# Academic Program: Assessment Report 2009-2010

Unit/Department: Chemistry  
Division: CAS/NSE  

## Program Mission Statement

**From your Program Assessment Plan** (Statement should articulate the unit/program mission in support of the institutional mission and include a clearly defined purpose appropriate to collegiate education.)

The mission of the USC Upstate chemistry program is to provide a baccalaureate level education in chemistry that will prepare students for scientific careers in the Upstate region and beyond. Graduates of the chemistry program will possess a broad knowledge of chemistry and the technical and communication skills needed to pursue excellence in their chosen careers and in further study in chemistry, medicine, or business.

## Goal 1

**From your Program Assessment Plan** (Describe broad learning outcomes and concepts (what you want students to learn) expressed in general terms (clear communication, problem-solving skills, etc). Goals should focus on discipline-specific outcomes relevant to the program.)

**Goal 1:** Chemistry majors will have a broad knowledge base of chemistry and be able to apply that knowledge in problem solving and analysis.

## Objectives SLO's

(Specific skills, values and attitudes students should be able to exhibit that reflect the broader goals. Objectives (student learning outcomes) transform the general program goals into specific student performance/behaviors that demonstrate student learning and skill development along these goals.)

1.1: Chemistry majors will have a sound knowledge base in the following subdisciplines of chemistry: inorganic, organic, analytical, biochemistry, and physical chemistry.

1.2: Chemistry majors will be effective problem solvers who possess the ability to think critically and analyze chemical information.

## Assessment Methods

(Describe the measure(s) by which the department will know the students are meeting the departmental learning objectives. Includes both direct and indirect assessment. Each SLO should have at least one assessment method.)

1.1: Educational Testing Service (ETS) Major Field Test in Chemistry  
Chemistry Major Survey/Exit interview  

1.2: Educational Testing Service (ETS) Major Field Test in Chemistry  
Chemistry Major Survey/Exit interview  

## Assessment Criteria

(Level of achievement you are targeting (Indicate benchmarks, scores on assessment instruments, etc… that would indicate acceptable achievement under your plan).)

Having all students scoring at or above the national mean on the ETS Major Field Test in Chemistry.  
Average score at or above 2 on the Chemistry Major Survey.
1.1 Knowledge in the subdisciplines of chemistry

ETS Major Field Test in Chemistry
SCHM 599 was not offered in 2009-2010 because there were no chemistry majors who had completed enough of the curriculum to be ready for this capstone course. Therefore, the ETS Major Field Test in Chemistry was not administered this year. The graph below shows the percentage of students scoring at or above the national mean in each of the subdisciplines and in overall score from 2007 to 2009 (n represents the number of students).

The average student scores on each subdiscipline and the national means are shown below for 2007 to 2009.

*Scores on subdisciplines are scaled scores and range from 20-100.
The ETS Major Field Test in Chemistry measures an assessment indicator in biochemistry as an average for the group (minimum of 5 students). Since only one student from this institution took this test in 2009, an assessment indicator in biochemistry could not be obtained for 2009.

Chemistry Major Survey/Exit interview

In Spring 2010, there were no graduating chemistry majors so the Chemistry Major Survey and the Exit Interview were not implemented.

In Spring 2009, two graduating chemistry majors completed the Chemistry Major Survey. Since the students were not in the same classes (one student had taken SCHM 599 prior to Spring 2007), they were asked to make comments on the chemistry program in place of the exit interview. In Spring 2008 (first implementation of this survey), 5 majors completed the Survey and Exit Interview. Points were assigned to responses of the survey according to the following: 4 = very strongly developed knowledge base, 3 = strong knowledge base, 2 = developed knowledge base, 1 = weak knowledge base, and 0 = poorly developed knowledge base. The average ratings for 2008 and 2009, all of which are above 2, are shown below.

1.2 Critical thinking and problem solving ability

ETS Major Field Test in Chemistry

The ETS Major Field Test in Chemistry measures an assessment indicator in critical thinking and reasoning skills as an average for the group (minimum of 5 students). Since only one student took the test in Spring 2009 and no students took the test in 2010, assessment indicators for these years could not be obtained.

In Spring 2008 the average score in critical thinking/reasoning was 63, and in Spring 2007 the average score in critical thinking/reasoning was 66 compared to the national mean of 43.6
### Chemistry Major Survey/Exit Interview

There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009, the two graduating chemistry majors completed the Chemistry Major Survey to rate their effectiveness as a problem solver in chemistry including the ability to think critically and analyze chemical information. Points were assigned to responses according to the following: 4 = highly effective problem solver, 3 = effective problem solver, 2 = somewhat effective problem solver, 1 = deficient in problem solving skills, and 0 = very deficient in problem solving skills. The average rating in Spring 2009 was 2.5. The average rating of 5 students in Spring 2008 was 3.2. So far the averages have been consistently above 2.

