2. **SLO(s) being assessed:** Student will..
   SLO 10: Students will understand and appreciate methods and issues of science and technology.

3. **AGSC Content Area of Alignment:**
   Area III: Science and Math

4. **Assessment Method(s):**
   [Explain how assessment for the measures associated with this SLO - not grading for the course as a whole - was conducted. You may cut/paste rubrics for inclusion here, identify faculty reviewing committees, or identify specific kinds of test questions important to your method. Is this the method you initially planned to use? Provide a separate paragraph for each method].
   An exam comprising of 20 multiple questions was given to students who took CHEM 1030 class (Spring 2013 semester). The exam was written such that 5 questions addressed a subsection of SLO 10 (SLO10-1, SLO 10-2, SLO 10-3 and SLO 10-5). The social impact portion (SLO 10-4) of assessment was not included.

5. **Findings: What assessment data did each assessment method produce?**
   The data provided the average ability of students who took CHEM 1030 class, in this case the students were assessed as having basic ability when the 4 subsections were combined. The data was further broken down to show the percentage of students' ability on each individual subsection i.e. each subsection of SLO 10 will have a percentage of students who emerged as having advanced ability, intermediate ability, basic ability and little/no ability.

   Attachment name: Freshman Chemistry CORE SLO Assessment Devise 2

6. **Based on the comprehensive rubric for the appropriate SLO(s), indicate the extent of competency of the average student who has completed this core course in each learning outcome assigned to it:**

<table>
<thead>
<tr>
<th>SLO</th>
<th>Level of Ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLO 10</td>
<td>basic</td>
</tr>
</tbody>
</table>

7. **How did you (or will you) use the findings for improvement?**
   [What questions / issues / concerns did your data raise for the faculty teaching the course? What discussion did the faculty have about the findings? What future actions to improve student attainment of this outcome will the department / program take as a result of this analysis?]
   The Undergraduate Program Committee will meet to discuss how the learning objectives can be improved in these courses so that appropriate recommendations can be made to the faculty. One possibility is direct coupling of the lecture with the lab so that concepts learned in the lecture class can be stressed more when students perform experimental exercises in the laboratory classes. This will be particularly helpful in improving scores for SLO 10-3 (Data interpretation) when students can correlate theoretical concepts learned in lectures to data obtained when performing experimental exercises.

8. **Additional Comments:**
   [What else would you like the Committee to know about your assessment of this course or plans for the future?]
Core Curriculum Assessment Report 2012-2013

<table>
<thead>
<tr>
<th>Department</th>
<th>Chemistry and Biochemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representative</td>
<td>Catherine Situma</td>
</tr>
<tr>
<td>Academic Year</td>
<td>2012_13</td>
</tr>
<tr>
<td>Course Name / number</td>
<td>CHEM1030/1031, CHEM1040/1041</td>
</tr>
</tbody>
</table>

9. Committee Comments:
Freshman Chemistry Core SLO Assessment Device

Please answer the questions on the provided scantron form. There are 20 questions.

**CHEM 1030**

**SLO 10-1 Historic Perspective**

1.1) Niels Bohr is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry / Thermodynamics
   c) Acid / Base Chemistry
   d) Quantum Mechanics
   e) Free Energy

1.2) The name Bronsted is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry / Thermodynamics
   c) Acid / Base Chemistry
   d) Quantum Mechanics
   e) Atomic structure

1.3) The name Boyle is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry / Thermodynamics
   c) Acid / Base Chemistry
   d) Gas laws
   e) Atomic structure

1.4) The term Hess’s Law is most closely associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry / Thermodynamics
   c) Acid / Base Chemistry
   d) Quantum Mechanics
   e) Atomic structure

1.5) The name Rutherford is most closest associated with which of the following areas:
   a) Electrochemistry
   b) Thermochemistry / Thermodynamics
   c) Acid / Base Chemistry
   d) Quantum Mechanics
   e) Atomic structure
SLO 10-2 Scientific Method

2.1) Please provide the correct answer:

a) Collecting data, forming a hypothesis, designing a test and forming a theory
b) Collecting data, forming a theory, designing a test and forming a hypothesis
c) Collecting data, forming a theory, designing a test and establishing a law
d) Forming a theory, collecting data to support theory and establishing a law
e) Forming a theory, collecting data to support theory and forming a hypothesis

