Chemistry Department Assessment Plan, 2009

Performance Criteria for Learning Outcomes for Missouri S&T

Learning Outcomes

Programs must demonstrate that their graduates have:

(1) an ability to communicate effectively both orally and in writing.
(2) an ability to think critically and analyze effectively.
(3) an ability to apply disciplinary knowledge and skills in solving critical problems.
(4) an ability to function in diverse learning and working environments.
(5) an understanding of professional and ethical responsibility.
(6) an awareness of national and global contemporary issues.
(7) a recognition of the need for, and an ability to engage in, life-long learning.

DISCLAIMER: The list of performance criteria in this document is not meant to be authoritative; they were developed to help departments with assessment. Use or modify the performance criteria to work for your program and supplement the list as necessary. Please provide feedback and suggestions for improvement.

Learning Outcome (1): Communications

Programs must demonstrate that their graduates have an ability to communicate effectively both orally and in writing.

Performance Criteria (Choose at least one and preferably two or three, or add your own)

1.1 Communicates effectively in individual oral presentations.
1.2 Communicates effectively in group oral presentations.
1.3 Communicates effectively in written technical reports and memos.
1.4 Communicates effectively in written non-technical reports.
1.5 Communicates effectively in email communications.

Rubric Categories for Performance Criterion 1.1

- Organization: Presents material in a logical sequence and makes points clearly.
- Visual Presentation: Uses effective slides or props.
- Vocal Delivery: Maintains clear voice, good pace and expression.
• Relating to Audience: Engages audience; uses appropriate eye contact and adjusts presentation to audience.

Rubric Categories for Performance Criterion 1.2

• Organization: Presents material in a logical sequence and makes points clearly.
• Visual Presentation: Uses effective slides or props.
• Vocal Delivery: Maintains clear voice, good pace and expression.
• Relating to Audience: Engages audience; uses appropriate eye contact and adjusts presentation to audience.
• Teamwork: Material is logically divided among group members and all share in presentation appropriately.
• Transitions: Transitions between speakers are smooth.

Rubric Categories for Performance Criterion 1.3

• Organization: Presents material in a logical sequence and makes points clearly.
• Mechanics: Articulates ideas well using proper spelling and grammar. Uses professional style of writing.
• Use of graphs and charts: Uses tables, graphs and figures to enhance understanding and support arguments.

Rubric Categories for Performance Criterion 1.4

• Organization: Presents material in a logical sequence and makes points clearly.
• Mechanics: Articulates ideas well using proper spelling and grammar. Uses appropriate style of writing.
• Relating to Audience: Writing style and content is appropriate for intended audience.

Rubric Categories for Performance Criterion 1.5

• Choice of Form: Uses email communication in appropriate situations.
• Address: Uses appropriate subject line, greeting and closing. Displays proper level of respect.
• Mechanics: Articulates ideas effectively using proper spelling and grammar. Uses appropriate style of writing.
• Organization: Limits length of message as appropriate for email communication. Confines message to one main point, which is obvious and related to subject line.

Performance Criteria for Learning Outcome (2): Critical Thinking
Programs must demonstrate that their graduates have an ability to think critically and analyze effectively.

**Performance Criteria** (Choose at least one and preferably two or three, or add your own)

2.1 Critiques writing or publication within discipline.

2.2 Critiques writing or publication outside of discipline.

2.3 Composes research paper.

**Rubric Categories for Performance Criterion 2.1**

- Identification: Identifies and summarizes the problem/question/work assignment
- Context: Identifies and considers the influence of context and assumptions
- Own perspective: Develops and communicates own perspective, hypothesis or position.
- Data analysis: Presents, assesses and analyzes appropriate supporting data/evidence.
- Other perspectives: Integrates issue using other perspective and positions
- Conclusions: Identifies and assesses conclusions, implications and consequences.