### Action Plan

What actions or modifications have been or will be made based on this assessment?

In Spring 2009, more opportunities to practice taking multiple choice exams in chemistry were provided in order to improve performance on the Major Field Test. In addition, the test was administered during final exams after all material had been covered in physical chemistry. With only one student taking the exam in Spring 2009, it is difficult to determine if these measures impacted the student’s scores. In future offerings of SCHM 599, the instructor will suggest that students use the Learning Express Library (available through the USC Upstate Library) to help improve reasoning skills and provide further practice in taking standardized tests.

In the exit interview of chemistry majors in Spring 2008, students who had not taken biochemistry felt that they were at a disadvantage when taking the Major Field Test since some questions involved biochemical topics. In response to this, the chemistry curriculum was modified in 2008-2009 to make biochemistry (SCHM 581) a required course in the major. This requirement began with freshman majors who entered Fall 2009. Advisors are recommending that majors already in the pipeline take this course. Biochemistry was also added to the list of subdisciplines in SLO 1.1.

In Spring 2009 to address the difficulty students had in remembering organic reactions as noted in the exit interview in 2008, one of the organic chemistry professors provided the student in SCHM 599 with a summary of the major organic reactions as a study guide. With only one student taking the exam, it is difficult to determine if this impacted the student’s score in organic chemistry. The SCHM 599 instructor will continue to provide the study guide in order to improve performance.

Since there was no additional assessment data collected for Goal 1 in 2009-2010, there are no additional proposed actions or modifications.

### Implementation and Evaluation of Previous Years’ Action Plan

Which of the modifications indicated in the previous years’ reports were implemented this year and what was the impact?

There were no modifications in 2009-2010 since there were no graduating chemistry majors.
## Component Description

### Goal 2

From your Program Assessment Plan (Describe broad learning outcomes and concepts (what you want students to learn) expressed in general terms (clear communication, problem-solving skills, etc). Goals should focus on discipline-specific outcomes relevant to the program.)

**Goal 2:** Chemistry majors will be able to communicate chemical concepts, methods, and results effectively both in written and oral communications.

### Objectives SLO’s (student learning outcomes)

From your Program Assessment Plan (Describes the specific skills, values and attitudes students should be able to exhibit that reflect the broader goals. Objectives (student learning outcomes) transform the general program goals into specific student performance/behaviors that demonstrate student learning and skill development along these goals.)

2.1: Chemistry majors will be able to clearly explain methods, results, and chemical concepts in a laboratory report.

2.2: Chemistry majors will be able to effectively analyze and present research methods and results in research papers and oral presentations.

### Assessment Methods

From your Program Assessment Plan (Describes the measure(s) by which the department will know the students are meeting the departmental learning objectives. Includes both direct and indirect assessment. Each SLO should have at least one assessment method.)

2.1: Selected lab reports taken from SCHM 331L & 332L and SCHM 541L & 542L will be used. Rubrics, specifically designed for these lab reports will be used for the assessment.

Chemistry Major Survey/Exit interview

2.2: Students are required to write a research paper in both the junior and senior seminar courses (SCHM 397 and 599). Rubrics that are specifically designed for the research papers will be used for assessment.

Students are required to give oral presentations in the senior seminar course (SCHM 599). These presentations will be assessed using a rubric designed by the chemistry faculty for oral presentations.

Chemistry Major Survey/Exit interview

### Assessment Criteria

Level of achievement you are targeting (Indicate benchmarks, scores on assessment instruments, etc... that would indicate acceptable achievement under your plan)

A score of 70% or higher on assessments of reports, papers and presentations.

Having all students rate their written and oral communication skills as adequate or stronger on the Chemistry Major Survey.
2.1 Laboratory Reports

Selected Lab reports in SCHM 331L and SCHM 332L

In SCHM 331L, four lab reports (solubility, crystallization, caffeine extraction/sublimation, and spinach pigments/column chromatography) were selected for this assessment. The average scores of four of the chemistry majors were 69%, 76%, 69%, and 94%. Two students just missed the 70% benchmark. One of these two students showed significant improvement as the semester progressed, earning a 57 on the first lab report followed by scores in the upper seventies and mid eighties on lab reports completed toward the end of the semester. The other student’s average was based on two incomplete lab reports. Consequently, it is difficult to determine whether the structure of the course or lack of student self-motivation is the reason for the low average. The average student score was 77%. Compared to previous years, student performance slightly declined. In Fall 2008, all three majors scored above 70% and the average student score was 81%. Both majors met the 70% benchmark in Fall 2007, having an average student score of 84%. No majors were enrolled in 331L in 2006-2007.