2.2) Choose the correct association

Law
a) Tentative explanation of an observation
b) Tested hypothesis
c) Belief
d) Relationship that hold true in all experiments

2.3) Choose the correct association

Theory
a) Tentative explanation of an observation
b) Tested hypothesis
c) Belief
d) Relationship that hold true in all experiments

2.4) Choose the correct association

Hypothesis
a) Tentative explanation of an observation
b) Tested hypothesis
c) Belief
d) Relationship that hold true in all experiments

2.5) Argon dating of rock shows an age of 4 million years. If bone is bedded in the rock, this shows the bone is also 4 million years old.

a) True
b) False
3.1 If the correct answer is 3.0, but the experimental values are 3.51, 3.47 and 3.53, the experimental results are:
   a) accurate
   b) precise
   c) accurate and precise
   d) neither accurate not precise
   e) precise but not accurate

3.2 – 3.3) The following questions refer to the plot below of the mass of precipitate (Ag₂CO₃) found as a function of the initial concentrations of both AgNO₃ and Li₂CO₃.

3.2 Identify the species that are soluble
   a) Li₂CO₃, AgNO₃, LiNO₃, Ag₂CO₃
   b) Li₂CO₃, AgNO₃, LiNO₂
   c) Li₂CO₃, AgNO₃
   d) Ag₂CO₃
   e) LiNO₂

3.3. The dashed line indicates the amount of precipitate when
   a) Li₂CO₃ is the limiting reagent
   b) AgNO₃ is the limiting reagent
   c) Ag₂CO₃ is the limiting reagent
   d) LiNO₂ is the limiting reagent
3.4 When doing an experiment, it is better to:

a) use all data collected whether valid or not
b) use only some of the data
c) use all data except when there is a clear experimental error
d) keep repeating experiment until expected results is obtained and use that value.
e) Copy the results from another student

3.5 When determining the moles of Ag₂CO₃ from the reaction, one should:

a) weigh the solution
b) filter the precipitate, dry and weigh it
c) pour off the liquid and weigh the wet precipitate
d) measure the volume of solution
e) copy results from another student
SLO 10-5 Demonstrating understanding of Science

5.1) What is the formula for sodium sulfate?

a) NaS  
b) NaSO₃  
c) Na₂SO₄  
d) NaSO₄  
e) NaSO

5.2) What is the correct stoichiometry for the reaction

\[ \text{aC}_2\text{H}_4 + \text{bO}_2 \rightarrow \text{cCO}_2 + \text{dH}_2\text{O} \]

a) abcd = 1111  
b) abcd = 2222  
c) abcd = 1212  
d) abcd = 1322  
e) abcd = 2121

5.3) What is the unit for 10³ meters?

a) kilometer  
b) millimeter  
c) centimeter  
d) megameter  
e) decimeter

5.4) How many moles of water are in 36.0 g of H₂O? (At wt. H=1.0 amu; O = 16 amu)

a) 1.0 moles  
b) 2.0 moles  
c) 0.5 moles  
d) 4.0 moles  
e) 10.0 moles

5.5) How many protons and neutrons are in the isotope \(^{14}\text{C}\)?

a) 14p, 6n  
b) 6p, 14n  
c) 14p, 20n  
d) 6p, 8n  
e) 8p, 6n
Assessment Methods:

The Freshman Chemistry CORE SLO Assessment Device was administered to all students taking freshman Chemistry at the end of the Spring 2013 semester. Students taking the exam were given 5 points towards their grade to increase student participation and ensure the questions were being answered to the best of their abilities. The exams were organized and proctored by the Freshman Chemistry Coordinator, Steve Swann, and were graded by Steve and his staff. The five chemistry courses described below were given the test:

Chem1020- second semester of a terminal course sequence that combines general and organic chemistry
Chem1030 and 1040-two semester general chemistry courses
Chem1120-second semester of general chemistry for scientists and engineers
Chem1127-second semester of honors chemistry

The exam was comprised of 20 multiple choice questions, and were constructed so that each question covered a subsection of SLO#10 as listed below:

Questions 1-5/SLO10-1 Historical perspective
Questions 6-10/SLO10-2 Scientific method
Questions 11-15/SLO10-3 Data interpretation
Questions 21-25/SLO10-5 Demonstrate understanding of science.