**Rubric Categories for Performance Criterion 2.2**

- Identification: Identifies and summarizes the problem/question/work assignment
- Context: Identifies and considers the influence of context and assumptions
- Own perspective: Develops and communicates own perspective, hypothesis or position.
- Data analysis: Presents, assesses and analyzes appropriate supporting data/evidence.
- Other perspectives: Integrates issue using other perspective and positions
- Conclusions: Identifies and assesses conclusions, implications and consequences.

**Rubric Categories for Performance Criterion 2.3**

- Identification: Identifies and summarizes the problem/question/work assignment
- Context: Identifies and considers the influence of context and assumptions
- Own perspective: Develops and communicates own perspective, hypothesis or position.
- Data analysis: Presents, assesses and analyzes appropriate supporting data/evidence.
- Other perspectives: Integrates issue using other perspective and positions
- Conclusions: Identifies and assesses conclusions, implications and consequences.

**Performance Criteria for Learning Outcome (3): Problem Solving**

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1 Adapted from Washington State University Guide to Rating Integrative and Critical Thinking, www.wsuctproject.wsu.edu/ctr.htm
Programs must demonstrate that their graduates have an ability to apply disciplinary knowledge and skills in solving critical problems.

**Performance Criteria**² (Choose at least one and preferably two or three, or add your own)

3.1 Solves problem within discipline using skills and knowledge gained through program.

3.2 Solves problem related to social issues related to discipline.

3.3 Designs and conducts experiments.

**Rubric Categories for Performance Criterion 3.1**

- Identification: Identifies problem
- Knowledge: Applies previous knowledge
- Information: Identifies additional information to solve problem
- Analysis: Analyzes various components of problem
- Interpretation: Interprets results to draw conclusion

**Rubric Categories for Performance Criterion 3.2**

- Identification: Identifies problem
- Knowledge: Applies previous knowledge
- Information: Identifies additional information to solve problem
- Analysis: Analyzes various components of problem
- Interpretation: Interprets results to draw conclusion

**Rubric Categories for Performance Criterion 3.3**

- Identification: Identifies problem
- Knowledge: Applies previous knowledge
- Design: Designs means to obtain information needed to solve problem
- Application: Conducts experiment
- Analysis: Analyzes data
- Interpretation: Interprets results to draw conclusion

**Learning Outcome (4): Diverse Environments/Teamwork.**

Programs must demonstrate that their graduates have an ability to function in diverse learning and working environments.

² Adapted from Chemical Engineering CRCD Project, Iowa State University, www3.cbe.iastate.edu/CRCD/rubric-problem-solving.doc
Performance Criteria (Choose at least one and preferably two or three, or add your own)

4.1 Functions as team player.

4.2 Conducts effective and efficient meetings.

Rubric Categories for Performance Criterion 4.1

• Role: Demonstrates understanding of role on team by fulfilling appropriate duties.
• Duty: Fulfills duty to team by sharing equally in workload.
• Communication: Communicates well with teammates and resolves conflict.
• Altruism: Takes initiation in areas as needed to promote team effectiveness.
• Understanding: Understands advantage of a team approach to a problem.
• Discernment: Distinguishes when a problem is better suited to solution by individual or team.
• Recognition: Recognizes the advantage of diversity in forming teams.
• Utilization: Uses the diverse skills and experiences of team members in solving problems.

Rubric Categories for Performance Criterion 4.2

• Decision: Recognizes when to call a meeting and when to work one-on-one or in small groups.
• Agenda: Invites appropriate individuals, prepares effective agenda and provides pre-work as necessary.
• Logistics: Proceeds through agenda in a timely manner, allowing appropriate amount of time for each agenda item.
• Engaging team: Engages all attendees in meeting and utilizes the strengths of the individuals to achieve optimal results.

Note that while it is not advisable to have all assessments of a learning outcome performed by students, it may be appropriate at times to have students assess one another in situations where the instructor does not participate in an activity.

Learning Outcome (5): Professional and Ethical Responsibility.

Programs must demonstrate that their graduates have an understanding of professional and ethical responsibility.

Performance Criteria (Choose at least one and preferably two or three, or add your own)

5.1 Demonstrates knowledge of code of ethics and applies code to case studies.

5.2 Understands ethical models and applies appropriate model to ethical dilemma.
5.3 Understands process, purpose, privileges and responsibilities associated with licensure within profession.