In SCHM 332L, four lab reports were selected for this assessment: 2-butanol dehydration (GC), Diel’s-Alder synthesis, Grignard synthesis, and Friedel-Crafts synthesis. In Spring 2010 the average scores of the five chemistry majors were 75%, 75%, 93%, 92%, and 71%, which were all above 70% for this assessment. The average student score was 81%, which is within the range of averages earned in the past. Of these five students, three students were assessed on lab reports in SCHM 331L in Fall 2009. One student showed improvement from 331L to 332L; the average score increased from 69% to 75%. The remaining two students retained similar averages in both courses. In Spring 2009 one of two students showed an improvement in average scores from SCHM 331L to 332L (66% to 90%) while the other student’s average decreased from 90% to 84%. In Spring 2008, the one major increased the average score from 78% in 331L to 85% in 332L.

The graph below shows the percentage of majors meeting or exceeding the benchmark in SCHM 331L/332L.
The average scores on the assessments are shown below.

Selected Lab reports in SCHM 541L and SCHM 542L
SCHM 541L and 542L are offered every other year and so were not offered in 2009-2010. In SCHM 541L two lab reports, the first and last during the semester, are assessed based on a rubric which measures competency in writing lab reports. In SCHM 542L, the final lab report is also assessed. In 2008-2009, there was one chemistry major in 541L and 542L. This student scored 78% on both the first and last reports in 541L and 88% on the last report in 542L indicating there was considerable improvement from 541L to 542L.

In 2006-2007, ten majors scored an average of 64% on the first report and 73% on the last report with 50% of the students increasing their score on the last report. Of these students 80% (8 students) scored above 70% on the last report. In 542L the average score on the final report was 86% with 100% of the students scoring above 70%.
Chemistry Major Survey/Exit Interview
There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009, the two graduating chemistry majors completed the Chemistry Major Survey. With regards to SLO 2.1, one student rated communication skills in writing lab reports as strong, and the other student rated skills as adequate. Previously in Spring 2008, 4 out of 5 students rated skills as strong and one student rated skills as very strong.

2.2 Written and Oral Communications

Research papers in SCHM 397
In SCHM 397 (Junior Seminar), students are required to write two research papers based on primary literature. A rubric is used to evaluate the content and style (language usage and organization) of the paper. In Spring 2010, both the first and second papers from each student were evaluated separately on content and style. The average scores of the three students on content and style on the first paper were 82% and 78%, respectively, with an overall average score of 80%. On the second paper the average scores on content and style were 83% and 77%, respectively, with an overall average score of 80%. However, when looking at the individual scores in content (85%, 65%, and 95%) and style (75%, 65%, and 95%) on the first paper, one student failed to meet the 70% benchmark in both content and style. On the second paper, the individual scores in content (90%, 65%, and 95%) and style (85%, 60%, and 85%) were not much improved, and the same student still failed to meet the 70% benchmark in both content and style. The instructor noted that this student was a non-native English speaker who struggled with grammar and sentence structure. The student also struggled with the chemistry content perhaps because the student had just recently changed to a chemistry major and had not made higher than a C in chemistry course work so far.

The percentage of majors meeting or exceeding the benchmark over the past several years is shown below. SCHM 397 was not offered in 2008-2009.
The average assessment scores on content and style of the research papers over the past several years is shown below.

![Bar Chart](chart.png)

**Research paper in SCHM 599**

SCHM 599 was not offered in 2009-2010. Below is a summary of results from the previous three years. Chemistry majors in the senior seminar course are required to write a research paper based on primary literature. A rubric is used to evaluate the content and style (including language usage and organization) of the paper. Each paper is graded by two instructors.

In Spring 2009, one student was enrolled in SCHM 599. The average scores on content and style of this student’s paper were 85% and 77%, respectively, giving an average overall score of 81%. The instructors who assessed the senior seminar paper noted that it was evident that the student had not put much time into editing the paper.

In Spring 2008, 4 out of 5 students enrolled were assessed. The average content and style scores were 93% and 89%, respectively. The average overall score was 91%. One student did not turn in a research paper and so could not be assessed. This student did not pass the course.

In Spring 2007, four students were assessed on content and style of which the average scores were 88%, on each. The average overall score was 88%.

Since 2006-2007, 100% of our majors who were assessed met or exceeded the benchmark for the research paper in both content and style. The average scores on content and style are shown below.
Chemistry Major Survey/Exit Interview
There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009, the two graduating chemistry majors completed the Chemistry Major Survey. With regards to ability to communicate in a research paper, one student rated writing skills as strong, and the other one rated skills as adequate. In the Spring 2008 survey (first time implemented), all 5 students rated their writing skills as strong. One student commented on the 2009 survey that students in junior seminar should be encouraged to start selecting and researching their topics for senior seminar.

