

# Assessment Report Chemistry Department

## Part I-Assessment SUMMARY (2003-2004)

### 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 and write about scientific literature that is relevant and appropriate to a specific course.

### C. Benchmarks

Benchmarks for each of the three 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.

#### **Assessment activity #2: Calibrated Peer Review (CPR) writing assignments**

Benchmark: 25% of the students participating in the CPR assignments required in CHE 111/112 (General College Chemistry I/II) will achieve an RCI score of 5 or higher. 75% of the students will achieve and RCI score of 4 or higher. (RCI is the Reviewer Competency Index. The RCI score is indicative of how well students understand the chemistry content

of each assignment. RCI scores range from 0 (poor performance on the calibration essays) to 6 (excellent performance on the calibration essays).

### **Assessment activity #3: Laboratory practical exam**

Benchmark: 75% of the students enrolled in CHE 112 should achieve a score of 70% or higher on the practical exam.

## **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 have used the results of previous year's assessment activities to evaluate course requirements and instructional strategies.

### **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 fall, 2003 and spring, 2004 semesters. This was an embedded assessment. The average score on this exam was 35 out of 60.

#### **Assessment activity #2: Calibrated Peer Review**

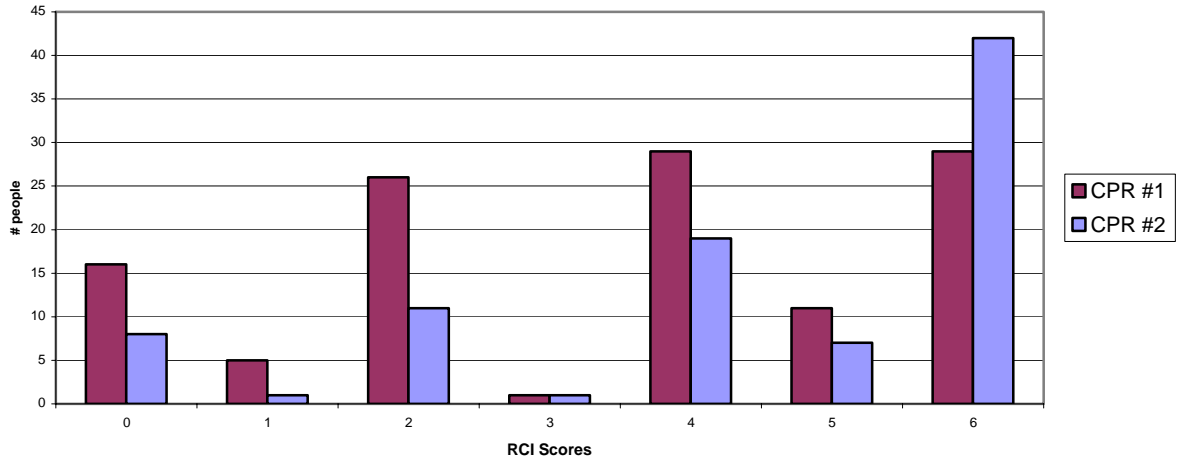
Calibrated Peer Review (CPR) is an internet-based program that enables students to write about scientific topics and to learn about the peer-review process. CPR assignments were embedded assessments. All students enrolled in CHE 111 and CHE 112 in fall, 2003 and spring, 2004 were required to complete two CPR assignments during each course. More information about CPR may be found at <http://cpr.molsci.ucla.edu>.

Each CPR assignment requires students to complete calibration essays. Students are assigned a score based on their performance on these calibration essays. This score is reported as the Reviewer Competency Index – RCI. The RCI score is indicative of how well students understand the chemistry content of each assignment. RCI scores range from 0 (poor performance on the calibration essays) to 6 (excellent performance on the calibration essays).

#### **Results for CPR assignments in CHE 111**

A total of 117 students participated in the first CPR assignment; 89 students participated in the second assignment. The following graph shows the RCI scores as a function of the number students who achieved that score on each CPR assignment. The graph shows that a greater percentage of students received higher RCI scores on the second CPR assignment than on the first assignment.

