

Chemistry SAC Core Outcome Assessment 2011-12

1. Describe changes that have been implemented towards improving students' attainment of outcomes that resulted from outcome assessments carried out in 2010-2011. These may include but are not limited to changes to content, materials, instruction, pedagogy etc.

The following is a list of the changes made based on the results of last year's assessment. The chemistry SAC took the advice given in the letter we received and did not try and implement all 9 changes mentioned.

- A. *Modify instructions in the current lab reports to clarify the communication requirements for the students.*

The SAC believes that it is important that chemistry students should understand the links between the concepts they are learning in the classroom and their everyday lives. We also believe students should be able to communicate about these links. Last year we found many labs that did not give students the opportunity to demonstrate their understanding in this way. To this end, reflection statements that ask students to communicate about these links were added to many labs across the district.

- B. *Incorporate more peer-review opportunities for the students.*

The SAC believes that peer reviews provide an excellent opportunity for students to improve their lab reports. One limitation to this process is the lack of time allowed in already-packed 3-hour lab sessions. To circumvent this issue the SAC decided to implement peer review of smaller portions of the lab. Instructors are creating rubrics for various labs at all levels (CH 100, CH 221-3, and CH 241-3) of the curriculum for their students to complete a peer-review evaluation of an early lab report during a scheduled lab session. Not only will the students gain invaluable feedback, this will also provide students with very clear expectations for the lab reports. The SAC sees this happening at least once a quarter during each course.

2. Describe the assessment design (tool and processes) used. Include relevant information about:

Self Reflection

Self reflection in the study of science is an extremely important skill. Many tools that encourage students to self reflect were being used throughout the district already. For this assessment the SAC adapted a tool being using at the Sylvania campus for the purposes of assessing how well our students are self reflecting. (Appendix 1) Our assessment goal with this tool was as follows: Can students effectively self reflect about their performance in our courses?

The tool has three distinct sections. Each section was presented to students in the form of a worksheet at the times mentioned below and then collected. The first is a pre-exam section. This encourages the students to plan specifically for how to study for the first exam of the course and reflect on the concepts that the student finds unclear in their minds. The second is

a self reflection after the first exam of the quarter. This section encourages students to reflect on their performance on the exam and discuss strategies for either changing or maintaining their performance on the next exam. The third is a self reflection after the second exam on how these assignments had changed or impacted their performance on the second exam. It also encourages students to ponder the worth of self reflection in other classes and aspects of their life.

Data using this tool was to be collected during winter quarter from students in CH 100, CH 104 and CH 221 courses from all four campuses. The SAC felt that the process of self-reflection would have the most impact in these courses, as they are our introductory or first quarter classes in a series course.

The SAC created a rubric (Appendix 1) to apply to the student's answers of the questions in the three sections of the tool above. The rubric focuses on the following aspects of the student's answers: Clarity, relevance, Analysis, Assessment experience outside of Chemistry and Self-criticism (Appendix 2). The rubric was then applied during the spring SAC meeting. The scores for each student's answers were entered into a score sheet. Before scoring, the results of five students self reflection were used to normalize the rubric amongst the faculty members who would be using the rubric. Faculty members discussed how to score two of the five students in detail as a group. The other three were done individually and then discussed to ensure faculty members were scoring each of these in a similar fashion.

Ideally, the collection and scoring of 5 student's reports for each course at each campus would have resulted in 20 CH 100, 15 CH 104 and 15 CH 221 students during the spring in-service. Five students from each course were decided upon as the amount of time to read through a student's response to all three sections of the tool was quite time consuming. (Note: SE Center only offers CH100 currently). However, not all sections and instructors that were supposed to administer the tool or all three sections of the tool did. This resulted in only 5 CH 100 and 8 CH 221 students being evaluated. 20 students in CH 104 were evaluated to have a better data set since we had access to the reports for analysis.

Environment and Community Responsibility

The Chemistry SAC used a synthesis of biodiesel laboratory experiment to assess the community and environmental responsibility core outcome within general and organic chemistry students. CH 222 and CH 243 were chosen, as the topics of chemistry surrounding biodiesel are covered in these two courses of each year long series. This laboratory activity was designed to enhance student understanding of the science, development, and the use of environmentally responsible biodiesel fuel. To evaluate learning gains, students were given a pre- and post- lab assignment which covered the learning objectives for the laboratory activity. A majority of the questions were design to assess evidence based mastery of outcomes.

Prior to the laboratory activity, students were given an unannounced pre-lab assignment, (Appendix 3) to determine their background level of knowledge. One week after the laboratory activity, students were given the same assignment along with the additional

questions (Appendix 4). The SAC created the rubric to apply to the student's answers to the pre-lab and the post-lab assignment (Appendix 5). The rubric focuses on the following aspects of the student's answers: knowledge of the fuels, advantages and disadvantages of different fuels, and ways the environment and the community are impacted by using biodiesel vs., conventional fuel.

Student responses were collected during the winter and spring terms from students in CH 222, and CH 243 courses at each campus (Note: 243 is not taught at CA). Data was collected from students in 7 out of 14 CH 222 laboratory sections, and from students in 2 out of 3 CH 243 laboratory sections.

The rubric was then applied during the spring SAC meeting. The design of the pre-lab scoring sheet did not require normalization amongst the faculty members. However, after scoring the post lab assignments, most of which were collected after the SAC meeting, we realized that the answers for the last question on the post-lab assignment should have been normalized among the faculty members. For those reasons the analysis of the results was focused on student's answers to questions 2-5 and 7-8 which did not require normalization. It was also noted that questions 9 and 10 on the post lab assignment were poorly designed and the answers to these two questions were not analyzed.