The historical perspective questions were modified based on the material covered in that respective course. All other questions related to a specific subsection of SLO10 were the same.

The exams for the five courses are included.

Assessment Criteria

In order to evaluate student progress the following assessment was used for SLO 10-1, 10-2, 10-3, 10-5:

≤50  little/none
51-70  basic
71-90  intermediate
91-100  advanced

Findings:

The table shown below summarizes the individual class averages and their overall assessment.

<table>
<thead>
<tr>
<th>Course</th>
<th>Class average</th>
<th>Assessment Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1020, n = 101</td>
<td>43 %</td>
<td>Little /none</td>
</tr>
<tr>
<td>CHEM 1030, n = 691</td>
<td>53 %</td>
<td>Basic</td>
</tr>
<tr>
<td>CHEM 1040, n = 582</td>
<td>67 %</td>
<td>Basic</td>
</tr>
<tr>
<td>CHEM 1120, n= 55</td>
<td>75 %</td>
<td>Intermediate</td>
</tr>
<tr>
<td>CHEM 1127, n = 65</td>
<td>78 %</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>
Results:

CHEM 1020, n = 101

<table>
<thead>
<tr>
<th>Student Learning Objectives</th>
<th>Assessment Rubrics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced</td>
</tr>
<tr>
<td>SLO10-1; Historic perspective</td>
<td>7.92 %</td>
</tr>
<tr>
<td>SLO 10-2; Scientific method</td>
<td>4.95 %</td>
</tr>
<tr>
<td>SLO 10-3; Data Interpretation</td>
<td>2 %</td>
</tr>
<tr>
<td>SLO 10-5; Demonstrate understanding of science</td>
<td>0 %</td>
</tr>
</tbody>
</table>

8 % of the 101 students that took the exam scored advanced on historic perspective topic, 5 % scored advanced on the scientific method, 2 % scored advanced on data interpretation and none scored advanced on “demonstrate understanding of science” topic. Based on the established assessment criteria, over 55 % of the 101 students scored little / none on all 4 learning objectives. This is a second semester terminal course sequence that combines general and organic chemistry with majority of students taking this course being non science majors.

CHEM 1030, n = 691

<table>
<thead>
<tr>
<th>Student Learning Objectives</th>
<th>Assessment Rubrics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced</td>
</tr>
<tr>
<td>SLO10-1; Historic perspective</td>
<td>3.18 %</td>
</tr>
<tr>
<td>SLO 10-2; Scientific method</td>
<td>8.54 %</td>
</tr>
<tr>
<td>SLO 10-3; Data Interpretation</td>
<td>3.76 %</td>
</tr>
<tr>
<td>SLO 10-5; Demonstrate understanding of science</td>
<td>20.26 %</td>
</tr>
</tbody>
</table>

3 % of the 691 students that took the exam scored advanced on historic perspective topic, 9 % scored advanced on scientific method, 4 % scored advanced on data interpretation and 20 % of the students scored advanced on “demonstrate understanding of science” topic. Generally, over 40 % of the students scored basic or higher on each individual student learning objective with 68 % scoring basic or higher on SLO 10-5 (demonstrate understanding of science). There was a percentage increase (scoring of basic or higher) on all student learning objectives when CHEM 1020 students are compared with CHEM 1030 students and this is expected given that many of the students in Chem1030 class are science majors.
CHEM 1040, n = 582

<table>
<thead>
<tr>
<th>Student Learning Objectives</th>
<th>Assessment Rubrics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced</td>
</tr>
<tr>
<td>SLO10-1; Historic perspective</td>
<td>26.29 %</td>
</tr>
<tr>
<td>SLO 10-2; Scientific method</td>
<td>14.43 %</td>
</tr>
<tr>
<td>SLO 10-3; Data Interpretation</td>
<td>7.39 %</td>
</tr>
<tr>
<td>SLO 10-5; Demonstrate understanding of science</td>
<td>39.35 %</td>
</tr>
</tbody>
</table>