5.4 Assumes responsibility for actions.

Rubric Categories for Performance Criterion 5.1

- Knowledge: Demonstrates knowledge of code of ethics related to profession.
- Identification of Dilemma: Identifies situations in case study that are relevant to code.
- Application and Recommendation: Considers various aspects of case, makes recommendations based on code, and defends recommendations.

Rubric Categories for Performance Criterion 5.2

- Knowledge: Describes ethical models.
- Identification of Dilemma: Identifies ethical dilemma and chooses appropriate model for application.
- Application and Recommendation: Considers various aspects of case, makes recommendations based on model, and defends recommendations.

Rubric Categories for Performance Criterion 5.3

- Process: Describes process required for licensure in profession.
- Purpose: Understands purpose of licensure and associated privileges.
- Comprehension of responsibilities: Explains responsibilities and limitations associated with position in profession.

Rubric Categories for Performance Criterion 5.4

- Class attendance: Is attentive in class and arrives on time.
- Performance: Turns in assignments on time. Takes pride in work.
- Responsibility for Actions: Recognizes weaknesses in performance and takes action for improvement.


Programs must demonstrate that their graduates have awareness of national and global contemporary issues.

Performance Criteria (Choose at least one and preferably two or three, or add your own)

6.1 Identifies national contemporary issues related to discipline.

6.2 Identifies global contemporary issues related to discipline.
6.3 Understands relationship of discipline to energy issues.
6.4 Understands relationship of discipline to environmental issues.
6.5 Understands relationship of discipline to the economy.

Rubric Categories for Performance Criterion 6.1
Knowledge: Identifies national contemporary issues related to discipline and reads articles or attends presentations that address issues.
Comprehension: Discusses or writes thoughtful essay about articles or presentations.

Rubric Categories for Performance Criterion 6.2
Knowledge: Identifies global contemporary issues related to discipline and reads articles or attends presentations that address issues.
Comprehension: Discusses or writes thoughtful essay about articles or presentations.

Rubric Categories for Performance Criterion 6.3
Knowledge: Identifies contemporary issues related to energy, and reads articles or attends presentations that address issues.
Comprehension: Discusses or writes thoughtful essay about articles or presentations.

Rubric Categories for Performance Criterion 6.4
Knowledge: Identifies contemporary issues related to the environment, and reads articles or attends presentations that address issues.
Comprehension: Discusses or writes thoughtful essay about articles or presentations.

Rubric Categories for Performance Criterion 6.5
Knowledge: Identifies contemporary issues related to the economy, and reads articles or attends presentations that address issues.
Comprehension: Discusses or writes thoughtful essay about articles or presentations.
A suggestion for addressing this learning outcome is to convene a group of faculty at the beginning of the fall semester to discuss and identify contemporary issues related to your program. Identify three courses, preferably at the sophomore, junior and senior levels, in which reading assignments can be given related to the identified issues. Have the students identify and read articles (or the instructor can assign them) and write an essay on the topic.

This same assignment could be used to assess Learning Outcome (1) Communication. The essay could be assessed for written communication skills. An additional assessment of oral communication could be performed if the students were asked to make a presentation on their essays.

Learning Outcome (7): Lifelong Learning.

Programs must demonstrate that their graduates have a recognition of the need for, and an ability to engage in, life-long learning.

Performance Criteria (Choose at least one and preferably two or three, or add your own)

7.1 Demonstrates initiative in learning.
7.2 Participates in professional and service activities.
7.3 Reads professional publications.
7.4 Attends seminars and presentations significant to the profession.

Rubric Categories for Performance Criterion 7.1

- Cognition: Expresses independent thought.
- Performance: Demonstrates ability to perform beyond requirements.

Rubric Categories for Performance Criterion 7.2

- Professional and Service Societies: Participates in student chapter of professional society.
- Citizenship: Participates in service activities of student or community organization.
- Personal Development: Engages in activities to promote personal, physical and/or spiritual growth.