Oral Presentations in SCHM 599
SCHM 599 was not offered in 2009-2010. Below is a summary of results from the previous three years. In SCHM 599, senior chemistry majors present a short and a long oral presentation on a research topic. Each presentation is assessed for style and content. The average scores are shown in the graph below.
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Of the 10 students assessed to date, only one student in 2007-2008 failed to meet the 70% benchmark in both style and content for the short presentation and in style for the long presentation. This student failed to meet requirements designed to help students in the preparations for their presentations such as turning in an outline, discussing their topic with the instructor or other chemistry faculty, and giving a practice presentation.

**Chemistry Major Survey/Exit Interview**

There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009, the two graduating chemistry majors completed the Chemistry Major Survey. With regards to ability to communicate in an oral presentation, one student rated communication skills as very strong, and the other one rated skills as adequate. On the Spring 2008 survey (first time implemented), four out of five students rated their skills as strong, and one rated skills as deficient.

### Action Plan

<table>
<thead>
<tr>
<th>What actions or modifications have been or will be made based on this assessment?</th>
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<tbody>
<tr>
<td><strong>2.1 Laboratory Reports</strong></td>
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</table>

**Selected Lab reports in SCHM 331L/332L**

In order to increase the number of students who meet the benchmark and to improve lab reports, more emphasis will be placed on the writing of the reports. Since most students enrolled in SCHM 331L & 332L have never written a full lab report, having future students transition into writing one may lead to improved scores on this assessment. At the beginning of the semester, the instructor will provide detailed handouts describing what should be included in each section. Students will be required to submit certain sections of the lab for a grade and will receive timely feedback. To make the students less reliant on the handouts, discussions at the beginning of lab in which students brainstorm about what they think belongs in each section will occur. Ideally, these students will be able to write lab reports independently by mid-semester.

**Selected Lab reports in SCHM 541L and SCHM 542L**

In response to suggestions from the major exit interview in 2008, in Fall 2008 the instructor gave students the opportunity to redo the first lab report in 541L as students often do not understand what is expected. The score on the first report in 2008 (78%) was higher than the average score on the first report in 2006 (64%). The instructor of SCHM 541L/542L will continue to allow students to redo the first lab report and will revise the lab report handout to include more specifics on what is to be included in the reports. There are no additional actions or modifications since SCHM 541L/542L were not offered in 2009-2010.

**2.2 Written and Oral Communications**

**Research papers in SCHM 397**

To address the deficiencies noted in this year’s data, the SCHM 397 instructor will strongly recommend that students who are struggling with English visit the campus Writing Center to get intensive help. Also, after finishing their first paper, students will hand a copy to another student who will read and evaluate the paper to give constructive criticism.
<table>
<thead>
<tr>
<th>Implementation and Evaluation of Previous Years’ Action Plan</th>
<th>Which of the modifications indicated in the previous years’ reports were implemented this year and what was the impact?</th>
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</thead>
</table>

**Research paper/oral presentations in SCHM 599**

SCHM 599 was not offered in 2009-2010 so no actions or modifications affecting oral presentations and the senior research paper could be made.

In the 2007-2008 assessment report it was suggested that the instructor of SCHM 599 meet individually with students throughout the semester to help students progress with their research so that they would be able to successfully complete the requirements of the course, specifically the oral presentations and research paper. Since only one student was enrolled in SCHM 599 in Spring 2009, the instructor was able to meet with the student frequently to check on the student’s progress and guide the student in preparation of the presentations and paper. This student had difficulty in selecting a focus for the paper and presentations and so benefited from the frequent guidance. The SCHM 599 instructor will continue to meet with students periodically throughout the semester.

To improve the quality of the research papers and students’ confidence in their writing skills, the SCHM 599 instructor will require students to submit rough drafts of their research papers to be edited by their peers in the class. This will force students to allow time for revision and editing. The instructor will encourage students to make use of the Writing Center and workshops it presents, as well as the Learning Express Library to improve writing skills and grammar.

Since SCHM 599 was not offered in 2009-2010, there are no additional actions or modifications.

**2.1 Laboratory Reports**

**Selected Lab reports in SCHM 331L/332L**
The modifications suggested in the 2008-2009 report were not implemented this year due to the fact that the two lab instructors were adjusting to teaching these courses for the first time with a full complement of other courses.

**Selected Lab reports in SCHM 541L and SCHM 542L**
SCHM 541L and 542L were not offered in 2009-2010 so no actions or modifications affecting the preparation of lab reports could be made in this course.

