs by hand.

The chemistry instructors decided keep assigning the post-lab questions but require a summary section where errors would be analyzed and related to the theory and underlying assumptions on which the experiment was based as well as the actual execution of the experiment. It was also decided that all experiments would be graded using the rubric. Both the new format and the grading rubric would be introduced at the beginning of the semester so that by the time the Heat of Neutralization experiment was reached, the students would be familiar with it.