

# Course Student Learning Outcomes Assessment

**CHEM 259 Organic Chemistry II**

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## **General Information (Course Student Learning Outcomes Assessment)**

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## Standing Requirements

### Course Description

This course is the second semester of a year of organic chemistry (continuation of Chemistry 249). It includes units on structure elucidation aromatic compounds carbonyl compounds carboxylic acids and their derivatives amines and classes of biologically important compounds. More complex synthetic routes are explored. Laboratory work includes multi-step syntheses and unknown identification. Reaction mechanisms and use of spectroscopic techniques continue to be emphasized.

### Course Student Learning Outcomes

#### CHEM 259 Organic Chemistry II Outcome Set

Outcome	
Outcome	Mapping
Outcome 1 Apply major concepts of chemical reactivity of organic compounds to solve problems.	<b>Institutional Student Learning Outcomes:</b> Act 1, Act 2, Communicate 1, Communicate 2, Learn 1, Think 1, Think 2
Outcome 2 Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.	<b>Institutional Student Learning Outcomes:</b> Act 1, Act 2, Communicate 1, Communicate 2, Learn 1, Learn 2, Think 1, Think 2
Outcome 3 Perform experiments with published protocols, use standard laboratory procedure and instruments to analyze data to determine the identity of an unknown organic compound.	<b>Institutional Student Learning Outcomes:</b> Act 1, Act 2, Communicate 1, Communicate 2, Learn 1, Learn 2, Think 1, Think 2

## 2014-2015 Assessment Cycle

### Measurements

#### Outcomes and Measures

#### CHEM 259 Organic Chemistry II Outcome Set

##### Outcome

###### Outcome 1

Apply major concepts of chemical reactivity of organic compounds to solve problems.

▼ **Measure:** Chem 259 SLO A  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO A will be assessed using a standardized year-long national Organic Chemistry exam provided by the American Chemical Society (ACS). We will compare our average to the national average.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students are having the national average or above.

**Cycle of Assessment:** It is a yearly cycle where the course will be assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

###### Outcome 2

Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.

▼ **Measure:** Chem 259 SLO B  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO B will be assessed using a mechanism question on part II of the final exam.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means having 70% of the students obtaining competent or above on writing a mechanism. A rubric is used to evaluate how they can draw a mechanism based on reactivity. Achieving the SLO means that 70% of the students achieved competent or above on the rubric (12 points out of 18)

**Cycle of Assessment:** Yearly cycle with the course assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

###### Outcome 3

Perform experiments with published protocols, use standard laboratory procedure and instruments to analyze data to determine the identity of an unknown organic compound.

▼ **Measure:** Chem 259 SLO C  
Course level; Direct - Other

**Description of Measurement Tool:** SLO C will be assessed using a laboratory unknown report. The report will be graded using a rubric

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students achieved competent or above on their unknown report (20 points or above).

**Cycle of Assessment:** Yearly assessment cycle in the fall.

**Who is Responsible for Assessment Activity?:** Instructor of the course.

### Findings

#### Finding per Measure

## CHEM 259 Organic Chemistry II Outcome Set

### Outcome

#### Outcome 1

Apply major concepts of chemical reactivity of organic compounds to solve problems.

▼ **Measure:** Chem 259 SLO A  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO A will be assessed using a standardized year-long national Organic Chemistry exam provided by the American Chemical Society (ACS). We will compare our average to the national average.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students are having the national average or above.

**Cycle of Assessment:** It is a yearly cycle where the course will be assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

#### Findings for Chem 259 SLO A

**Summary of Findings:** The data was collected for 10 students in one section. Class average was 40.3. That average is above the national average of 36.99 for the 2012 version of the ACS Organic Chemistry exam.

Although the class average was above the national average, not all students achieved a score above the national average. Four students (40%) got less than 37 correct answers on the ACS exam. Thus, this class had 60% of the students meeting the SLO.

**Results:** Criteria for Success Achievement Status: Not Met

**Analysis of Findings:** There were 7 questions on the 2012 version of the national ACS exam in Organic Chemistry that were not explicitly covered in our course (6 of these were missed by 50% or more of the students). The attached sheet analyzes the most missed questions and the topics covered. The exam in general does seem to focus on some very specific reactions, rather than overall concepts.


About half of the most missed questions on the exam are on topics that are covered in Chem 249. Most students that take Chem 259 in Fall, had Chem 249 the previous Spring, with summer in between. More review on these topics may be useful.

