### Assessment Overview

**Discipline/Program Name:** Chemistry Department  
**Assessment Year:** 2008-2009

<table>
<thead>
<tr>
<th>Student Learning Outcome</th>
<th>Outcome Type</th>
<th>Methodology</th>
<th>n</th>
<th>History</th>
<th>Benchmark</th>
<th>Results</th>
<th>Strength of Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demonstrate mastery of competencies from competency-based syllabus</td>
<td>GE, Discipline</td>
<td>CHE112: standardized exam (ACS final)</td>
<td>CHE112: 42</td>
<td>CHE112: 7 yrs.</td>
<td>CHE112: dept. will meet or exceed national average 41.0</td>
<td>CHE112: dept. avg was 37.74</td>
<td>Neutral</td>
</tr>
<tr>
<td>2. Demonstrate ability to use chemical apparatus, instrumentation and equipment properly and safely.</td>
<td>GE, Discipline</td>
<td>CHE111: standardized exam (ACS Toledo test)</td>
<td>CHE111: 120</td>
<td>CHE111: 4 yrs.</td>
<td>CHE112:75% or more of students identify at least 4 of 5 unknowns</td>
<td>CHE112: 89% of students identified at least 4 of 5 unknowns</td>
<td>Strong</td>
</tr>
<tr>
<td>3. Demonstrate mastery of scientific method and apply these principles to solve problems</td>
<td>GE, Discipline</td>
<td>Laboratory project</td>
<td>CHE112: 37</td>
<td>CHE112: 2 yrs.</td>
<td>CHE111:75% or more of students determine acid concentration to within 4%</td>
<td>CHE111: 98% of students found concentration to within 4%</td>
<td>Strong</td>
</tr>
<tr>
<td>4. Demonstrate ability to read and write about material relevant to course</td>
<td>GE, Discipline</td>
<td>Rubric Graded Lab Notebooks</td>
<td>89</td>
<td>2 yrs</td>
<td>85% or more of students score at least 3 out of 4 for each lab notebook component reviewed</td>
<td>89.9% of students scored at least 3 out of 4 for each component reviewed</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>GE, Discipline</td>
<td>Rubric Graded literature review</td>
<td>71</td>
<td>2 yrs</td>
<td>85% or more of students will score at least 4 out of 5 on the</td>
<td>83.1% of students scored at least 4 out of 5 on the standard rubric</td>
<td>weak</td>
</tr>
<tr>
<td>Describe the Learning Outcome That You Have Measured</td>
<td>Pre-Post Test, Judged Competition, Embedded Questions, Rubric Graded Essay</td>
<td>Number of Students Assessed</td>
<td># of Years This Outcome Has Been Assessed</td>
<td>Measurement Standard</td>
<td>Report the Results of Your Data Analysis</td>
<td>rubric</td>
<td></td>
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<tr>
<td>GE, Discipline or Other</td>
<td></td>
<td></td>
<td></td>
<td>Strong: Exceeds Benchmark</td>
<td>Neutral: Meets Benchmark</td>
<td>Weak: Misses Benchmark</td>
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</tbody>
</table>
Program / Discipline Assessment Report

Program/Discipline: Chemistry Department
Responsibility: Kim Stasiewicz

Program/Discipline's Mission Statement:
The mission of the chemistry department, within the physical science department, is to provide learning-centered chemical education to students. The chemistry department strives to educate traditional and non-traditional students who intend to pursue further educational or career opportunities about chemical principles in a dynamic, supportive, learning-centered environment. The chemistry department is committed to integrating appropriate technology, modern instrumentation, traditional and contemporary pedagogical approaches, and assessment of student achievement into classes in an attempt to create an environment that engages students in classroom activities that facilitate learning for students of all learning styles.

Program/Discipline's Assessment History:
By using the assessment process as an evaluative technique, how has it previously affected your program's curricula and/or teaching strategies?

We have adopted strategies to improve retention in general chemistry, such as assigning, grading, and giving credit for homework.

By using the assessment process as an evaluative technique, what changes to student learning have been noted?

Student scores on the standardized ACS exam have improved.