Rubric Categories for Performance Criterion 7.3

- Exposure: Reads articles related to profession.
- Comprehension: Writes essay or engages in thoughtful discussion about article.

Rubric Categories for Performance Criterion 7.4
• Exposure: Attends presentation.
• Comprehension: Writes essay or engages in thoughtful discussion about presentation.

**Learning Outcome (1):** an ability to communicate effectively both orally and in writing

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>Chem 002 (gen)</td>
<td>Writing lab reports</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 008 (gen)</td>
<td>Writing lab reports</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.1</td>
<td>Chem 011 (gen)</td>
<td>Presentation</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>1.1</td>
<td>Chem 012 (gen)</td>
<td>Presentation</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 151 (anal)</td>
<td>Prepare graphs &amp; charts</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 251 (anal)</td>
<td>Use graphs &amp; charts</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 224 (org)</td>
<td>Writing lab reports</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 242 (phys)</td>
<td>Writing lab reports</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 244 (phys)</td>
<td>Writing lab reports</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.1 &amp; 1.3</td>
<td>Chem 237 (inorg)</td>
<td>Presentation</td>
<td>Rubric for 1.1 and 1.3 Numerical score</td>
</tr>
<tr>
<td>1.3</td>
<td>Chem 238 (inorg)</td>
<td>Test/quiz</td>
<td>Numerical score</td>
</tr>
<tr>
<td>1.1</td>
<td>Chem 363 (biochem)</td>
<td>Organization</td>
<td>Numerical score Numerical score</td>
</tr>
</tbody>
</table>

**Learning Outcome (2):** an ability to think critically and analyze effectively

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Chem 002 (gen)</td>
<td>Journal synopsis</td>
<td>Numerical score</td>
</tr>
<tr>
<td>2.1 &amp; 2.3</td>
<td>Chem 151 (anal)</td>
<td>Write lab reports, identification, data analysis</td>
<td>Numerical score</td>
</tr>
<tr>
<td>2.1 &amp; 2.3</td>
<td>Chem 251 (anal)</td>
<td>Write lab reports, identification, data analysis</td>
<td>Numerical score</td>
</tr>
<tr>
<td>2.1 &amp; 2.3</td>
<td>Chem 355 (anal)</td>
<td>Write lab reports, identification, data analysis</td>
<td>Numerical score</td>
</tr>
<tr>
<td>2.1 &amp; 2.4</td>
<td>Chem 237 (inorg)</td>
<td>Presentation Quizzes</td>
<td>Rubric for 2.1 and 2.4 Numerical score</td>
</tr>
<tr>
<td>2.3</td>
<td>Chem 238 (inorg)</td>
<td>Research report</td>
<td>Numerical score</td>
</tr>
<tr>
<td>2.3</td>
<td>Chem 362 (biochem)</td>
<td>Data analysis</td>
<td>Numerical score</td>
</tr>
</tbody>
</table>
### Learning Outcome (3): Problem Solving

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Chem 001 (gen)</td>
<td>Exam, Quizzes, Homework, Reading &amp; note taking, Clicker responses</td>
<td>Numerical score, Numerical score, Numerical score, Numerical score, Numerical score</td>
</tr>
<tr>
<td></td>
<td>Chem 002 (gen)</td>
<td>Exam, Quizzes</td>
<td>Numerical score, Numerical score</td>
</tr>
<tr>
<td></td>
<td>Chem 003 (gen)</td>
<td>Exam, Homework, Clicker responses</td>
<td>Numerical score, Numerical score, Numerical score</td>
</tr>
<tr>
<td></td>
<td>Chem 008 (gen)</td>
<td>Exam, Lab reports</td>
<td>Numerical score, Numerical score</td>
</tr>
<tr>
<td></td>
<td>Chem 251 (anal)</td>
<td>Design &amp; conduct experiments</td>
<td>Rubric for 3.1 &amp; 3.3</td>
</tr>
<tr>
<td></td>
<td>Chem 226 (org)</td>
<td>Exam, Quizzes, Lab reports</td>
<td>Numerical score, Numerical score, Numerical score</td>
</tr>
<tr>
<td></td>
<td>Chem 237 (inorg)</td>
<td>Exam, Quizzes</td>
<td>Numerical score, Numerical score</td>
</tr>
<tr>
<td></td>
<td>Chem 238 (inorg)</td>
<td>Performance of experiments</td>
<td>Numerical score, Rubric for 3.3</td>
</tr>
<tr>
<td></td>
<td>Chem 331 (inorg)</td>
<td>Exams, Homework</td>
<td>Numerical score, Numerical score</td>
</tr>
<tr>
<td>3.3</td>
<td>Chem 362 (biochem)</td>
<td>Design methods of obtaining information, Visual presentation, Vocal delivery, Conducts experiments, Analyzes data</td>
<td>Rubric for 3.3, Numerical score</td>
</tr>
</tbody>
</table>