**Recommendations:** As a department we will consider returning to using the 2008 version of the ACS exam for Organic Chemistry as our assessment tool. It seems to be in better alignment with the learning outcomes we have for our students here at SCC.

Also, since the exam is cumulative for the entire Organic Chemistry sequence, we will look into offering more review of Chem 249 material or separating out and analyzing only Chem 259 material when looking at this SLO.

The benchmark of 70% may be too high of expectations. We will discuss if lowering the cutoff to 50 or 60% is a better choice or not.

#### Substantiating Evidence:

 Chem 259 ACS data analysis (Excel Workbook (Open XML)) (See appendix)

#### This Findings is associated with the following Actions:

**We will discuss the assessment tool currently used for SLO 1.**  
(Plans of Action; 2014-2015 Assessment Cycle)

#### Outcome 2

Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.

▼ **Measure:** Chem 259 SLO B  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO B will be assessed using a mechanism question on part

II of the final exam.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means having 70% of the students obtaining competent or above on writing a mechanism. A rubric is used to evaluate how they can draw a mechanism based on reactivity. Achieving the SLO means that 70% of the students achieved competent or above on the rubric (12 points out of 18)

**Cycle of Assessment:** Yearly cycle with the course assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

### Findings for Chem 259 SLO B

**Summary of Findings:** One section was assessed with 10 students.

A rubric was used to evaluate how well they can draw the mechanism and predict the product of an intramolecular aldol condensation (different mechanism from the previous assessment cycle). Students were expected to identify the first step in a mechanism, draw arrows correctly and show each step with the correct electron flow and charges to reach the final product.

Data shows that 70% of the students (7 out of 10) achieved overall competent or above in writing the mechanism (with 12 pts or more out of 18 possible points on the rubric). This means that the students did meet SLO B for the course.

**Results:** Criteria for Success Achievement Status: Met


**Analysis of Findings:** By analyzing the scores on the individual sections of the rubric, it shows that the students had the most difficulty showing all proton transfer steps and the correct usage of charge in acidic and basic media. These two steps are related to each other and are important on an aldol condensation, as the enolate attack typically occurs in basic conditions (neutral and negatively charged species present); whereas the condensation/loss of water is catalyzed by acidic conditions (neutral and positively charged species present).

2 of the 3 students that did not meet the SLO has scores of 11/18, which is just below competent (12/18).

This is an improvement over last year's scores. It should be noted that a different mechanism was analyzed this year.

**Recommendations:** Keep focusing on mechanistic-based teaching of Organic reactions.

**Substantiating Evidence:**

 Chem 259 intramolecular aldol condensation mechanism rubric (Microsoft Word) (See appendix)

### Outcome 3

Perform experiments with published protocols, use standard laboratory procedure and instruments to analyze data to determine the identity of an unknown organic compound.

▼ **Measure:** Chem 259 SLO C  
Course level; Direct - Other

**Description of Measurement Tool:** SLO C will be assessed using a laboratory unknown report. The report will be graded using a rubric

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students achieved competent or above on their unknown report (20 points or above).

**Cycle of Assessment:** Yearly assessment cycle in the fall.

**Who is Responsible for Assessment Activity?:** Instructor of the course.

### Findings for Chem 259 SLO C

**Summary of Findings:** One section was assessed with 10 students was assessed.

A rubric was used to evaluate how they can determine some physical data (boiling point, solubility), halide test, nitro group presence, unsaturation in the unknown, functional group determination, IR interpretation, followed by correct identification of the unknown.

Overall, 90% of the students achieved the laboratory SLO.

**Results:** Criteria for Success Achievement Status: Met

**Analysis of Findings:** From the given data, 70% of the students (7/10) were able to correctly

determine the name and the structure of the unknown liquid compound but only 50% had the correct B.P. The majority of students were not able to determine the boiling point correctly. Students did not have any difficulty with solubility, halide test, nitro group test, unsaturation test or IR interpretation. They all determined the correct functional group, but some had trouble with derivatization and coupled with incorrect bp data, they were unable to identify their unknown.

**Recommendations:**

## Overall Recommendations

No text specified

## Plans of Action

### Actions

## CHEM 259 Organic Chemistry II Outcome Set

### Outcome

#### Outcome 1

Apply major concepts of chemical reactivity of organic compounds to solve problems.

▼ **Action:** We will discuss the assessment tool currently used for SLO 1.

