### Goals

**G 1: Scientific Observations, Laws, and Theories**
Students will prepare an essay explaining the relationship of scientific observations, laws, and theories using a course content relevant example suggested and agreed to by the instructors of all sections of the course. Faculty will use a rubric to assess scientific understanding, written communication skills, and critical thinking skills.

**G 2: Chemical Calculations and Meanings**
Students will document the solution of a course content relevant chemical calculation problem suggested and agreed to by the instructors of all sections of the course. Students will interpret the meaning of the results obtained. Faculty will use a rubric to assess scientific understanding, critical thinking skills and empirical and quantitative skills.

**G 3: Chemical Use - Benefits and Hazards**
Students will prepare a group presentation explaining the relative benefits and hazards of a contemporary, course relevant issue suggested and agreed to by the instructors of all sections of the course. Faculty will use a rubric to assess scientific understanding, understanding of the interactions of natural phenomena, communication skills, and teamwork.

### Student Learning Outcomes/Objectives, with Any Associations and Related Measures, Targets, Findings, and Action Plans

**SLO 1: Scientific Observations, Laws, and Theories**
Students will prepare an essay explaining the relationship of scientific observations, laws, and theories using a course content relevant example suggested and agreed to by the instructors of all sections of the course. Faculty will use a rubric to assess scientific understanding, written communication skills, and critical thinking skills.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Exemplary (4)</th>
<th>Very Good (3)</th>
<th>Good (2)</th>
<th>Fair (1)</th>
<th>Poor (0)</th>
<th>Assessed Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Understanding</strong></td>
<td>In depth understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Advanced understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Detailed understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Basic understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Little or no understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td></td>
</tr>
<tr>
<td><strong>Written Communication Skills</strong></td>
<td>Written material had no lapses in clarity.</td>
<td>Written material had fewer than three lapses in clarity.</td>
<td>Written material had fewer than five lapses in clarity.</td>
<td>Written material had fewer than seven lapses in clarity.</td>
<td>Written material had more than seven lapses in clarity.</td>
<td></td>
</tr>
<tr>
<td>(Clarity)</td>
<td>Written material had no errors in grammar and/or spelling.</td>
<td>Written material had fewer than three errors in grammar and/or spelling.</td>
<td>Written material had fewer than five errors in grammar and/or spelling.</td>
<td>Written material had fewer than seven errors in grammar and/or spelling.</td>
<td>Written material had more than seven errors in grammar and/or spelling.</td>
<td></td>
</tr>
<tr>
<td><strong>Written Communication Skills</strong></td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with complete accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with nearly complete accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with good accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with fair accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with little or no accuracy.</td>
<td></td>
</tr>
<tr>
<td>(Grammatical)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Critical Thinking Skills</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Relevant Associations:**
Standard Associations

**New Core Component Areas**
2. Life & Physical Science (L & PS)

**New Core Objectives**
1. Critical Thinking (CT)
2. Communication (COM)

**General Education/Core Curriculum Associations**
1. Critical Thinking: Students will apply critical thinking appropriately to identify, analyze and resolve complex issues.
3. Communication: Students will develop written and oral presentations that are clear, precise, organized, efficient and appropriately adapted to audience and purpose.

**Related Measures**

**M 1: Scientific Observations, Laws, and Theories**
Students will prepare an essay explaining the relationship of scientific observations, laws, and theories using a course content relevant example suggested and agreed to by the instructors of all sections of the course. Faculty will use a rubric to assess scientific understanding, written communication skills, and critical thinking skills.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Exemplary (4)</th>
<th>Very Good (3)</th>
<th>Good (2)</th>
<th>Fair (1)</th>
<th>Poor (0)</th>
<th>Assessed Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Understanding</strong></td>
<td>In depth understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Advanced understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Detailed understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Basic understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td>Little or no understanding of the relationships and nuances between scientific observations, laws, and theories demonstrated.</td>
<td></td>
</tr>
<tr>
<td><strong>Written Communication Skills</strong></td>
<td>Written material had no lapses in clarity.</td>
<td>Written material had fewer than three lapses in clarity.</td>
<td>Written material had fewer than five lapses in clarity.</td>
<td>Written material had fewer than seven lapses in clarity.</td>
<td>Written material had more than seven lapses in clarity.</td>
<td></td>
</tr>
<tr>
<td><strong>Written Communication Skills</strong></td>
<td>Written material had no errors in grammar and/or spelling.</td>
<td>Written material had fewer than three errors in grammar and/or spelling.</td>
<td>Written material had fewer than five errors in grammar and/or spelling.</td>
<td>Written material had fewer than seven errors in grammar and/or spelling.</td>
<td>Written material had more than seven errors in grammar and/or spelling.</td>
<td></td>
</tr>
<tr>
<td><strong>Critical Thinking Skills</strong></td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with complete accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with nearly complete accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with good accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with fair accuracy.</td>
<td>Interprets the content relevant example in terms of the scientific observations, laws and theories with little or no accuracy.</td>
<td></td>
</tr>
</tbody>
</table>

Source of Evidence: Written assignment(s), usually scored by a rubric

**Target:**
Students assessed will achieve an average attainment level of 2 out of 4 overall and for each subordinate category.