What unintended consequences, if any, have occurred because of the assessment process?

None

Who receives information about your department's assessment and why? (Please note if you plan on altering either of these items for the coming year.)

All chemistry faculty receive the information in order to improve the curriculum, improve teaching strategies, and enhance student learning in chemistry.

Part 1: Previous Academic Year Assessment Summary

Previous Academic Year: 2007-08

Please duplicate or remove the tables on the following pages for each outcome you have assessed. If there are five outcomes in the last year, use/create five tables. (For your convenience, four tables have been generated, three Discipline/Program related and one General Education related.)
(To select an entire table, hover over part of the table; an icon should appear with four arrows in the table’s upper-left corner ... click on it. You can also drag over all the cells of the table to select it.) Once selected, choose Edit > Copy, click in the space immediately following the table, and choose Edit > Paste.
<table>
<thead>
<tr>
<th>Outcome Type (choose by bolding): Discipline/Program; General Ed; Other</th>
<th>Outcome Title: Content Competency</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>If General Education outcome (choose by bolding): Communication; Critical Thinking; Quantitative Reasoning; Use of Technology; Diversity and Global Awareness; Leadership and Teamwork</th>
<th>Outcome Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will demonstrate mastery of competencies identified on the competency-based syllabus for the specific course.</td>
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</table>

<table>
<thead>
<tr>
<th>Benchmark for success</th>
<th>This outcome is assessed in two chemistry courses, using different methods:</th>
</tr>
</thead>
</table>
| 1) Please specify what percentage of the sample size is expected to meet or exceed your benchmark.  
2) What is the rationale for choosing this measure? | CHE112  
Students taking CHE112 (second semester general chemistry) should score at or above the national average on the American Chemical Society (ACS) standardized exam; this ensures that they are prepared for future science (chemistry) courses as they transfer to four year schools.  
CHE111  
75% of students who are prepared for CHE111 (as predicted by their scores on the ACS Toledo test of basic skills) will complete CHE111 with a grade of “C” or better. This is the fourth year that this test has been used as part of the chemistry assessment, and it is intended to track trends in student and department performance and retention. |

| Description of assessment process: | CHE112  
1) Standardized test (ACS exam)  
2) Scoring at or above the national average on this exam ensures that students are prepared for future science classes.  
3) This outcome is measured yearly; data is collected in fall and spring semesters to maximize sample size.  
4) This year, 42 students took the ACS exam.  
CHE111  
1) Standardized diagnostic exam (ACS Toledo test of basic skills) and correlation with final grades.  
2) The grades on this exam are correlated with final grades in CHE111 to track retention and student success in the course. We compare the number of students who SHOULD be able to successfully complete the course (based on this diagnostic exam) with the number of students who actually DO successfully complete it.  
3) This outcome is measured yearly; data is collected in fall and spring semesters to maximize sample size.  
4) We have data from 120 students. |

| Results | CHE112  
The department average on the ACS exam was 37.74 out of 70. |
|---------|--------------------------------------------------|
CHE111
Out of 117 students whose ACS Toledo scores predicted that they were at least moderately well prepared for CHE111, 82 complete the course with a grade of C or higher.

What did the department learn?
1) How did group performance compare to the benchmark?
2) How does the data compare to the previous year, if applicable?
3) If multiple measures were used, how do they compare to each other?

CHE112
1) The benchmark (department average on the ACS exam will meet or exceed the national average) was missed. The department average was 37.74; the national average was 41.0.
2) This shows a decline from the previous year (see chart below for historical performance)
For CHE111,

The following flowchart shows the results of students taking the ACS Toledo diagnostic exam, and their subsequent performance in CHE111:

1) The benchmark was not achieved. Only 70% of students whose diagnostic scores indicated they were ready for the course actually succeeded in the course. The benchmark is set at 75% of students succeeding.
2) This result is a HUGE improvement over last year’s results, when only 45% of prepared students succeeded in the course.

Student performance summary
1) Based on the findings, how does the department rate student performance in regards to this outcome (strong, weak, or neutral)?
2) How does this assessment affect plans for this coming year in terms of curricula, teaching strategies, and assessment methods?