**This Action is associated with the following Findings**

**Findings for Chem 259 SLO A**

(Measurements and Findings; 2014-2015 Assessment Cycle)

**Summary of Findings:** The data was collected for 10 students in one section. Class average was 40.3. That average is above the national average of 36.99 for the 2012 version of the ACS Organic Chemistry exam.

Although the class average was above the national average, not all students achieved a score above the national average. Four students (40%) got less than 37 correct answers on the ACS exam.

Thus, this class had 60% of the students meeting the SLO.

**Details of Plan of Action:** The current tool is a standardized exam covering the entire year of Organic Chemistry, which is actually two courses taken in succession (Chem 249 & Chem 259). We will look into using the same tool, but analyzing the data to separate out questions covering material from the different courses and/or changing our benchmark of 70% of the students meeting the national average, which only 50% of the students in the nation actually meet.

**Plan of Action Timeline:** We will discuss this before the next round of assessment in Fall 2016.

**Who is responsible for carrying out the Plan of Action?:** The department (all fulltime faculty) will discuss this together. The lead faculty, will do the actual analysis/analyses decided on.

**How will you determine if the Plan of Action has been effective?:** We will analyze the next round of data two ways (the one currently used and the new method developed) and see if the SLO achievement results more align with the students' success in the course.

**Additional Resources Required (if any):** None, just faculty time for further analysis.

**Budget request amount:** \$0.00

**Priority:** Medium



 Status Reports

## Action Statuses

## CHEM 259 Organic Chemistry II Outcome Set

## Outcome

## Outcome 1

Apply major concepts of chemical reactivity of organic compounds to solve problems.

▼ **Action:** We will discuss the assessment tool currently used for SLO 1.

**Details of Plan of Action:** The current tool is a standardized exam covering the entire year of Organic Chemistry, which is actually two courses taken in succession (Chem 249 & Chem 259). We will look into using the same tool, but analyzing the data to separate out questions covering material from the different courses and/or changing our benchmark of 70% of the students meeting the national average, which only 50% of the students in the nation actually meet.

**Plan of Action Timeline:** We will discuss this before the next round of assessment in Fall 2016.

**Who is responsible for carrying out the Plan of Action?:** The department (all fulltime faculty) will discuss this together. The lead faculty, will do the actual analysis/analyses decided on.

**How will you determine if the Plan of Action has been effective?:** We will analyze the next round of data two ways (the one currently used and the new method developed) and see if the SLO achievement results more align with the students' success in the course.

**Additional Resources Required (if any):** None, just faculty time for further analysis.

**Budget request amount:** \$0.00

**Priority:** Medium

**Status** for We will discuss the assessment tool currently used for SLO 1.

*No Status Added*

## Status Summary

*No text specified*

## Summary of Next Steps

*No text specified*

## 2013-2014 Assessment Cycle

### Measurements

#### Outcomes and Measures

### CHEM 259 Organic Chemistry II Outcome Set

#### Outcome

##### Outcome 1

Apply major concepts of chemical reactivity of organic compounds to solve problems.

▼ **Measure:** Chem 259 SLO A  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO A will be assessed using a standardized year-long national Organic Chemistry exam provided by the American Chemical Society (ACS). We will compare our average to the national average.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students are having the national average or above.

**Cycle of Assessment:** It is a yearly cycle where the course will be assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

##### Outcome 2

Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.

▼ **Measure:** Chem 259 SLO B  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO B will be assessed using a mechanism question on part II of the final exam.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means having 70% of the students obtaining competent or above on writing a mechanism. A rubric was used to evaluate how they can draw a mechanism based on reactivity. The mechanism used was a Friedel-Crafts alkylation of an aromatic ring with a rearrangement of the carbocation. Achieving the SLO means that 70% of the students achieved competent or above on the rubric (10 points out of 15)

**Cycle of Assessment:** Yearly cycle with the course assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

##### Outcome 3

Perform experiments with published protocols, use standard laboratory procedure and instruments to analyze data to determine the identity of an unknown organic compound.

▼ **Measure:** Chem 259 SLO C  
Course level; Direct - Other

**Description of Measurement Tool:** SLO C will be assessed using a laboratory unknown report. The report will be graded using a rubric

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students achieved competent or above on their unknown report (20 points or above).

**Cycle of Assessment:** Yearly assessment cycle in the fall.

**Who is Responsible for Assessment Activity?:** Instructor of the course.

### Findings

## Finding per Measure

## CHEM 259 Organic Chemistry II Outcome Set

## Outcome

## Outcome 1

Apply major concepts of chemical reactivity of organic compounds to solve problems.