### Learning Outcome (4): Diverse Environments/Teamwork

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Chem 228 (org)</td>
<td>Team work</td>
<td>Observation/Numerical score</td>
</tr>
<tr>
<td>4.1</td>
<td>Chem 242 (phys)</td>
<td>Team work</td>
<td>Observation/Numerical score</td>
</tr>
<tr>
<td>4.1</td>
<td>Chem 244 (phys)</td>
<td>Team work</td>
<td>Observation/Numerical score</td>
</tr>
<tr>
<td>4.1</td>
<td>Chem 362 (biochem)</td>
<td>Demonstrates understanding of role on team by fulfilling appropriate duties</td>
<td>Numerical score</td>
</tr>
</tbody>
</table>

**Learning Outcome (5): Professional and Ethical Responsibility**

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4</td>
<td>Chem 355 (anal)</td>
<td>Timeliness with attendance and assignments</td>
<td>Numerical score</td>
</tr>
<tr>
<td>5.4</td>
<td>Chem 361 (biochem)</td>
<td>Timeliness with attendance and assignments</td>
<td>Numerical score</td>
</tr>
</tbody>
</table>

**Learning Outcome (6): Awareness of National and Global Contemporary Issues**

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1, 6.3, 6.4</td>
<td>Chem 355 (anal)</td>
<td>Lab experiments</td>
<td>Lab experiments -- relate chem knowledge to national, energy, and environmental issues</td>
</tr>
</tbody>
</table>

**Learning Outcome (7): Lifelong Learning**

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Class</th>
<th>Achievement Activity</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Chem 001 (gen)</td>
<td>LEAD sessions</td>
<td>Level of participation</td>
</tr>
<tr>
<td>7.1</td>
<td>Chem 003 (gen)</td>
<td>LEAD sessions</td>
<td>Level of participation</td>
</tr>
<tr>
<td>7.4</td>
<td>Chem 011 (gen)</td>
<td>Presentation/attendance</td>
<td>Numerical score</td>
</tr>
<tr>
<td>7.4</td>
<td>Chem 012 (gen)</td>
<td>Presentation/attendance</td>
<td>Numerical score</td>
</tr>
<tr>
<td>7.1</td>
<td>Chem 221 (org)</td>
<td>Help/discussion sessions</td>
<td>Level of participation</td>
</tr>
<tr>
<td>7.1</td>
<td>Chem 224 (org)</td>
<td>Help/discussion sessions</td>
<td>Level of participation</td>
</tr>
<tr>
<td>7.1</td>
<td>Chem 343 (phys)</td>
<td>LEAD sessions</td>
<td>Level of participation</td>
</tr>
<tr>
<td>7.3</td>
<td>Chem 363 (biochem)</td>
<td>Exposure: reads articles related to profession Comprehension: writes essay or engages in thoughtful discussion about article</td>
<td>Numerical score</td>
</tr>
<tr>
<td>7.3</td>
<td>Chem 363 (biochem)</td>
<td>Exposure: reads articles related to profession Comprehension: writes essay or engages in thoughtful discussion about article</td>
<td>Numerical score</td>
</tr>
</tbody>
</table>