**2.2 Written and Oral Communications**

**Research papers in SCHM 397**

In the 2007-2008 report, students noted the difficulty they had in choosing suitable topics for the junior and senior seminar papers and presentations. In the 2008-2009 report it was proposed to have students choose papers from a list of topics (with a specific focus on relevant chemistry) provided by the instructor to help them pick topics more readily and give a starting point for organization. Additionally, for the first paper, students will be given a deadline early in the semester to scan the literature and find several (e.g., 5) relevant papers appropriate to their topic.
In Spring 2010, students in SCHM 397 again were required to write two research papers during the semester. Since two of the three students already had outside employment in a lab setting, choosing a topic was not as difficult for them, though the remaining student did have difficulty. Shortly after writing their first paper, students were given a list of topics from which to choose for the focus of their second paper. This decreased the amount of time searching for a topic, so that students could delve into the relevant literature more quickly. Providing feedback on the first paper, showed modest gains for two of the three students; the other student struggled with language (both writing and interpreting the literature) and did not show improvement.

**Research paper/oral presentations in SCHM 599**

SCHM 599 was not offered in 2009-2010 so no actions or modifications affecting oral presentations and the senior research paper could be made.
## Goal 3

From your Program Assessment Plan *(Describe broad learning outcomes and concepts (what you want students to learn) expressed in general terms (clear communication, problem-solving skills, etc). Goals should focus on discipline-specific outcomes relevant to the program.)*

**Goal 3:** Chemistry majors will have basic technical skills to execute chemical inquiry.

### Objectives SLO’s (student learning outcomes)

From your Program Assessment Plan *(Describes the specific skills, values and attitudes students should be able to exhibit that reflect the broader goals. Objectives (student learning outcomes) transform the general program goals into specific student performance/behaviors that demonstrate student learning and skill development along these goals.)*

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
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<tbody>
<tr>
<td>3.1:</td>
<td>Chemistry majors will have the technical skills to work competently in a laboratory setting.</td>
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<tr>
<td>3.2:</td>
<td>Chemistry majors will be able to use appropriate computer skills to solve problems and model chemical systems.</td>
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<tr>
<td>3.3:</td>
<td>Chemistry majors will be able to search and retrieve chemical information from the library or online databases.</td>
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</table>

### Assessment Methods

From your Program Assessment Plan *(Describes the measure(s) by which the department will know the students are meeting the departmental learning objectives. Includes both direct and indirect assessment. Each SLO should have at least one assessment method.)*

<table>
<thead>
<tr>
<th>Assessment Method</th>
<th>Description</th>
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<tbody>
<tr>
<td>3.1:</td>
<td>Competency in technical skills will be evaluated by selected experiments in SCHM 321L and SCHM 332L. Instructor designed rubrics will be used to assess the technical skills. A 3-scale rating (E (exceeds basic competency), B (basic competency), and BB (below basic competency)) measuring lab skills will be given based on observations by the lab instructor in selected lab courses. These courses may include SCHM 332L, SCHM 321L, and SCHM 541L &amp; 542L. Chemistry Major Survey/Exit interview</td>
</tr>
<tr>
<td>3.2:</td>
<td>Selected exercises that require application of computer skills will be used for assessment. These exercises may come from SCHM 541, 541L, 542, 542L, and SCHM 321L. These exercises will be assessed using specifically designed rubrics for each exercise. Chemistry Major Survey/Exit interview</td>
</tr>
<tr>
<td>3.3:</td>
<td>Selected assignments, which require search and retrieval of chemical information, in the junior and senior seminar courses, SCHM 397 and 599, will be used. A specifically designed rubric to assess search and retrieval skills will be used. Chemistry Major Survey/Exit interview</td>
</tr>
</tbody>
</table>
### Assessment Criteria

**Level of achievement you are targeting** (Indicate benchmarks, scores on assessment instruments, etc... that would indicate acceptable achievement under your plan)

- A score of 70% or higher on the assessments of experiments, exercises, and assignments.
- An E or B rating on laboratory skills.
- Having all students rate their technical skills as somewhat developed or higher on the Chemistry Major Survey.

### Assessment Results & Analysis

**Actual results and data collected** (Make sure to break down data by subgroups (e.g. other campuses or emphases), As appropriate, also include item or category analysis and explain what conclusions can be made from the data analysis.)

### 3.1 Technical Skills

#### Technical Skills in Selected Experiments in SCHM 321L

In 2009-2010, lab skills in SCHM 321L were assessed by the accuracy of analytical results obtained on six experiments. The average student scores are shown below along with scores from previous years. SCHM 321L was not offered in 2006-2007.

![Graph showing average scores for technical skills in SCHM 321L]

During the past three years, all students have exceeded 70% on this assessment.