▼ **Measure:** Chem 259 SLO A  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO A will be assessed using a standardized year-long national Organic Chemistry exam provided by the American Chemical Society (ACS). We will compare our average to the national average.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students are having the national average or above.

**Cycle of Assessment:** It is a yearly cycle where the course will be assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

## Findings for Chem 259 SLO A

**Summary of Findings:** The data was collected for 18 students in one section. Class average was 50.1. That average exceeds the national average of 39.48. The class achieved the national average. Four students (22%) got less than 40 correct answers on the ACS exam. This group had 78 % of the students meeting the SLO with getting above the average score on the national ACS exam.

**Results:** Criteria for Success Achievement Status: Met


**Analysis of Findings:** Some of these questions more than 50% students missed:

Question # 11(New) Boiling point  
Question # 15 (Acidic hydrogens)  
Question # 18 (Number of chiral centers)  
Question # 19 (New) E alkene  
Question # 24 (SN1 vs SN2)  
Question # 39 (New) addition of Grignard to a cyano group  
Question # 49 (New) Decarboxylation of a beta keto acid  
Question # 51 (New) cis hydroxylation of cyclohexene  
Question # 62 (New) Grignard workup  
Question # 67 (New) Mass spectrometry  
Question # 68 (Polymer)

This group of students had 11 questions/70 questions with more than 50% incorrect answers

**Recommendations:**

**Substantiating Evidence:**

 SLO A Data.pdf (Adobe Acrobat Document) (See appendix)

## Outcome 2

Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.

▼ **Measure:** Chem 259 SLO B  
Course level; Direct - Exam

**Description of Measurement Tool:** SLO B will be assessed using a mechanism question on part II of the final exam.

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means having 70% of the students obtaining competent or above on writing a mechanism. A rubric was used to evaluate how they can draw a mechanism based on reactivity. The mechanism used was a Friedel-Crafts alkylation of an aromatic ring with a rearrangement of the carbocation. Achieving the SLO means that 70% of the students achieved competent or above on the rubric (10 points out of 15)

**Cycle of Assessment:** Yearly cycle with the course assessed in the fall.

**Who is Responsible for Assessment Activity?:** The instructor of the course.

### Findings for Chem 259 SLO B

**Summary of Findings:** One section was assessed with 18 students.

A rubric was used to evaluate how they can draw a mechanism based on reactivity. Students were expected to identify the first step in a mechanism, draw arrows correctly and show each step with the correct electron flow and charges and reach the final product. Rearrangement of the carbocation was supposed to be the second step in the mechanism.

Data shows that only 50% of the students (9 out of 18) achieving overall competent or above in writing the mechanism (with 10 pts or more on the rubric). This means that the students did not meet SLO B for the course.


**Results:** Criteria for Success Achievement Status: Not Met

**Analysis of Findings:** From analyzing the rubric by which the mechanism was graded, the students were not able to achieve that SLO. Seventy two percent recognized the type of mechanism as EAS and used the correct arrows to draw the first step. Fifty five percent of the students were able to draw the carbocation rearrangement in its right place in the mechanism and sixty seven percent of the students were able to use the correct charges. This is due to the fact that the later parts of the mechanism students either get inaccurate (0 points) or accomplished (3 points).

**Recommendations:** The sample used for assessment is a very small sample. We will need to accumulate few more sections (over a couple of years) to obtain statistically valid data. Writing a mechanism is always a challenge for the students. Practicing writing mechanisms and also devoting more practice time for drawing mechanism might help the students

**Substantiating Evidence:**

 Chem 259\_Final exam mechanism assessment rubric.doc (Microsoft Word) (See appendix)

 SLO B Data.pdf (Adobe Acrobat Document) (See appendix)

### Outcome 3

Perform experiments with published protocols, use standard laboratory procedure and instruments to analyze data to determine the identity of an unknown organic compound.

▼ **Measure:** Chem 259 SLO C  
Course level; Direct - Other

**Description of Measurement Tool:** SLO C will be assessed using a laboratory unknown report. The report will be graded using a rubric

**Criteria for Success: Individual & Collective Student Criterion:** Success in achieving the SLO means 70% of the students achieved competent or above on their unknown report (20 points or above).