**SLO 2: Chemical Calculations and Meanings**
Students will document the solution of a course content relevant chemical calculation problem suggested and agreed to by the instructors of all sections of the course. Students will interpret the meaning of the results obtained. Faculty will use a rubric to assess scientific understanding, critical thinking skills and empirical and quantitative skills.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Exemplary (4)</th>
<th>Very Good (3)</th>
<th>Good (2)</th>
<th>Fair (1)</th>
<th>Poor (0)</th>
<th>Assessed Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advanced understanding</strong></td>
<td>In depth understanding</td>
<td>Detailed understanding</td>
<td>Basic understanding</td>
<td>Little or no understanding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Relevant Associations:

#### Standard Associations

**New Core Component Areas**
- 2 Life & Physical Science (L & PS)

**New Core Objectives**
- 1 Critical Thinking (CT)
- 3 Empirical & Quantitative Skills (EQS)

#### General Education/Core Curriculum Associations

1. Critical Thinking: Students will apply critical thinking appropriately to identify, analyze and resolve complex issues.
2. Quantitative Thinking: Students will demonstrate mastery of quantitative reasoning and algorithms used to address applied problems

### Related Measures

**M 2: Chemical Calculations and Meanings**

Students will document the solution of a course content relevant chemical calculation problem suggested and agreed to by the instructors of all sections of the course. Students will interpret the meaning of the results obtained. Faculty will use a rubric to assess scientific understanding, critical thinking skills and empirical and quantitative skills.

### Criteria Table

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Exemplary (4)</th>
<th>Very Good (3)</th>
<th>Good (2)</th>
<th>Fair (1)</th>
<th>Poor (0)</th>
<th>Assessed Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Understanding</td>
<td>Advanced understanding of the meaning of the results obtained from the calculation problem.</td>
<td>In depth understanding of the meaning of the results obtained from the calculation problem.</td>
<td>Detailed understanding of the meaning of the results obtained from the calculation problem.</td>
<td>Basic understanding of the meaning of the results obtained from the calculation problem.</td>
<td>Little or no understanding of the meaning of the results obtained from the calculation problem.</td>
<td></td>
</tr>
<tr>
<td>Critical Thinking Skills</td>
<td>Justified all procedures used to obtain the results presented.</td>
<td>Justified most procedures used to obtain the results presented.</td>
<td>Justified major procedures used to obtain the results presented.</td>
<td>Justified some procedures used to obtain the results presented.</td>
<td>Justified no procedures used to obtain the results presented.</td>
<td></td>
</tr>
<tr>
<td>Empirical and Quantitative Skills</td>
<td>Results obtained are completely accurate and documented.</td>
<td>Results obtained are mostly accurate and documented.</td>
<td>Results obtained are generally accurate and documented.</td>
<td>Results obtained are somewhat accurate and documented.</td>
<td>Results obtained are not accurate nor documented.</td>
<td></td>
</tr>
</tbody>
</table>

---

**Source of Evidence:** Project, either individual or group

**Target:**

Students assessed will achieve an average attainment level of 2 out of 4 overall and for each subordinate category.

**SLO 3: Chemical Use - Benefits and Hazards**

Students will prepare an group presentation explaining the relative benefits and hazards of a contemporary, course relevant issue suggested and agreed to by the instructors of all sections of the course. Faculty will use a rubric to assess scientific understanding, understanding of the interactions of natural phenomena, communication skills, and teamwork.
### Scientific Understanding
- In depth understanding the relative benefits and hazards associated with the issue.
- Advanced understanding the relative benefits and hazards associated with the issue.
- Detailed understanding the relative benefits and hazards associated with the issue.
- Basic understanding the relative benefits and hazards associated with the issue.
- Little or no understanding the relative benefits and hazards associated with the issue.

### Understanding of Natural Phenomena
- In depth understanding of how natural phenomena interact to produce the results presented.
- Advanced understanding of how natural phenomena interact to produce the results presented.
- Detailed understanding of how natural phenomena interact to produce the results presented.
- Basic understanding of how natural phenomena interact to produce the results presented.
- Little or no understanding of how natural phenomena interact to produce the results presented.

