



**School/College: College of Arts and Sciences**  
**Program: Chemistry – ACS Certified**  
**Degree Level: *Bachelor of Science (BS)***  
***Program Assessment Plan***

**Date Plan was Approved by Department: 5/18/2018**

Please note: Assessment plans must be reviewed/updated and reapproved every five (5) years.

**Name of Person Submitting Plan: John I. Gelder**

**A. Program Information:**

**Assessment Coordinator's Name**

**Assessment Coordinator's Email Address:**

**B. Program Mission Statement**

**In the box below, provide the mission statement for the program.**

*The mission statement, educational objectives, and goals for program should guide the assessment process. The mission statement should align with department, college, and institutional mission statements.*

The Department of Chemistry at Oklahoma State University: promotes the advancement and dissemination of knowledge that is central to many science reliant degree programs both within A&S and across College lines; nurtures the growth of future scientists through undergraduate and graduate research; supports creative endeavors in innovative instruction paradigms and scientific research by faculty and staff; enriches civilization by contributing to education and new technological developments.

**C. Student Learning Outcomes**

On the pages that follow, list the Student Learning Outcomes associated with the program identified in this assessment form.

**C1) Student Learning Outcome #1:** Students will know and be able to apply scientific reasoning to concepts important to foundational concepts in chemistry.

**Identify opportunities for students to learn this outcome during the academic program:**

*For example, include a curriculum map that lists the courses or other learning experiences in which the student learning outcome is taught. Another example is a written narrative that describes how the learning outcome is integrated into the program.*

Undergraduate courses including: CHEM 2113, 2122, 3053, 3112, 3153, 3353, 3433, 3553, 3552, 4320, 4020, and 4990.

**How will students be selected to participate in the assessment of this outcome?**

Students will be randomly selected who are enrolled in the above courses and are in this degree program.

**Assessment Methods**

*Identify the method(s) used to assess this learning outcome. Check all that apply.*

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Survey  | <input type="checkbox"/> Satisfaction Survey  | <input type="checkbox"/> Internship                               |
| <input type="checkbox"/> Rating of skills (e.g., rubrics)                      | <input type="checkbox"/> Benchmarking   | <input type="checkbox"/> Interviews                               |
| <input checked="" type="checkbox"/> Analysis of written artifacts              | <input type="checkbox"/> Measuring effectiveness relative to professional standards | <input type="checkbox"/> Performance or jury                      |
| <input type="checkbox"/> Comprehensive, certification, or professional exam(s) | <input type="checkbox"/> Review of thesis/dissertation/ creative component          | <input type="checkbox"/> Visual collection (photos, videos, etc.) |
| <input type="checkbox"/> Oral presentation                                     | <input type="checkbox"/> Capstone project   | <input type="checkbox"/> Review of student research               |
| <input type="checkbox"/> Course project  |   | <input type="checkbox"/> Other (please specify):                  |
- [Click here to specify.](#)

**Describe the how the assessment method will be implemented, administered, and/or conducted.**

Student artifacts will be collected during the semester students are enrolled in the particular course selected for this LO. Student names will be redacted from the artifacts. Scientific reasoning and problem solving skills will be assessed using a modified science reasoning rubric developed in the Chemistry Department. Members of the department assessment committee will review collected artifacts.

**Does your department/program faculty have a goal set for this learning outcome?**  Yes  No

*For example, "80% of students included in the assessment will receive a 4 on the rubric" or "80% of students included in the assessment will achieve a passing score on the certification exam." If yes, please describe the goal below.*

70% of students will receive a 3, 4 or 5 using the science reasoning rubric.

**Timeline for Planned Assessment**

*Indicate the timeline for the assessment of this learning outcome. While outcomes assessment must be conducted every year, not all student learning outcomes for a given program must be assessed every year. If the assessment of a particular learning outcome occurs on cycle or rotation, please describe and provide the rationale for the cycle/rotation below.*

- Each Semester  Yearly  Every other year
- Other (please specify): If the assessment of Learning Outcome 1 occurs on a cycle or rotation, click here to describe and provide the rationale.