CHE112
1) Based on the results of the ACS exam, the department rates student performance as neutral. The benchmark of scoring at or above the national average was missed, but not by a large margin. The department average for 2008-2009 was lower than it has been for the last two years, but was still in line with the historical averages over the last several years.
2) This assessment does not change current curriculum, teaching strategies, or assessment methods. The ACS exam will be given in future semesters and the results will continue to be tracked.

For CHE111,
1) Based on the results presented above, the department rates student performance as neutral. Although the benchmark was not achieved, these results showed marked gains over the previous year in terms of student success in CHE111.

2) Based on this assessment, the department will continue to look for ways to increase student retention and success in CHE111. Holding open office hours, collecting and grading homework, and use of college retention strategies such as Early Alert will continue to be employed.
<table>
<thead>
<tr>
<th>Outcome #: 2</th>
<th>Outcome Title: Laboratory Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome Type</strong> (choose by bolding):</td>
<td>Outcome Description:</td>
</tr>
<tr>
<td>Discipline/Program; General Ed; Other</td>
<td>A student will demonstrate the ability to use chemical apparatus, instrumentation and equipment properly and safely.</td>
</tr>
<tr>
<td>If General Education outcome (choose by bolding): Communication; Critical Thinking; Quantitative Reasoning; Use of Technology; Diversity and Global Awareness; Leadership and Teamwork</td>
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<tr>
<td><strong>Benchmark for success</strong></td>
<td>This outcome is assessed in two different chemistry courses.</td>
</tr>
<tr>
<td>1) Please specify what percentage of the sample size is expected to meet or exceed your benchmark.</td>
<td><strong>CHE111: (unknown acid concentration)</strong></td>
</tr>
<tr>
<td>2) What is the rationale for choosing this measure?</td>
<td>At least 50% of students will determine their unknown acid concentration to within 1%.</td>
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<td></td>
<td>At least 75% of students will determine their unknown acid concentrations to within 4%.</td>
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<td></td>
<td>Last year was the first year for this assessment method. The highest benchmark was for students to determine an unknown acid concentration to within 10%. This benchmark was achieved by all students, and most did much better. So this year the benchmarks reflect a more realistic expectation for success.</td>
</tr>
<tr>
<td><strong>Description of assessment process:</strong></td>
<td><strong>CHE112: (identification of unknowns in a sample)</strong></td>
</tr>
<tr>
<td>1) What assessment methods were used to measure this outcome (i.e. pre/post test, portfolio review, etc.)?</td>
<td>At least 50% of students will correctly identify all 5 unknowns present in their sample.</td>
</tr>
<tr>
<td>2) How do these methods show students are learning?</td>
<td>At least 75% will correctly identify 4 out of 5 unknowns present in their sample.</td>
</tr>
<tr>
<td>3) What frequency is this outcome being measured (i.e.: each semester, yearly, every other year, etc.) and why?</td>
<td>Last year was the first year for this assessment method. The benchmarks that were set were exceeded by a large margin. These new benchmarks are a more realistic goal.</td>
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<tr>
<td>4) How many students made up the sample size?</td>
<td></td>
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<tr>
<td>For CHE111.</td>
<td><strong>For CHE112.</strong></td>
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<tr>
<td>1) This assessment is a practical demonstration of students’ lab abilities, given at approximately the midpoint of the first semester of general chemistry. Students first standardize a solution of sodium hydroxide by titrating it with a standard KHP solution which they prepare. Then, they use the standardized sodium hydroxide solution to determine the concentration of an unknown acid solution, using acid-base titration techniques.</td>
<td>1) This assessment is a practical demonstration of students’ lab abilities, given toward the end of the second semester of general chemistry. This lab practical involves detecting and identifying the</td>
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<tr>
<td>2) In order for students to succeed at this task, they must have mastered the skills of acid-base titration (involving the use of many laboratory techniques such as proper weighing, pipeting, and buret reading). They must also understand and be able to apply the critical thinking and problem-solving skills that are needed to analyze their results and calculate the concentration of the unknown.</td>
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</table>
elements present in an unknown mixture of five elements, using qualitative analysis. Students are first given a series of solutions of known cations and anions, and are shown how to test for each ion qualitatively. Then, students are given an unknown solution containing five of the ions, and they are asked to identify which five ions are present in their solution.