### Communication Skills (Clarity)
- Presented material had no lapses in clarity.
- Presented material had fewer than three lapses in clarity.
- Presented material had fewer than five lapses in clarity.
- Presented material had fewer than seven lapses in clarity.
- Presented material had more than seven lapses in clarity.

### Communication Skills (Grammatical)
- Presented material had no errors in grammar and/or spelling.
- Presented material had fewer than three errors in grammar and/or spelling.
- Presented material had fewer than five errors in grammar and/or spelling.
- Presented material had fewer than seven errors in grammar and/or spelling.
- Presented material had more than seven errors in grammar and/or spelling.

### Communication Skills (Technical)
- Presented material was completely understandable and was visually exemplary.
- Presented material was highly understandable and was visually very good.
- Presented material was mostly understandable and was visually good.
- Presented material was slightly understandable and was visually fair.
- Presented material was not understandable and/or was visually displeasing.

### Teamwork
- Exemplary evidence of teamwork provided.
- Very good evidence of teamwork provided.
- Good evidence of teamwork provided.
- Fair evidence of teamwork provided.
- Little or no evidence of teamwork provided.

### Relevant Associations:
**Standard Associations**
- **New Core Component Areas**
  - Life & Physical Science (L & PS)
- **New Core Objectives**
  - Critical Thinking (CT)
  - Communication (COM)
  - Teamwork (TW)

**General Education/Core Curriculum Associations**
1. Critical Thinking: Students will apply critical thinking appropriately to identify, analyze and resolve complex issues.
2. Communication: Students will develop written and oral presentations that are clear, precise, organized, efficient and appropriately adapted to audience and purpose.
3. Teamwork: includes the ability to collaborate effectively, consider different points of view, and work with others to support a shared purpose or goals.

### Related Measures
**M 3: Chemical Use - Benefits and Hazards**
Students will prepare an group presentation explaining the relative benefits and hazards of a contemporary, course relevant issue suggested and agreed to by the instructors of all sections of the course. Faculty will use a rubric to assess scientific understanding, understanding of the interactions of natural phenomena, communication skills, and teamwork.
<table>
<thead>
<tr>
<th>Scientific Understanding</th>
<th>Understanding of Natural Phenomena</th>
<th>Communication Skills (Clarity)</th>
<th>Communication Skills (Grammatical)</th>
<th>Communication Skills (Technical)</th>
<th>Teamwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>the relative benefits and hazards associated with the issue.</td>
<td>In depth understanding of how natural phenomena interact to produce the results presented.</td>
<td>Presented material had no lapses in clarity.</td>
<td>Presented material had no errors in grammar and/or spelling.</td>
<td>Presented material was completely understandable and was visually exemplary.</td>
<td>Exemplary evidence of teamwork provided.</td>
</tr>
<tr>
<td>the relative benefits and hazards associated with the issue.</td>
<td>Advanced understanding of how natural phenomena interact to produce the results presented.</td>
<td>Presented material had fewer than three lapses in clarity.</td>
<td>Presented material had fewer than three errors in grammar and/or spelling.</td>
<td>Presented material was highly understandable and was visually very good.</td>
<td>Very good evidence of teamwork provided.</td>
</tr>
<tr>
<td>the relative benefits and hazards associated with the issue.</td>
<td>Detailed understanding of how natural phenomena interact to produce the results presented.</td>
<td>Presented material had fewer than five lapses in clarity.</td>
<td>Presented material had fewer than five errors in grammar and/or spelling.</td>
<td>Presented material was mostly understandable and was visually good.</td>
<td>Good evidence of teamwork provided.</td>
</tr>
<tr>
<td>the relative benefits and hazards associated with the issue.</td>
<td>Basic understanding of how natural phenomena interact to produce the results presented.</td>
<td>Presented material had fewer than seven lapses in clarity.</td>
<td>Presented material had fewer than seven errors in grammar and/or spelling.</td>
<td>Presented material was slightly understandable and was visually good.</td>
<td>Fair evidence of teamwork provided.</td>
</tr>
<tr>
<td>the relative benefits and hazards associated with the issue.</td>
<td>Little or no understanding of how natural phenomena interact to produce the results presented.</td>
<td>Presented material had more than seven lapses in clarity.</td>
<td>Presented material had more than seven errors in grammar and/or spelling.</td>
<td>Presented material was not understandable and/or was visually displeasing.</td>
<td>Little or no evidence of teamwork provided.</td>
</tr>
</tbody>
</table>

Source of Evidence: Presentation, either individual or group

**Target:**
Students assessed will achieve an average attainment level of 2 out of 4 overall and for each subordinate category.