#### Technical Skills in Selected Experiments in SCHM 332L

In SCHM 332L, students are assessed on their ability to identify unknowns using distillation and qualitative analysis. The average scores on these assessments are shown below for the past four years.
In 2009-2010, all but one student (67%) scored above 70% on this assessment. In the previous three years, 100% of the students scored at or above 70%.

Laboratory Skills Ratings in SCHM 321L

Students' pipetting and quantitative transfer skills were observed and assessed by the instructor in SCHM 321L. The average student scores on these two skills for the past three years are shown below. SCHM 321L was not offered in 2006-2007.

Each student’s average score was above 70% however not all individual scores met the minimum threshold in both pipetting and quantitative transfer. In 2009-2010, one student out of six scored 67% on pipetting skills while two students of the six scored 50% on quantitative transfer skills. In 2007-2008 and 2008-2009, students have been weakest in pipetting skills with 5 out of 9 meeting the SLO in pipetting and all 9 meeting the SLO in quantitative transfer.
Based on the scores of these assessments, students have been assigned an overall rating of either exceeding basic competency (E), basic competency (B), or below basic competency (BB). The assigned ratings from the past three years are shown below. In the past three years, 12 out of 15 students (80%) were judged to have basic or exceeding basic competency in SCHM 321L.

**Laboratory Skills Ratings in SCHM 332L**

In SCHM 332L, students' lab skills are rated by the lab instructor based on the Qualitative Analysis and Microscale Fractional Distillation experiments. The assigned ratings (exceeding basic competency (E), basic competency (B), or below basic competency (BB)) from the past four years are shown below. In the past four years, all chemistry majors (10 students) have met the SLO and 4 students (40%) have received a score of E.
## Laboratory Skills Ratings in SCHM 541L/542L

Overall laboratory skills ratings (exceeding basic competency (E), basic competency (B), or below basic competency (BB)) are assigned to students by the lab instructor based on the instructor’s observations. SCHM 541L and 542L are offered every other year and so were not offered in 2009-2010. In 2008-2009, one chemistry major was rated as B in both 541L and 542L. In 2006-2007, 8 out of 11 students were rated as B in both courses, one student was rated as E for both courses, and one student improved from B in 541L to E in 542L. One student was rated as BB in SCHM 541L and did not continue as a chemistry major. Overall, all students in the past four years who have persisted as chemistry majors (11 students) have been rated as B (82%) or E (18%) by the end of SCHM 542L.

### Chemistry Major Survey/Exit Interview

There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009 since the two graduating students were not in the same classes, they were asked to make comments on the chemistry program in place of the exit interview. With regards to SLO 3.1, one student rated lab skills as highly developed, and the other rated them as somewhat developed. There were no comments on lab skills.

In Spring 2008, the majority of majors (3 out of 5) rated their skills as highly developed. Two students rated their ability as somewhat developed. In the Exit Interview of senior chemistry majors, students said that there are two instruments (GC-MS and NMR) that USC Upstate should have since they are so frequently used in the chemical industry. Students would also like more opportunities to do undergraduate research projects. Being involved in these projects would require them to work independently in the lab which they felt would further develop their lab skills.

In the past three years in which the survey has been given, 57% of the students felt their skills were highly developed while the remainder (43%) felt their lab skills were just somewhat developed.

### 3.2 Application of Computer Skills in Selected Exercises

#### Computer Skills in Selected Exercises in SCHM 321L

Chemistry majors in SCHM 321L were assessed on their ability to use spreadsheet skills in a laboratory exercise. In 2009-2010, the average student score was 82 with 100% of the students (6) scoring at or above 70%. The SCHM 321L instructor noted though that some students relied on methods other than spreadsheet calculations, especially in determining slope and y-intercept of data. The average student scores in 2008-2009 and 2007-2008 were 80 and 87, respectively, with all students (8 total) scoring above 70%.
### Computer Skills in Selected Exercises in SCHM 541 and SCHM 542L

Spreadsheet skills on a class assignment are assessed at the beginning of fall semester in SCHM 541 and these skills are assessed again in the last half of SCHM 542L. SCHM 541L and 542L are offered every other year and so were not offered in 2009-2010.

In 2008-2009 the one chemistry major scored 94% on the first assessment and 88% on the second. In 2006-2007, the average scores of 10 students on the first and second assessments were 74% and 91%, respectively, with all students scoring well above 70% on the second assessment. SCHM 541/542 was not offered in 2007-2008.

Overall in the past four years, all majors have scored above 70% by the second assessment and about 60% showed an improvement over the academic year.

