

Assessment Report Chemistry Department

Part I-Assessment SUMMARY (2005-2006)

A. Program/Discipline 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.

B. Intended Outcomes

After successfully completing a chemistry course (including the lecture and laboratory components) at Arapahoe Community College,

1. A student will demonstrate mastery of competencies identified on the competency-based syllabus for that specific course.
2. A student will acquire the ability to analyze data, consider problems, and propose scientifically reasonable and acceptable solutions to these problems.
3. A student will acquire the ability to use chemical apparatus, instrumentation and equipment properly and safely.
4. A student will demonstrate mastery of the approach and rationale of the scientific method and be able to apply these principles to solve problems.
5. A student will demonstrate the ability to read scientific literature and to discuss topics that are relevant to and appropriate for a specific course.

C. Benchmarks

Benchmarks for each of the four assessment activities administered by the chemistry department have been established.

Assessment activity #1: The American Chemical Society (ACS) standardized exam
Benchmark: The student average on this exam should be the same as or higher than the national average. (Outcome: 1)

Assessment activity #2: The American Chemical Society (ACS) Toledo Exam

This exam is a diagnostic exam used to determine if students are prepared to take CHE 111. The grades on this exam will be correlated with final grades in CHE 111. This exam will be used to track retention through CHE 111.

Benchmark: 95% of students enrolled in CHE 111 will take this exam. 75% of students who are prepared to take CHE 111 (as predicted by their scores on the Toledo exam) will successfully complete CHE 111. (Outcome: 1)

Assessment activity #3: Writing assignment: Abstracts in Organic Chemistry I (originally proposed for Organic Chemistry II)

Benchmarks: (Outcome: 1, 5)

1. 20% of the students will score a 2 on a scale from 0 to 2 in each area reviewed.
2. 75% of the students will score a 1 on a scale from 0 to 2 in each area reviewed.

Assessment activity #4: Guided Inquiry Experiment in General College Chemistry I

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 70% of the groups will score a 2 on a scale from 0 to 4 in each area reviewed.
2. 10% of the groups will score a 4 a scale from 0 to 4 in each area reviewed.

Assessment activity #5: Guided Inquiry Experiment in General College Chemistry II

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 75% of the groups will score a 2 on a scale from 0 to 4 in each area reviewed.
2. 15% of the groups will score a 4 a scale from 0 to 4 in each area reviewed.

Assessment activity #6: Experiment in Organic Chemistry II (originally proposed for Organic Chemistry I)

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 75% of the students will synthesize the desired product.

D. Assessment Results

1. Historical Context

Faculty who teach in the chemistry department are dedicated to helping students learn the required content and skills in each course they teach. Faculty use the results of previous year's assessment activities to evaluate course requirements, course activities, and instructional strategies.

A variety of techniques are used to assess student understanding of information that is learned in the classroom as well as in the laboratory.

The faculty in the chemistry department strive to teach students content as well as skills that students will use throughout their academic and professional careers. To this end, the faculty in the chemistry department uses a variety of projects to help teach students the skills we feel are essential for their success in the chemistry classroom and beyond. For example: the ACS Toledo Exam assesses if students are sufficiently prepared (with respect to pre-requisite chemistry content knowledge as

well as math skills) to take general college chemistry (CHE 111); ACS exams are used to assess content knowledge; A guided inquiry approach to teaching general chemistry labs; Students are expected to prepare posters about their guided inquiry experiments in general college chemistry (CHE 111/112); Students enrolled in organic chemistry (CHE 211/212) are expected to write abstracts and to do a presentation relevant to organic chemistry.