26% of the 582 students that took the exam scored advanced on historic perspective topic, 14% scored advanced on scientific method, 7% scored advanced on data interpretation and 39% of the students scored advanced on “demonstrate understanding of science” topic. There was a significant increase in the percentage of students who attained a basic or higher on all 4 objectives (82%, 67%, 65% and 87% for SLO 10-1, SLO 10-2, SLO 10-3 and SLO 10-5 respectively) when CHEM 1030 students are compared with CHEM 1040 students. The Historical Perspective questions correlate scientific discoveries and principles with individuals that made major contributions in these fields. The general improvement for CHEM 1040 students can be attributed to the fact that these students have been exposed to these principles in both CHEM 1030 and CHEM 1040 classes. CHEM 1040 is a second semester General Chemistry class and students who enroll in this class have taken CHEM 1030 already.

CHEM 1120, n = 55

<table>
<thead>
<tr>
<th>Student Learning Objectives</th>
<th>Assessment Rubrics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced</td>
</tr>
<tr>
<td>SLO10-1; Historic perspective</td>
<td>40 %</td>
</tr>
<tr>
<td>SLO 10-2; Scientific method</td>
<td>23.64 %</td>
</tr>
<tr>
<td>SLO 10-3; Data Interpretation</td>
<td>7.27 %</td>
</tr>
<tr>
<td>SLO 10-5; Demonstrate understanding of science</td>
<td>69.09 %</td>
</tr>
</tbody>
</table>

Majority of the 55 students that were tested scored a basic or higher on all 4 student learning objectives (82%, 73% 76% and 96% for SLO 10-1, SLO 10-2, SLO 10-3 and SLO 10-5 respectively). There was a substantial increase in their understanding of science (SLO-5), (69% of students scored advanced) when compared with Chem1040 students. This is a second semester course for scientists and engineers; therefore, their basic understanding of science is stronger overall. In addition to the course being more rigorous than the General Chemistry courses (Chem1030 and Chem1040), these students may have taken advanced chemistry courses in high school.
CHEM 1127, n = 65

<table>
<thead>
<tr>
<th>Student Learning Objectives</th>
<th>Assessment Rubrics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced</td>
</tr>
<tr>
<td>SLO10-1 ; Historic perspective</td>
<td>40 %</td>
</tr>
<tr>
<td>SLO 10-2 ; Scientific method</td>
<td>12.31 %</td>
</tr>
<tr>
<td>SLO 10 -3 ; Data Interpretation</td>
<td>16.92 %</td>
</tr>
<tr>
<td>SLO 10 -5 ; Demonstrate understanding of science</td>
<td>78.46 %</td>
</tr>
</tbody>
</table>

40 % of the 65 students that took the exam scored advanced on historic perspective topic, 12 % scored advanced on scientific method, 17 % scored advanced on data interpretation and 78 % of the students scored advanced on “demonstrate understanding of science” topic. Generally, over 75 % of the students scored basic or higher on all 4 student learning objectives. Majority of these students (78 %) scored advanced on SLO 10-5 which is slightly higher when compared with CHEM 1120 students. This class is for honor students who often take advanced chemistry courses in high school. Honors laboratory classes are also coupled to their lecture counterparts making it is easier for students to connect scientific principles learned in lectures with experimental exercises. This might be one of the reasons why this group of students scored higher on data interpretation problems when compared with the other 4 courses.

**Improvement**

There is an obvious need for improvement in the General Chemistry courses (Chem 1020, Chem1030 and Chem1040) based on this assessment. Many of Chem1030 and Chem1040 students are science majors, and these objectives will be important in their ongoing education. The Undergraduate Program Committee will meet to discuss how the learning objectives can be improved in these courses so that appropriate recommendations can be made to the faculty. The primary difference between the General Chemistry and Honors courses is the direct coupling of lecture and lab. Therefore, we need to devise a method to stress the concepts learned in class in the General Chemistry courses in the laboratory environment. This will be particularly helpful in improving scores for SLO 10-3 (Data interpretation) when students can correlate theoretical concepts learned in lectures to data obtained when performing experimental exercises. In addition, the top Graduate Students in the department are the Graduate Teaching Assistants for the Honors chemistry courses. These students are selected based on their course performance and teaching abilities. Therefore, we need the resources to be able to recruit and compete with other institutions for outstanding graduate students, which we are unable to do at this time due to limited resources.