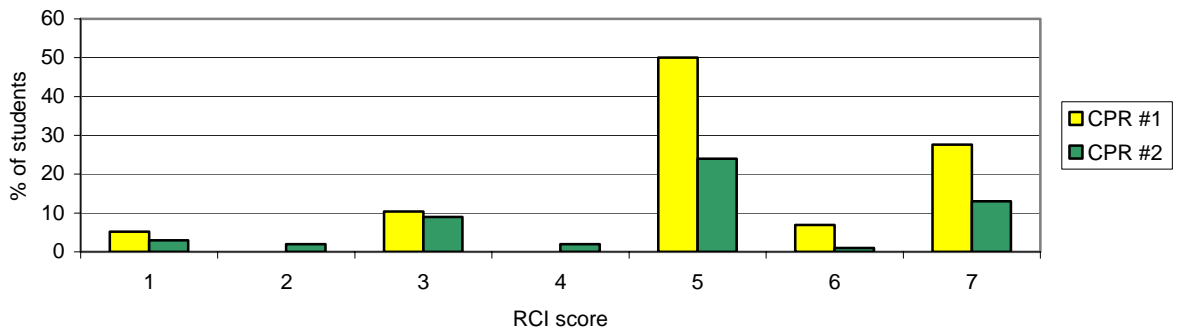
**CHE 111 - CPR Assignments  
RCI scores**



**Results for CPR assignments in CHE 112**

A total of 58 students participated in the first CPR assignment; 54 students participated in the second assignment. The following graph shows the RCI scores as a function of the number students who achieved that score of each CPR assignment. This graph shows that a greater percentage of students received higher RCI scores on the first CPR assignment than on the second.

**CHE 112 - CPR Assignments  
RCI scores**



### **Assessment activity #3: Laboratory practical exam**

A laboratory practical exam was administered to the 29 students enrolled in CHE 112 (General College Chemistry II) during the spring, 2004 semester. The assessment was an embedded assessment.

Students were asked to perform three tasks. These tasks were related to laboratory techniques and chemical concepts from CHE 111/112. Each task on the lab practical exam was graded by one of the three CHE 112 instructors. The highest possible score on the lab practical exam was 80 points. The average score on the exam was 58 out of 80 points (73%).

### **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 successfully achieved the benchmark established for this activity. The national average on this exam is 33 out of 60. The average score for ACC students is 35 out of 60. Thirty two out of 52 students (62%) achieved a score of 33 or higher on this exam.

For the second year in a row, students achieved the benchmark established for the ACS standardized exam. The results of the ACS exam show that students are learning the essential information in CHE 111/112, as this exam 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 appear in the appendix at the end of this report.)

#### **Assessment activity #2: Calibrated Peer Review (CPR)**

**Benchmark:** 25% of the students participating in the CPR assignments required in CHE 111/112 (General College Chemistry I/II) will achieve an RCI score of 5 or higher. 75% of the students will achieve an RCI score of 4 or higher. (RCI is the Reviewer Competency Index. The RCI score is indicative of how well students understand the chemistry content of each assignment. RCI scores range from 0 (poor performance on the calibration essays) to 6 (excellent performance on the calibration essays).)

The results for the CPR assignments are summarized below.

<b>CHE 111</b>	<b>% of students scoring</b>		<b>CHE 112</b>	<b>% of students scoring</b>	
	<b>RCI 4-6</b>	<b>RCI 5-6</b>		<b>RCI 4-6</b>	<b>RCI 5-6</b>
Assignment #1	59	34	Assignment #1	84	34
Assignment #2	76	55	Assignment #2	70	26

The data presented above indicates that the results of this assessment were mixed. In CHE 111, a larger percentage of students achieved a higher RCI rating in the second

CPR assignment than on the first. In CHE 112, fewer students received an RCI rating of 4 or higher on the second CPR assignment.

For a second year in a row, students enrolled in both CHE 111 and CHE 112 performed well on the CPR writing assignments. The results from this assessment show that students are mastering many important concepts from CHE 111/112. Furthermore, the results of this assessment show that students are learning how to read and write about scientific literature in a way that is relevant and appropriate to these specific courses.

**Assessment activity #3: CHE 112 Laboratory practical exam**

Benchmark: 75% of the students enrolled in CHE 112 should achieve a score of 70% or higher on the practical exam.

The average score on the CHE 112 lab practical exam was 73%. 62% of the students who took the lab practical exam scored at least 70%. This result is less than the benchmark established for this activity.

This was the first time a laboratory practical exam was administered in CHE 112. This assessment provides a great deal of information about what students are learning in the CHE 111/112 laboratory program. Overall, the results of this assessment suggest that students are learning many techniques that are relevant to the CHE 111/112 curriculum. The results also indicate that many students are not making connections between the tasks they were asked to complete on the practical exam and the tasks they had previously completed in the laboratory. This result suggests that the chemistry department should review and/or revise the goals of the CHE 111/112 lab curriculum.