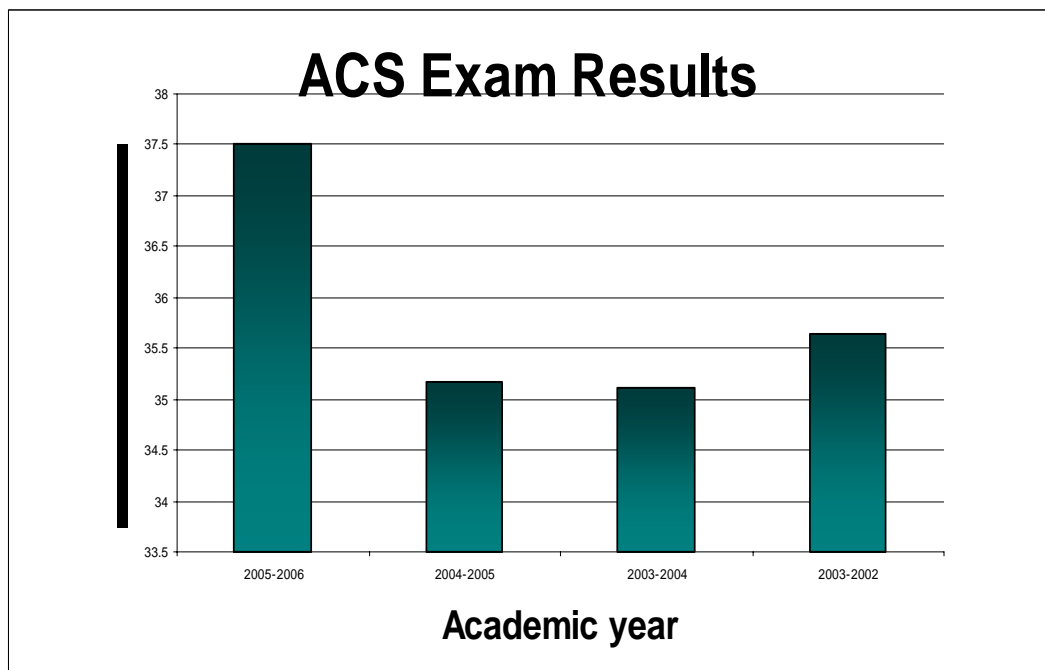
2. Current Year Data Results

Assessment activity #1: ACS Standardized exam

The ACS standardized exam was administered to 52 students enrolled in CHE 112 (General College Chemistry II) in during the fall, 2005 and spring, 2006 semesters. This was an embedded assessment. The average score on this exam was 37.5 out of 70. The national average on this exam is 41.0 out of 70. These results fail to meet the benchmark established for this assessment activity.

In previous years, the 2001 ACS Conceptual Exam for General Chemistry was administered to students enrolled in CHE 112. The 2005-2006 academic year was the second year in which the 2003 exam for General Chemistry was administered to students. Both exams focus on the same content; however the 2003 General Chemistry exam uses a more mathematical approach than the 2001 Conceptual Exam for General Chemistry. (The 2001 edition of the conceptual exam is the most recent version.)

The following graph presents average student performance on the ACS exam by year. Please note: Making comparisons between the conceptual and non-conceptual exam may or may not be valid.



Assessment activity #2: The American Chemical Society (ACS) Toledo Exam

This was the first year that the ACS Toledo Exam results were used as part of the chemistry assessment. The ACS Toledo Test of Basic Skills determines if students are adequately prepared (with respect to chemistry and math content knowledge) to begin CHE 111 – general college chemistry.

Eighty six students took the exam in the fall, 2005 and spring, 2006 semesters. Of these, 61 students completed CHE 111 with a grade of C or better. (C is transferable. Grades of “D” were not included as being retained, as these students will need to retake CHE 111 if they intend to transfer the class to a four-year institution.) This is 70.93% retention rate overall.

Assessment activity #3:

Writing assignment: Abstracts in Organic Chemistry I (originally proposed for Organic Chemistry II)

This assessment was not completed because the course instructor was not informed to collect assessment data using the designed rubric when evaluating the abstracts.

Four criteria were supposed to be selected from the rubric used to evaluate the abstracts. These criteria are:

1. The abstract provides the reader with a concise summary of the topic to be discussed.
2. The abstract stands alone.
3. The abstract is appropriate in length. One paragraph (80-200 words is adequate in most cases)
4. The abstract is scientifically accurate. (That is, the abstract contains no content errors or ambiguous statements.)