**Cycle of Assessment:** Yearly assessment cycle in the fall.

**Who is Responsible for Assessment Activity?:** Instructor of the course.

### Findings for Chem 259 SLO C

**Summary of Findings:** One section was assessed with 18 students.

A rubric was used to evaluate how they can determine some physical data (boiling point, solubility), halide test, nitro group presence, unsaturation in the unknown, functional group determination, IR interpretation, followed by correct identification of the unknown.


Overall, 100% of the students achieved the laboratory SLO.


**Results:** Criteria for Success Achievement Status: Met

**Analysis of Findings:** From the given data, 72% of the students (13/18) were able to correctly determine the name and the structure of the unknown liquid compound but only 50% had the correct B.P. The majority of students were not able to determine the boiling point correctly. Students did not have any difficulty with solubility, halide test, nitro group test, unsaturation test or IR interpretation. The difficulty was sometimes in determining the functional group and the correct tests that goes with that functional group.

**Recommendations:**

**Substantiating Evidence:**

 Chem 259\_lab report assessment rubric.doc (Microsoft Word) (See appendix)

 SLO C Data.pdf (Adobe Acrobat Document) (See appendix)

**Overall Recommendations**

*No text specified*

 **Plans of Action****Actions****CHEM 259 Organic Chemistry II Outcome Set****Outcome****Outcome 2**

Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.

▼ **Action:** Chem 259 SLO B**This Action is associated with the following Findings**

No supporting Findings have been linked to this Action.

**Details of Plan of Action:** 1- The sample used for assessment is a very small sample. We will need to accumulate few more sections (over a couple of years) to obtain statistically valid data.  
2- Writing a mechanism is always a challenge for the students. Practicing writing mechanisms and also devoting more practice time for drawing mechanism might help the students.  
3- Choosing an assessment that does not involve so many steps in the mechanism and changing the assessment question to one that is more general mechanism than very specific detailed oriented one.

**Plan of Action Timeline:** Fall 2014

**Who is responsible for carrying out the Plan of Action?:** Course instructor

**How will you determine if the Plan of Action has been effective?:** 1- We will use several sections to collect data to see if we have a large number of students to run a valid statistical analysis

2- We will collect SLO assessment data to measure how well they perform on SLO B .

**Additional Resources Required (if any):**

**Budget request amount:** \$0.00

**Priority:**

 **Status Reports****Action Statuses****CHEM 259 Organic Chemistry II Outcome Set****Outcome**

**Outcome 2**

Write in scientific terms and interpret patterns of reactivity on the basis of mechanistic reasoning.

**▼ Action: Chem 259 SLO B**

**Details of Plan of Action:** 1- The sample used for assessment is a very small sample. We will need to accumulate few more sections (over a couple of years) to obtain statistically valid data.  
2- Writing a mechanism is always a challenge for the students. Practicing writing mechanisms and also devoting more practice time for drawing mechanism might help the students.  
3- Choosing an assessment that does not involve so many steps in the mechanism and changing the assessment question to one that is more general mechanism than very specific detailed oriented one.

**Plan of Action Timeline:** Fall 2014

**Who is responsible for carrying out the Plan of Action?:** Course instructor

**How will you determine if the Plan of Action has been effective?:** 1- We will use several sections to collect data to see if we have a large number of students to run a valid statistical analysis  
2- We will collect SLO assessment data to measure how well they perform on SLO B .

**Additional Resources Required (if any):**

**Budget request amount:** \$0.00

**Priority:**

**Status** for Chem 259 SLO B

**Current Status:** In Progress

**Budget Status:** Other

**Explanation of current status:**

**Has the Plan of Action been effective? What are the next steps?:**

**Status Summary**

*No text specified*

**Summary of Next Steps**

*No text specified*

## 2012-2013 Assessment Cycle

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 **Measurements**

 **Findings**

 **Plans of Action**

 **Status Reports**

# Appendix

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- A. **Chem 259 ACS data analysis** (Excel Workbook (Open XML))
  - B. **Chem 259 intramolecular aldol condensation mechanism rubric** (Microsoft Word)
  - C. **Chem 259\_Final exam mechanism assessment rubric.doc** (Microsoft Word)
  - D. **Chem 259\_lab report assessment rubric.doc** (Microsoft Word)
  - E. **SLO A Data.pdf** (Adobe Acrobat Document)
  - F. **SLO B Data.pdf** (Adobe Acrobat Document)
  - G. **SLO C Data.pdf** (Adobe Acrobat Document)
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