## C2) Student Learning Outcome #2: Students will be able to critically analyze and solve problems

### Identify opportunities for students to learn this outcome during the academic program:

For example, include a curriculum map that lists the courses or other learning experiences in which the student learning outcome is taught. Another example is a written narrative that describes how the learning outcome is integrated into the program.

Undergraduate courses including: CHEM 2113, 2122, 3053, 3112, 3153, 3353, 3433, 3553, 3552, 4320, 4020, and 4990.

### How will students be selected to participate in the assessment of this outcome?

Students will be randomly selected who are enrolled in the above courses and are in this degree program.

### Assessment Methods

Identify the method(s) used to assess this learning outcome. Check all that apply.

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> Survey  | <input type="checkbox"/> Satisfaction Survey  | <input type="checkbox"/> Internship  |
| <input type="checkbox"/> Rating of skills (e.g., rubrics)                      | <input type="checkbox"/> Benchmarking   | <input type="checkbox"/> Interviews  |
| <input checked="" type="checkbox"/> Analysis of written artifacts              | <input type="checkbox"/> Measuring effectiveness relative to professional standards | <input type="checkbox"/> Performance or jury   |
| <input type="checkbox"/> Comprehensive, certification, or professional exam(s) | <input type="checkbox"/> Review of thesis/dissertation/ creative component          | <input type="checkbox"/> Visual collection (photos, videos, etc.)                          |
| <input type="checkbox"/> Oral presentation                                     | <input type="checkbox"/> Capstone project   | <input type="checkbox"/> Review of student research  |
| <input type="checkbox"/> Course project  |   | <input type="checkbox"/> Other (please specify):<br><a href="#">Click here to specify.</a> |

### Describe the how the assessment method will be implemented, administered, and/or conducted.

Student artifacts will be collected during the semester students are enrolled in the particular course selected for this LO. Student names will be redacted from the artifacts. Problem solving skills will be assessed using a modified science reasoning rubric developed in the Chemistry Department. Members of the department assessment committee will review collected artifacts.

### Does your department/program faculty have a goal set for this learning outcome? Yes No

For example, "80% of students included in the assessment will receive a 4 on the rubric" or "80% of students included in the assessment will achieve a passing score on the certification exam." If yes, please describe the goal below.

70% of students will receive a 3, 4 or 5 using the science reasoning rubric.

### Timeline for Planned Assessment

Indicate the timeline for the assessment of this learning outcome. While outcomes assessment must be conducted every year, not all student learning outcomes for a given program must be assessed every year. If the assessment of a particular learning outcome occurs on cycle or rotation, please describe and provide the rationale for the cycle/rotation below.

- Each Semester  Yearly  Every other year
- Other (please specify): If the assessment of Learning Outcome 2 occurs on a cycle or rotation, click here to describe and provide the rationale.

**C3) Student Learning Outcome #3:** Students will be able to use the chemical literature.

**Identify opportunities for students to learn this outcome during the academic program:**

*For example, include a curriculum map that lists the courses or other learning experiences in which the student learning outcome is taught. Another example is a written narrative that describes how the learning outcome is integrated into the program.*

CHEM 3112, 3552, 4320, 4020, and 4990.

**How will students be selected to participate in the assessment of this outcome?**

Students will be randomly selected who are enrolled in the above courses and are in this degree program.

**Assessment Methods**

*Identify the method(s) used to assess this learning outcome. Check all that apply.*

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Survey  | <input type="checkbox"/> Satisfaction Survey  | <input type="checkbox"/> Internship                               |
| <input type="checkbox"/> Rating of skills (e.g., rubrics)                      | <input type="checkbox"/> Benchmarking   | <input type="checkbox"/> Interviews                               |
| <input checked="" type="checkbox"/> Analysis of written artifacts              | <input type="checkbox"/> Measuring effectiveness relative to professional standards | <input type="checkbox"/> Performance or jury                      |
| <input type="checkbox"/> Comprehensive, certification, or professional exam(s) | <input type="checkbox"/> Review of thesis/dissertation/ creative component          | <input type="checkbox"/> Visual collection (photos, videos, etc.) |
| <input type="checkbox"/> Oral presentation                                     | <input type="checkbox"/> Capstone project   | <input type="checkbox"/> Review of student research               |
| <input type="checkbox"/> Course project  |   | <input type="checkbox"/> Other (please specify):                  |
|  |   | <a href="#">Click here to specify.</a>                            |

**Describe the how the assessment method will be implemented, administered, and/or conducted.**

Student artifacts will be collected during the semester students are enrolled in the particular course selected for this LO. Student names will be redacted from the artifacts. Laboratory reports and/or research reports (CHEM 4990) will be assessed using a rubric developed in the Chemistry Department. Members of the department assessment committee will review collected artifacts.