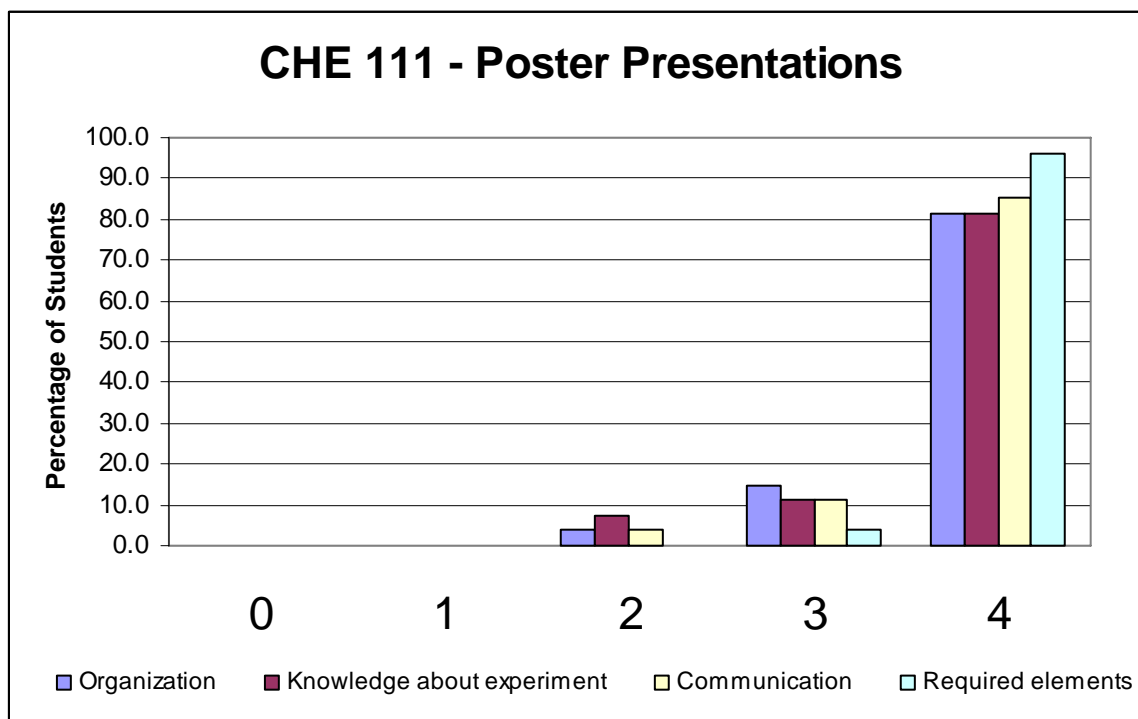
Assessment activity #4:

Poster Presentation: Guided Inquiry Experiment in General College Chemistry I

Four criteria were selected from the rubric used to evaluate the posters. These criteria are:

1. The material is organized in a logical sequence and with a clear structure. (Organization)
2. The poster provides evidence of knowledge and understanding of the experiment. (Knowledge about experiment)
3. The poster communicates clearly and effectively with the reader. (Communication)
4. All required elements of the poster present. (Required elements)

The graph below represents how students performed in each of the four categories evaluated.



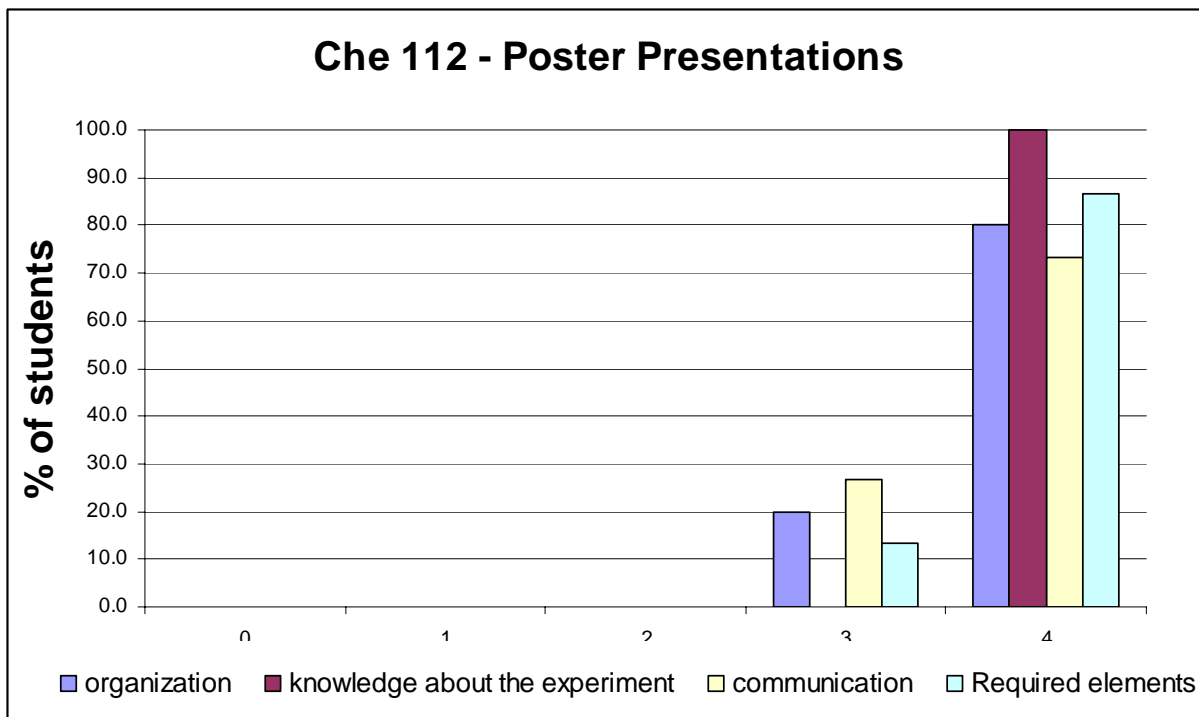
Assessment activity #5:

Poster Presentation: Guided Inquiry Experiment in General College Chemistry II (CHE 112)

Four criteria were selected from the rubric used to evaluate the posters. These criteria are:

1. The material is organized in a logical sequence and with a clear structure. (Organization)
2. The poster provides evidence of knowledge and understanding of the experiment. (Knowledge about experiment)
3. The poster communicates clearly and effectively with the reader. (Communication)
4. All required elements of the poster present. (Required elements)

The graph below represents how students performed in each of the four categories evaluated.



Assessment activity #6: Experiment in Organic Chemistry II (originally proposed for Organic Chemistry I)

The goal of this experiment was for second-semester organic students to synthesize slime and silly putty. Students were required to draw the mechanism of each reaction as part of this experiment.

All of the students who participated in this experiment were able to synthesize the desired product. All students successfully presented the mechanisms of these reactions.

3. Analysis

Assessment activity #1:

The American Chemical Society (ACS) standardized exam

Benchmark: The class average on this exam should be the same as or higher than the national average.

Students enrolled in CHE 112 did not achieve the benchmark established for this activity. The national average on this exam is 58.61%. The average score for ACC students is 50.26%. Only 22.22% of students scored at or above the national average on this exam

In previous years, students took the 2001 ACS Conceptual Exam in General Chemistry. This exam emphasizes a conceptual understanding of chemistry concepts. Although this instrument examines mathematical relationships in chemistry, it does not strongly emphasize mathematical concepts. For the second year in a row, students took the 2003 ACS General Chemistry Exam. This exam strongly emphasizes mathematical relationships in chemistry.

ACS standardized exams assesses many of the course competencies established for CHE 111/112. (Course competencies for CHE 111/112 were established by chemistry instructors as part of the Common Course Numbering project. These course competencies are available online at <http://cccns.cccs.cccoes.edu/combo.asp?prefix=CHE>)

The average student score on the ACS exam in 2005-2006 is still below the national average. It is important to note, however, that the results of this year's assessment indicate that students performed better on the ACS exam in 2005-2006 than in 2004-2005. This result may be explained by the following:

1. Improved instruction
 - As a result of the previous assessment, instructors may have addressed mathematical concepts more effectively in CHE 111/112.
2. A different group of students
 - The improved scores may simply be a result of changing the group of students who took the exam.
3. A combination of instruction and students
4. Another unidentified factor.

The ACS exam will be used again in the 2006-2007 academic year. It is hoped that student performance on this exam will continue to improve.

Assessment activity #2: **The American Chemical Society (ACS) Toledo Exam**

Benchmark: 95% of students enrolled in CHE 111 will take this exam. 75% of students who are prepared to take CHE 111 (as predicted by their scores on the Toledo exam) will successfully complete CHE 111. (Outcome: 1)

All of the students enrolled in CHE 111 in the fall, 2005 and spring, 2006 semesters who attended the first laboratory session took the ACS Toledo exam.

Results from this year's assessment show a 70.93% retention rate. This value falls short of the established benchmark of 75%.

It is important to note that this was the first year the results from the ACS Toledo exam were included in the assessment. Improvements in the way the results are collected will be made in light of the results of this year's assessment.

Tracking the results of the ACS Toledo exam proved to be more challenging than expected. Reasons for this:

1. This year, names and scores were not collected. The only data collected was (1) the number of students who took the exam and (2) the scores on the exam.
2. The Toledo exam is given during the first scheduled lab period. Students who add CHE 111 after the first lab period do not take the Toledo test. Also, many students drop the class before the drop/add deadline. This means that they have taken the Toledo test and their results are included in the data even though the student has dropped the class.
3. In the fall, 2005 and spring, 2006 semesters, all students enrolled in CHE 111 who attended the first lab session took the ACS Toledo exam. Not all of those results are included in this report.

Going forward, it will be important to consider the following:

1. Collect and compile data from all sections (or all selected sections) for the assessment report.
2. Remove students who drop CHE 111 after taking the Toledo test.
3. Do not count students who add CHE 111 after the Toledo test has been administered.

Assessment activity #3:

Writing assignment: Abstracts in Organic Chemistry I

Benchmark:

1. 20% of the students will score a 2 on a scale from 0 to 2 in each area reviewed.
2. 75% of the students will score a 1 on a scale from 0 to 2 in each area reviewed.