### Chemistry Major Survey/Exit Interview

There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009, the two graduating chemistry majors were given a survey to assess how they would rate their computer skills to solve chemical problems and model chemical systems. One student indicated that computer skills were very developed, and the other one indicated that skills were somewhat developed. In Spring 2008, 80% of students (4 out of 5) rated their skills as very to highly developed. One student felt computer skills were somewhat developed. In the past three years, 5 out of 7 majors (71%) rated their computer skills very or highly developed. Two students (29%) rated these skills as somewhat developed.

### 3.3 Search and Retrieval of Chemical Information

The literature search assessment in chemistry is given to majors in SCHM 397 and 599, junior and senior seminar respectively. These courses are taught concurrently under the same instructor. In Spring 2010 SCHM 599 was not offered so only students in SCHM 397 were assessed. The average student scores are shown below for the past four years. SCHM 397 was not offered in 2008-2009.
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In Spring 2010, only two of three students scored at or above 70%. The instructor noted that despite the instructions clearly indicating that databases from the library were to be used for this assignment, students were tempted to use Google search and Wikipedia to answer questions. All students seemed to struggle with the concept of a "full citation" and to whom credit should be given for publication of a journal (i.e., the parent organization). In one case, the student put the university affiliation of the authors, and in another case, a student simply put the name of the journal.

In the previous three years, all students in SCHM 599 (10 total) scored above 70% on this assessment.

Chemistry Major Survey/Exit Interview

There were no graduating chemistry majors in Spring 2010 so the Chemistry Major Survey and the Exit Interview were not implemented. In Spring 2009, the two graduating chemistry majors were given a survey to assess how they would rate their skills to search and retrieve chemical information from the library or online databases. One student indicated that skills were highly developed, and the other one indicated that skills were very developed. In Spring 2008, 80% of students (4 out of 5) felt their skills were very developed to highly developed. One student felt skills were somewhat developed.

Overall of the seniors surveyed, 86% (6 out of 7) indicated that skills were very to highly developed. One student (14%) felt skills were somewhat developed.
### Action Plan

| What actions or modifications have been or will be made based on this assessment? |
| 3.1 Technical Skills |

#### Technical Skills in Selected Experiments in SCHM 321L

The SCHM 321L instructor will continue to emphasize the lab skills needed to obtain accuracy in these experiments in the first lab exercise and throughout the semester. To improve assessment scores for future semesters, prelab assignments will include a question on where deviations from accuracy may occur. This will give students an opportunity to think critically BEFORE and DURING their experiments so they can be on the lookout for potential missteps leading to inaccuracy.

#### Technical Skills in Selected Experiments in SCHM 332L

To improve assessment scores, the SCHM 332L instructor will introduce activities that force the student to plan prior to performing the lab (e.g., hypothesis formulations and experimental design) and show examples of poor equipment set-ups and experimental events that lead to erroneous results. The intended result is to enable students to recognize dubious data before submitting their lab reports.

#### Laboratory Skills Ratings in SCHM 321L

The SCHM 321L instructor continued to emphasize pipetting and quantitative transfer skills throughout the semester. To improve scores, the SCHM 321L instructor will incorporate a written procedure in the student lab manual to complement the instructor's in-class demonstration of how to manipulate glassware using proper technique.

#### Laboratory Skills Ratings in SCHM 332L

The instructor will continue to provide lectures that include diagrams showing proper lab techniques. For certain experiments, the instructor will provide feedback by requesting students to show their equipment set-ups before starting the experiment.

#### Laboratory Skills Ratings in SCHM 541L/542L

In order to improve laboratory skills ratings, the instructor of SCHM 541L will provide reminders of correct lab techniques, especially with regards to the preparation of solutions, at the beginning of the lab period. If it is apparent that a student is lacking in skills, the instructor of 541L will provide additional guidance to the student.

#### Chemistry Major Survey/Exit Interview

To address student concerns from previous exit interviews regarding chemical instrumentation and undergraduate research opportunities, the chemistry faculty will continue to work to obtain new instrumentation and to provide research opportunities for our majors. In 2009-2010, three uv-vis
spectrophotometers (one with near IR ability) have been acquired along with a research grade fluorimeter and NMR spectrometer. The use of these new instruments will be incorporated into the appropriate lab courses and will be available for student research projects. Renovations of the Smith building have been initiated which will eventually allow for more space for teaching and research. With more space and instrumentation, faculty will be able to have more majors involved with research which should improve lab skills and students’ confidence in their skills.

The chemistry faculty remain committed to providing experiential learning opportunities for students. In 2003, Virginia Tech guaranteed admittance of two USC Upstate students to their NSF-REU summer research program. Participants perform polymer research for eleven weeks under the supervision of VT faculty and graduate students. To date, five students (four are chemistry majors) have participated in this summer program. Additionally, external funding for research has been secured, enabling students to work on projects at USC Upstate. In 2010-2011, two chemistry majors will be conducting research under the direction of one chemistry faculty member.