**Does your department/program faculty have a goal set for this learning outcome?**  Yes  No

*For example, "80% of students included in the assessment will receive a 4 on the rubric" or "80% of students included in the assessment will achieve a passing score on the certification exam." If yes, please describe the goal below.*

70% of students will receive a 3, 4 or 5 using the science reasoning rubric.

**Timeline for Planned Assessment**

*Indicate the timeline for the assessment of this learning outcome. While outcomes assessment must be conducted every year, not all student learning outcomes for a given program must be assessed every year. If the assessment of a particular learning outcome occurs on cycle or rotation, please describe and provide the rationale for the cycle/rotation below.*

- Each Semester  Yearly  Every other year
- Other (please specify): If the assessment of Learning Outcome 3 occurs on a cycle or rotation, click here to describe and provide the rationale.

#### C4) Student Learning Outcome #4 Students will be able to follow safety regulations and read material safety data sheets.

##### Identify opportunities for students to learn this outcome during the academic program:

For example, include a curriculum map that lists the courses or other learning experiences in which the student learning outcome is taught. Another example is a written narrative that describes how the learning outcome is integrated into the program.

Undergraduate courses including: CHEM 2122,, 3112, 3552, 4320, 4020, and 4990.

##### How will students be selected to participate in the assessment of this outcome?

Students will be randomly selected who are enrolled in the above courses and are in this degree program.

##### Assessment Methods

Identify the method(s) used to assess this learning outcome. Check all that apply.

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Survey  | <input type="checkbox"/> Satisfaction Survey  | <input type="checkbox"/> Internship                               |
| <input type="checkbox"/> Rating of skills (e.g., rubrics)                      | <input type="checkbox"/> Benchmarking   | <input type="checkbox"/> Interviews                               |
| <input checked="" type="checkbox"/> Analysis of written artifacts              | <input type="checkbox"/> Measuring effectiveness relative to professional standards | <input type="checkbox"/> Performance or jury                      |
| <input type="checkbox"/> Comprehensive, certification, or professional exam(s) | <input type="checkbox"/> Review of thesis/dissertation/ creative component          | <input type="checkbox"/> Visual collection (photos, videos, etc.) |
| <input type="checkbox"/> Oral presentation                                     | <input type="checkbox"/> Capstone project   | <input type="checkbox"/> Review of student research               |
| <input type="checkbox"/> Course project  |   | <input type="checkbox"/> Other (please specify):                  |
|  |   | <a href="#">Click here to specify.</a>                            |

##### Describe the how the assessment method will be implemented, administered, and/or conducted.

Student artifacts will be collected during the semester students are enrolled in the particular course selected for this LO. Student names will be redacted from the artifacts. Laboratory reports and/or research reports (CHEM 4990) will be assessed using a rubric developed in the Chemistry Department. Members of the department assessment committee will review collected artifacts.

##### Does your department/program faculty have a goal set for this learning outcome? Yes No

For example, "80% of students included in the assessment will receive a 4 on the rubric" or "80% of students included in the assessment will achieve a passing score on the certification exam." If yes, please describe the goal below.

70% of students will receive a 3, 4 or 5 using the science reasoning rubric.

##### Timeline for Planned Assessment

Indicate the timeline for the assessment of this learning outcome. While outcomes assessment must be conducted every year, not all student learning outcomes for a given program must be assessed every year. If the assessment of a particular learning outcome occurs on cycle or rotation, please describe and provide the rationale for the cycle/rotation below.

- Each Semester  Yearly  Every other year
- Other (please specify): If the assessment of Learning Outcome 4 occurs on a cycle or rotation, click here to describe and provide the rationale.