These benchmarks were not met because the course instructor was not informed to collect assessment data using the designed rubric when evaluating the abstracts.

Assessment activity #4: Guided Inquiry Experiment in General College Chemistry I

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 70% of the groups will score a 2 on a scale from 0 to 4 in each area reviewed.
2. 10% of the groups will score a 4 on a scale from 0 to 4 in each area reviewed.

Both of the benchmarks for this activity were achieved.

Faculty in the chemistry department were impressed with the efforts put forth by the students in CHE 111. Students were asked to determine the pH values of common household products. Students did a great job identifying the problem, limiting the scope of their investigations,

designing experiments, and executing those experiments. Furthermore, students assembled posters that were both informative and aesthetically pleasing.

Assessment activity #5: Guided Inquiry Experiment in General College Chemistry II

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 75% of the groups will score a 2 on a scale from 0 to 4 in each area reviewed.
2. 15% of the groups will score a 4 a scale from 0 to 4 in each area reviewed.

Both of the benchmarks for this activity were achieved.

Again, faculty in the chemistry department were quite impressed with the efforts put forth by the students in CHE 112. Students assessed the water quality (water hardness and alkalinity) of a variety of water samples. Students did a great designing and executing experiments. Students assembled posters that were both informative and aesthetically pleasing.

Assessment activity #6:

Experiment in Organic Chemistry II

Benchmark: 75% of the students will synthesize the desired product.

This benchmark was achieved. This result indicates that students enrolled in organic chemistry successfully learned the experimental techniques required to perform this experiment and the subsequent analysis of the reaction product. This result also shows that students understand how to “push arrows” and represent reaction mechanisms.

Overall, the chemistry department is pleased with the results of each assessment activity.

C. Use of Results

This assessment report will be shared with all faculty (full time and adjunct) who teach in the chemistry department.

The results of these assessment activities will be used to monitor, review, re-evaluate, and, if necessary, revise the goals of the CHE 111/112 and CHE 211/212 curricula.

Part II – Assessment PLAN (Academic Year 2006-2007)

A. Intended Outcomes

- Please see **Part I-B**

B. Identify Assessment Procedures/Methods

Learning outcome	ACS Final Exam CHE 111 CHE 112	ACS Toledo Exam CHE 111	Standardized Final Exam CHE 111	Laboratory Practical QA CHE 111	Guided inquiry experiment CHE 112
Demonstrate mastery of competencies identified by the competency-based syllabus for that specific course.	X	X	X	X	X
Acquire the ability to analyze data, consider problems, and propose scientifically reasonable and acceptable solutions to these problems.	X	X	X	X	X
Acquire the ability to use chemical apparatus, instrumentation and equipment properly and safely.				X	X
Demonstrate mastery of the approach and rationale of the scientific method and be able to apply these principles to solve problems.				X	X
Demonstrate the ability to read and write about scientific literature that is relevant and appropriate to a specific course.				X	X

C. Benchmarks

Benchmarks for each of the four assessment activities administered by the chemistry department have been established.

Assessment activity #1: The American Chemical Society (ACS) standardized exam
Benchmark: The class average on this exam should be the same as or higher than the national average. (Outcome: 1, 2)

Assessment activity #2: The American Chemical Society (ACS) Toledo Exam

This exam is a diagnostic exam used to determine if students are prepared to take CHE 111. The grades on this exam will be correlated with final grades in CHE 111. This exam will be used to track retention through CHE 111.

Benchmark:

1. 95% of students enrolled in CHE 111 will take this exam.
2. 75% of students who are prepared to take CHE 111 (as predicted by their scores on the Toledo exam) will successfully complete CHE 111. (Outcome: 1, 2)

Assessment activity #3: Standardized Final Exam in General College Chemistry I

This exam is designed by the chemistry faculty and is administered as the final cumulative exam for all CHE 111 sections. Data will be collected on student performance to assess each content area for General College Chemistry I. (Outcome: 1, 2)

Benchmark:

1. 75% of the groups will score a 75% on the exam.
2. 10% of the groups will score a 90% on the exam.

Assessment activity #4: Laboratory Practical QA in General College Chemistry I

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 75% of the groups will score a 2 on a scale from 0 to 4 in each area reviewed.
2. 15% of the groups will score a 4 on a scale from 0 to 4 in each area reviewed.

Assessment activity #5: Guided Inquiry Experiment in General College Chemistry II

Benchmarks: (Outcome: 1, 2, 3, 4, 5)

1. 75% of the groups will score a 2 on a scale from 0 to 4 in each area reviewed.
2. 15% of the groups will score a 4 on a scale from 0 to 4 in each area reviewed.