In 2009, one student, under the supervision of one faculty member, helped perform analysis of samples for Contec, a company making cleaning products for use in critical environments. Students may be involved with future projects, too.

3.2 Application of Computer Skills in Selected Exercises

Computer Skills in Selected Exercises in SCHM 321L

To encourage students to use built-in Excel formulas and to improve assessment scores, the SCHM 321L instructor will continue to emphasize these features on the first spreadsheet assignment, but also will highlight the built-in formula features in other spreadsheets as well for future semesters.

Computer Skills in Selected Exercises in SCHM 541 and SCHM 542L

To improve the instruction of computer skills, the instructor of SCHM 541/542 and 541L/542L will update the computer exercises/handouts to reflect the updates in the software used in these courses. In addition to spreadsheets, students in these courses use molecular modeling and symbolic mathematical manipulation software.

3.3 Search and Retrieval of Chemical Information

The instructor of SCHM 397/599 will continue to work with the science librarian to keep student training up to date on the relevant scientific databases for chemistry. To prevent students from using Google and Wikipedia to answer questions, students will be specifically instructed to avoid general search engines/aggregators in favor of the library databases; further, the session with the librarian may be modified to incorporate information about journal ownership.
## Implementation and Evaluation of Previous Years’ Action Plan

### Which of the modifications indicated in the previous years’ reports were implemented this year and what was the impact?

### 3.1 Technical Skills

#### Technical Skills in Selected Experiments in SCHM 321L

This year the SCHM 321L instructor continued to emphasize the lab skills needed to obtain accuracy in these experiments in the first lab exercise and throughout the semester. This year the average student score decreased slightly from the previous year however the number of students assessed is quite small.

#### Technical Skills in Selected Experiments in SCHM 332L

The modifications suggested in the 2008-2009 report were not implemented this year due to the fact that the two lab instructors were adjusting to teaching these courses for the first time with a full complement of other courses.

#### Laboratory Skills Ratings in SCHM 321L

This year the SCHM 321L instructor stressed the importance of coming to lab on time so as not to miss instructions given at the beginning of the lab period. The instructor continued to emphasize pipetting and quantitative transfer skills in the first lab exercise and again near the middle of the term. This year the average student score in pipetting increased, however the average score in quantitative transfer decreased from previous years. This year there were no students scoring below basic competency in lab skills rating which is an improvement over previous years. The numbers of students assessed are quite small, so the impact of modifications is difficult to judge.

#### Laboratory Skills Ratings in SCHM 332L

The modifications suggested in the 2008-2009 report were not implemented this year due to the fact that the two lab instructors were adjusting to teaching these courses for the first time with a full complement of other courses.

#### Laboratory Skills Ratings in SCHM 541L/542L

SCHM 541L and 542L were not offered in 2009-2010 so no actions or modifications affecting students’ lab skills could be made in these courses this year.

### Chemistry Major Survey/Exit Interview

In 2009-2010, three uv-vis spectrophotometers (one with near IR ability) were acquired along with a research grade fluorimeter and NMR spectrometer. These were acquired during the summer of 2010 so have not yet been used in courses or research. Smith building renovations of labs for chemistry will begin in 2010-2011.
3.2 Application of Computer Skills in Selected Exercises

Computer Skills in Selected Exercises in SCHM 321L

This year the SCHM 321L instructor did not add more spreadsheet exercises in this course as was suggested in the previous year’s assessment report. The SCHM 321L instructor was teaching an overload of chemistry courses and did not have time to develop a new exercise. The instructor’s encouragement to complete the exercises did result in a 100% completion of all exercises this year which is an improvement over last year’s 50% completion. The sample size is small however (2 students in 2008-2009 and 6 students in 2009-2010), so it is hard to determine if this increase is statistically significant.

Computer Skills in Selected Exercises in SCHM 541 and SCHM 542L

SCHM 541L and 542L were not offered in 2009-2010 so no actions or modifications affecting students’ computer skills could be made in these courses this year.

3.3 Search and Retrieval of Chemical Information

The instructor of SCHM 397/599 worked with the science librarian to keep student training up to date on the relevant scientific databases for chemistry. In particular, significant focus was dedicated to the powerful search tool “SciFinder Scholar”, while no time was used to discuss ChemAbstracts (which is both costly and restricted to after-hours use only). Instead of discussing all databases alphabetically, the information was broken into first and second tiers, with more relevant and powerful search capabilities in the first tier. This allowed students to have more training on databases they were more likely to use for researching their papers and presentations.

Of the three students in SCHM 397, only two met the expectations of this assessment this year despite two class sessions with a librarian on chemical databases and emphasis by the instructor to use the library’s databases.