Appendix III. Modified Science Reasoning and Critical Thinking Rubric

Component		1	2*	3	4**	5
A	Understanding of problem	Student does not exhibit a clear understanding of the problem; Displays little comprehension of the important elements of the		Response is free of misconceptions that lead to wrong answers; Student grasps basic parts of the problem as well as the general framework; Understands enough to work most of the problem; Can		Student manifests a thorough understanding of concepts and relationships between concepts; Identifies all the important elements of the problem; Organization of the response demonstrates clarity of understanding.
B	Graphical Interpretation	Fails to present data in graphical or tabular format.		Student has sufficient understanding to work the problem, but presentation is not sophisticated; Provides graphical representation but cannot extract abstract information or interpretation; Presents		Presents data in appropriate graphical or tabular format; Provides clear interpretation and conceptualization of results; Displays results graphically in a clear and illuminating way.
C	Calculations	Student provides no evidence of manipulation of mathematical expressions; Commits numerous arithmetic errors;		Response is mainly accurate with some minor arithmetic errors;		Response is fully mathematically accurate; Solution is clearly displayed with various computation steps shown; Student executes algorithms completely and correctly.
D	Solution and data interpretation	Student shows significant misunderstanding of the process; Does not correctly apply or even attempt to apply appropriate solution;		Student shows understanding of the process; Adopts a reasonable strategy for solving most of the problem; Displays solution in a rote manner indicating a simple conceptualization of the problem; Shows understanding of some of the problem's concepts.		Student shows mastery of the process; Presents a detailed solution characterized by logical sequencing and systematic progression; Offers strong supporting arguments; Uses relevant outside information; Solution reflects excellent problem-solving skills.

E	Answer and Use of terms	Answer lacks units or units are stated incorrectly; Student offers an invalid answer; Fails to offer any empirical findings. Student is unable to communicate scientific concepts through terminology; Fails to employ technical, mathematical, or scientific		Answer is stated in correct units; Student expresses empirical findings but is limited in identification of related issues; Is unable to demonstrate complete understanding of the mathematical result and its relationship to the conceptual model. Student uses most terminology and symbols correctly; Provides evidence of reasonable understanding of terms and symbols.		Answer is stated in correct units with any unit changes clearly illustrated; Student provides a complete response with a clear, unambiguous, accurate explanation; Fully describes findings in words; Convincingly connects the numeric results and the conceptual model. Student explains thoughts thoroughly using correct terminology and clearly displayed, appropriate symbols; Communicates ideas clearly and concisely; Demonstrates superior knowledge of scientific
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- 2\* - Exhibits most characteristics of '1' and some characteristics of '3'
- 4\*\* - Exhibits most characteristics of '3' and some characteristics of '5'

### Appendix III

#### Communications/Safety/Literature Rubric

##### Chemistry (BS) Learning Outcomes:

3. Graduates will be able to use the chemical literature;
4. Graduates will be able to follow safety regulations and read material safety data sheets;
5. Graduates will be able to present information in a clear and organized manner.

Skill	1	2*	3	4*	5
Chemical Literature	Uses immediately available information (textbook) with little discrimination.  Cannot independently seek out and locate required information.  Does not consistently		Can seek out and locate required information with minimal support.  Does not always discriminate effectively between sources of information. Does apply acceptable reference style.		Independently seeks out and locates relevant references. Is selective and discriminates between sources of information.

	apply acceptable reference style.			
Chemical Safety	Does not include proper safety information, safety procedures followed, or indicate any knowledge of hazards associated with any chemical reagents used in the experiment.		Safety information is included, but not thoroughly communicated. Safety information, procedures and/or hazards are partially incomplete, or missing.	All proper safety information is included, safety procedures followed, and an complete explanation of hazards associated with any chemical reagents used in the experiment are provided.
Presentation	Poor verbal communication and listening skills accompanied by a lack of self-awareness of impact on others.		Communicates ideas and relates sensitively to others. Can listen to the ideas of others and respond to them.	Balances listening and responding. Synthesizes what has been heard and responds and evaluates or elaborates on ideas, offering alternative perspectives.