2) Students must use critical thinking skills, along with proper lab technique, to design a series of tests that will allow them to deduce which ions are present.

3) This outcome is measured yearly. Data is collected in the spring semester.

4) For spring, 2009, the sample size was 37 students.

Results
What were the results of the assessment process? (List results for each method, if more than one were used.)

For CHE111,
Forty-two out of the sixty-four students determined the unknown acid concentration to within 1%. Sixty three students determined the concentration to within 4%.

For CHE112,
Out of 37 students, 16 identified all 5 ions in the sample; 17 identified 4 of the 5 ions, and 4 identified 3 of the ions. No students failed to identify at least 3 of the ions in the sample.
What did the department learn?
1) How did group performance compare to the benchmark?
2) How does the data compare to the previous year, if applicable?
3) If multiple measures were used, how do they compare to each other?

For CHE111,
1) The benchmark was exceeded. Over 65% of students determined their unknown acid concentration to within 1% of the true value. Over 98% came within 4% of the true concentration.
2) See chart above.
3) N/A

For CHE112,
1) The first benchmark was not met. Only 43% of students correctly identified all five ions in their sample; the benchmark was 50%. The second benchmark was exceeded, with over 89% of students correctly identifying at least four of five elements in their unknown samples.
2) See chart above for comparison to previous year.
3) N/A

Student performance summary
1) Based on the findings, how does the department rate student performance in regards to this outcome (strong, weak, or neutral)?
2) How does this assessment affect plans for this coming year in terms of curricula, teaching strategies, and assessment methods?

For CHE111 and CHE112,
1) Based on these results, the department rates student performance in regard to this outcome as strong. The only benchmark that was not met was only missed by a narrow margin. Performance compares well to the previous year.
2) Curriculum and teaching strategies will remain largely unchanged, as it seems that students are acquiring the desired laboratory skills.
<table>
<thead>
<tr>
<th><strong>Outcome #</strong>: 3</th>
<th><strong>Outcome Title</strong>: Scientific Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome Type</strong> (choose by bolding): <strong>Discipline/Program</strong>: General Ed; Other <strong>If General Education</strong> outcome (choose by bolding): Communication; Critical Thinking; Quantitative Reasoning; Use of Technology; Diversity and Global Awareness; Leadership and Teamwork</td>
<td><strong>Outcome Description</strong>: A student will demonstrate mastery of the approach and rationale of the scientific method and be able to apply these principles to solve problems.</td>
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<table>
<thead>
<tr>
<th><strong>Benchmark for success</strong></th>
<th><strong>Description of assessment process</strong>:</th>
</tr>
</thead>
</table>
| 1) Please specify what percentage of the sample size is expected to meet or exceed your benchmark.  
2) What is the rationale for choosing this measure? | 1) Student laboratory notebooks were reviewed and assessed at the end of the semester using a standard rubric. Seven components (Table of Contents, Purpose, Procedures, Data Collection, Tabulated Results, Discussions, Completion Signatures, and Dates) of the lab notebook were reviewed on a scale of 0 to 4.  
2) The ability to properly keep a lab notebook is a significant skill for chemistry students. Students who are able to score 3 or 4 out of a possible 4 in the components listed above are doing a good job of collecting, organizing, and analyzing real data from the laboratory, and are using this data to solve problems presented in lab.  
3) This outcome is measured yearly.  
4) This year, 89 students in CHE111 and CHE112 participated in this assessment. |

| **Results** | 1) At least 85% of CHE111 and CHE112 students will score a 3 on a scale of 0 to 4 in each component reviewed. At least 75% of CHE111 and CHE112 students will score a 4 on a scale of 0 to 4 in each component reviewed.  
2) This is the second year for this assessment method. Last year’s benchmarks were exceeded by a large margin, and these benchmarks seem like a reasonable goal. |
| What were the results of the assessment process? (List results for each method, if more than one were used.) | Of the 89 students participating, 80 scored at least 3 out of 4 in each component reviewed. This is 89.9%, which exceeds the first benchmark of 85%.  
Of the 89 students participating, 63 scored 4 out of 4 in each component reviewed. This is 70.8%, which does not meet the benchmark of 75%. |