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

**D. Use of Results**

This assessment report will be shared with all faculty in the chemistry department.

The results of these assessment activities will be used to review, re-evaluate, and, if necessary, revise the goals of the CHE 111/112 laboratory curriculum. Beginning in the fall, 2004 semester, a new curriculum has been introduced into the CHE 111/112 laboratory program. This program used a guided inquiry approach. The hope is that this new approach will help students to better understand how to approach problems and to propose meaningful solutions to the questions they encounter in the laboratory.

## Appendix

### Course competencies for CHE 111

- I. Apply scientific notation and significant figures in measurement and stoichiometric calculations.
- II. Apply atomic theory to the periodic table to explain various kinds of chemical principles and concept.
- III. Illustrate polarity, geometry, bond angle, hybridization, physical and chemical properties of different compounds using Lewis structures.
- IV. Interconvert masses, moles, numbers of particles, and volume.
- V. Interpret the computed outcome of a chemical calculation to determine its validity.
- VI. Connect real world applications to chemical models.
- VII. Compare and contrast the basic bonding theories of valence shell electron pair repulsion theory, valence bond theory and molecular orbital theory, pointing out the strengths and weaknesses.
- VIII. Classify the basic types of chemical reactions and predict the products for a given set of reactants.
- IX. Conceptually and graphically illustrate the relationships of pressure, volume, mole quantity and temperature for a gas at ideal conditions.
- X. Predict the states of matter based on intermolecular forces of attraction.
- XI. Apply the first law of thermodynamics to thermal systems.
- XII. Identify strong and weak electrolytes.
- XIII. Identify oxidation, reduction half reactions and oxidizing and reducing agents in a redox reaction.
- XIV. Be able to name compounds from formula or write formula from names.
- XV. Read, analyze, and apply to new situations, written material related to the study of chemistry.
- XVI. Write and speak clearly and logically in presentations and essays about topics related to chemistry.
- XVII. Demonstrate the ability to select and apply contemporary forms of technology to solve problems or compile information in the study of chemistry.

### Course competencies for CHE 112

- I. Use kinetics to describe equilibrium and nuclear decay.
- II. Examine the various kinds of equilibria and discuss which would apply to a specific system.
- III. Through calculations, demonstrate how equilibrium would have a major influence on a system if subjected to a stress.
- IV. By experiment, demonstrate the relationship between free energy, moles and cell potential.
- V. Mathematically, describe the relationship of standard cell potentials and the equilibrium constant.
- VI. Compare and contrast the various areas where nuclear chemistry plays a part.
- VII. Use the nomenclature of an organic or biochemical compound and determine what kinds of physical and chemical properties exist.

- VIII. Conceptually and mathematically, report on how each of the concepts above are applied when conducting an experiment.
- IX. Draw structures of hydrocarbons from names and be able to write names, given the structures.
- X. Identify/Draw/Name geometric and structural isomers.
- XI. Read, analyze, and apply to new situations, written material related to the study of chemistry.
- XII. Write and speak clearly and logically in presentations and essays about topics related to chemistry.

## Part II – Assessment PLAN (Academic Year 2004-2005)

### A. Intended Outcomes

- Please see **Part I-B**

### B. Identify Assessment Procedures/Methods

Learning outcome	Assessment Methods			
	ACS Exam for CHE 111/112	CPR assignments	CHE 112 Guided inquiry experiment	CHE 212 Lab exercise
Demonstrate mastery of competencies identified by the competency-based syllabus for that specific course.	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
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	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 or higher than the national average.

**Assessment activity #2:** Calibrated Peer Review (CPR)

Benchmark: 75% of the students will achieve an RCI score of 4-6. (RCI = Reviewer Competency Index.)

**Assessment activity #3:** CHE 112 Guided inquiry experiment

Benchmark: 75% of the students enrolled in CHE 112 should achieve a score of 70% or higher on the guided inquiry experiment.

**Assessment activity #4:** CHE 212 Lab exercise

Benchmark: 70% of the students enrolled in CHE 212 should correctly identify how to characterize two unknown samples via chemical and spectroscopic analysis.

**\*\*SUBMIT BUDGET WORKSHEET WITH THIS PLAN\*\***  
(ATTACHED SPREADSHEET)