| **What did the department learn?** | 1) The group exceeded the first benchmark but failed to meet the second.  
2) Last year, the group far exceeded both benchmarks, but the benchmarks were adjusted accordingly. Therefore, overall performance on this assessment remained about the same for both years.  
3) N/A |
| 1) How did group performance compare to the benchmark?  
2) How does the data compare to the previous year, if applicable?  
3) If multiple measures were used, how do they compare to each other? | |

<p>| <strong>Student performance summary</strong> | 1) Based on these results, the department rates student performance in regards to this outcome as strong. Students are doing a good job of properly keeping a laboratory notebook throughout the semester. |
| 1) Based on the findings, how does the department rate student performance in regards to this outcome | |</p>
<table>
<thead>
<tr>
<th>(strong, weak, or neutral)?</th>
<th>2) How does this assessment affect plans for this coming year in terms of curricula, teaching strategies, and assessment methods?</th>
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<tbody>
<tr>
<td></td>
<td>2) The results of this assessment indicate that students are doing a good job keeping lab notebooks and using them to collect and analyze data. This is an important skill which needs to continue in the curriculum of CHE111 and CHE112, and teaching strategies will not be adjusted.</td>
</tr>
<tr>
<td>Outcome #:</td>
<td>4</td>
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<tr>
<td><strong>Outcome Type</strong> (choose by bolding):</td>
<td><strong>Outcome Title</strong>: Scientific Literacy</td>
</tr>
<tr>
<td>Discipline/Program; General Ed; Other</td>
<td><strong>Outcome Description</strong>: A student will demonstrate the ability to read and write about scientific literature that is relevant and appropriate to a specific course.</td>
</tr>
<tr>
<td>If General Education outcome (choose by bolding): Communication; Critical Thinking; Quantitative Reasoning; Use of Technology; Diversity and Global Awareness; Leadership and Teamwork</td>
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</tbody>
</table>
| **Benchmark for success** | 1) At least 85% of students will score a 4 on a scale from 0 to 5 in accordance to card completion, and at least 75% of students will score a 5 on a scale from 0 to 5.  
2) New benchmarks were set after last year’s benchmarks were exceeded by a large margin. |
| **Description of assessment process:** | 1) Students completed a physical property reference card for a chemical compound using the CRC (Chemical Rubber Company Handbook of Chemistry and Physics) and/or online resources. Students were assessed according to a rubric on whether the data was correct, and on whether it was recorded with correct units.  
2) For this assessment, students were required to use common reference materials to look up typical data about a compound. In order to succeed, students needed to be able to correctly identify the compound given only the name, and then interpret the data from the literature reference.  
3) This outcome is measured yearly.  
4) This year, 71 students participated in this assessment. |
| **Results** | Of the 71 students who were asked to determine some of the physical properties of a given chemical compound, 59 of them scored at least a 4 on a scale of 0 to 5. This is 83.1%, which just misses the benchmark of 85%. Of these students, 44 scored a 5 out of 5, meaning that they correctly identified the compound and reported its physical properties with correct units. This represents 62.0% of the entire sample, which misses the benchmark of 75%. |
| **What did the department learn?** | 1) Group performance just missed both benchmarks established for this assessment.  
2) For 2007-2008, the benchmarks were set much lower and were easily exceeded. Overall, student performance was slightly worse this year. (92.8% reaching the first benchmark last year, and only 83.1% reaching it this year.) This is thought to be largely a matter of carelessness on the part of students participating, rather than on a lack of learning. This assessment method is offered for either no credit, or for a small amount of extra credit in our classes. Therefore, it was noted that many students rushed through the assessment with little effort.  
3) N/A |
| **Student performance summary** | 1) Based on these results, the department rates student performance as weak.  
2) This outcome will be tabled for the 2009-2010 school year. Although this may be an area in which the department needs improvement, this particular assessment method is not assessing |
2) How does this assessment affect plans for this coming year in terms of curricula, teaching strategies, and assessment methods?

<table>
<thead>
<tr>
<th>weak, or neutral)?</th>
<th>student learning. Many teachers feel that collecting this data is cumbersome, as it is not an embedded assessment. We also feel that the data being generated is not really telling us anything reliable about student learning.</th>
</tr>
</thead>
</table>


Part 2: Current Academic Year Assessment Plan

Introduction to a more flexible approach

Assessment planning is more flexible than in previous years.

- Your program may wish to examine how retention differs among sections of an important course or you may choose to do an analysis of grade inflation across courses within your program/discipline. Such items aren't truly student outcomes, but they certainly affect learning. As such, these outcomes will be classified as "Other" in the summary you create next year. (Measuring such outcomes is purely optional.)
- Two or more instruments of measuring an objective may provide greater clarity and validity, but only one is required. The department or program makes the decision. The Program Assessment committee and deans are available for consultation.
- In the past, some programs have been identified purely by prefix or in some cases by the type of section offered. Sometimes, a very limited pool of students have been available for such a program to assess, or the program lacks full-time faculty to plan, assess, and report outcomes. If your program has such difficulties, please contact either the Program Assessment committee’s chair or your School’s Program Assessment committee representative. We will work with you to find a solution.
- CTE programs with external accreditation may use the accreditation report to in addition or in lieu of these forms, please contact the Program Assessment committee representative if this format is desired. In absence of this contact, these forms are expected.
- Outcomes are to be measured annually. Exceptions are made with VPI approval for outcomes that clearly need a less (or more) frequent review.

Outcome minimums

- At least two outcomes are to be program-related.
- At least two outcomes are to be General Education in nature. One General Education outcome must be continued from the prior year to develop a historical trend. General Education outcomes need to be assessed and reported annually, regardless of the frequency of reporting for other outcomes.
- Both outcomes above are classified as "student learning" outcomes, requiring benchmarks and analysis. It is strongly recommended that you use the table provided in Part 1 of this report for this function. Definitions and examples of these outcomes are provided in Appendix A at the end of this document. Your Program Assessment committee is available to assist.
- An assessment report is requested annually. Such a report may only consist of a report on General Education outcomes and a plan summarizing where your program is in an assessment with multi-year frequency.
Current Academic Year: 2009-10

Intended Learning Outcomes (only include if they differ from those noted in Part 1)
Outcomes 1-3 are to be the same as in Part 1.
Outcome #4: Students will demonstrate the ability to use critical thinking and quantitative reasoning to solve problems related to chemistry concepts
Outcome #5: Students prepared for first semester general chemistry (CHE111) will successfully complete the course.

Assessment Method(s) (only include if they differ from those noted in Part 1)
Outcome #1: CHE112 standardized exam
Outcome #2: CHE111 laboratory project
Outcome #3: CHE112 laboratory project
Outcome #4: CHE111 pre/post test
Outcome #5: CHE111 standardized diagnostic exam and correlation with final grades

Benchmarks (only include if they differ from those noted in Part 1)
Outcome #1: department average on the ACS standardized exam will meet or exceed national average
Outcome #2: At least 75% of students will determine the concentration of an unknown acid to within 4% of the true concentration, and at least 50% of students will determine the concentration to within 1%.
Outcome #3: At least 75% of students will identify at least 4 of 5 unknown ions in a sample, and at least 50% of students will identify all 5 ions.
Outcome #4: There will be a statistically significant improvement on the pre/post test.
Outcome #5: At least 75% of students who are prepared for CHE111 (as predicted by their scores on the ACS Toledo diagnostic exam) will complete the course with a grade of “C” or better.

Have you submitted a separate budget worksheet? (Choose by bolding; for information about this worksheet, please refer to the specific budgeting e-mail sent by the committee chairperson.)
   Yes   No

Please submit this report (including both last year's summary and this year's plan) in a Word document to the Program Assessment committee chairperson (cheyne.bamford@arapahoe.edu). If you have any questions about the process, please contact the chairperson.