Data was analyzed for 10 of the students in each section. This resulted in total of 70 analyzed responses (about 26% of students taking the course) for CH 222 class and 20 analyzed responses for CH 243 (about 40 % of students taking the course).

3. Provide information about the results (i.e., what did you learn about how well students are meeting the outcomes)?

Self Reflection

The results discussed below are concerning the CH 104 students as the SAC felt we had enough data to discuss results. Overall the students scored very well on the assignment when applying the self-reflection rubric. We interpret this as in general the students given the opportunity to self reflect complete the process well. The results of this analysis are summarized in Table 1 with the corresponding scoring system.

The students had a 3.30 average out of 4 on the relevance section. This means most of the students found the process meaningful/useful towards their attainment of the course outcomes. They believe it was a worthwhile experience. This also means the students were able to reflect on their experience in a way that the SAC felt was moving them toward the course outcomes.

The students had a 2.90 average out of 4 on the analysis section. This means the students were able to analyze the experience on a meta-cognitive level. Students did not just describe what they had done or learned, but reflected on what they did that helped them learn and why it helped them learn.

Table 1: Self Reflection Rubric Results

	CH 104 averages
Clarity	2.90
Relevance	3.30
Analysis	2.90
Outside Subject	2.90
Self-Criticism	3.45

Rating	Beginning	Developing	Accomplished	Exemplary
	1	2	3	4

The students had a 2.90 average out of 4 on the assessment experience outside subject matter section. This means most students were able to see how this self-reflection experience could transfer outside the discipline of chemistry and be useful in other classes and well as outside the classroom.

The section that the students scored highest on was the self-criticism section. This was a pleasant surprise the SAC as we felt this might be one of the more difficult things for students to admit and display. They had a 3.45 average out of 4 on this section. Students were able to take ownership of their learning and be critical of themselves as to how well they were doing at attaining the course outcomes. They also were able to talk about how they might change their study habits in the future to attain a greater learning. It was great to see students taking ownership for their own learning.

The SAC did not focus on the results from the CH 100 or CH 221 course as data for only 5 or 8 students total were put to the rubric. In general, similar trends to those found in the CH 104 results were seen in these data sets.

Environment and Community Responsibility

For each sub-category (question) outlined in the rubric (Appendix 5) the average values were calculated for the analyzed pre-lab and post-lab assignment for each course (CH 222, and CH 243). The results of this analysis are summarized in Table 2 with the corresponding scoring system.

Table 2: Community and Environmental Responsibility Rubric Results by Course

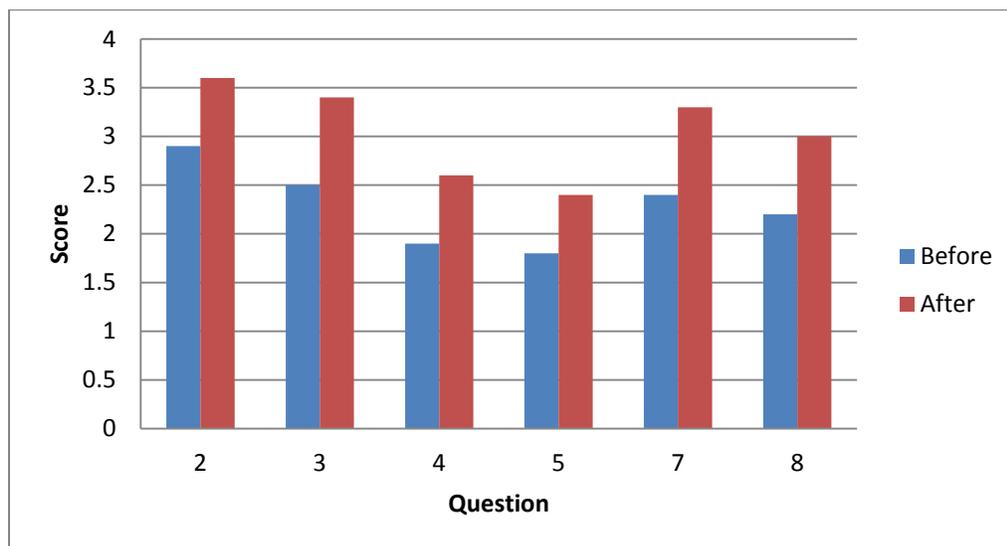
	Avg.CH 222 Before	Avg.CH 222 After	Avg.CH 243 Before	Avg.CH 243 After
Question 2	2.9	3.6	3.1	3.8
Question 3	2.5	3.4	3.3	3.0
Question 4	1.9	2.6	2.0	3.9
Question 5	1.7	2.4	2.3	3.6
Question 7	2.4	3.3	2.7	3.8
Question 8	2.2	3.1	2.5	3.6
Average Score	2.3	3.1	2.6	3.6
Question 11		3.4		3.9
Question 12		2.3		2.4

Note: Question 12 was not analyzed

Rating	Beginning	Developing	Accomplished	Exemplary
	1	2	3	4

Combining all seven sections for CH 222, students significantly increased their overall average score of 2.3 on the pre-lab assignment to an overall average of 3.1 on the post-lab assignment. A closer look at each individual question (Fig 1) demonstrates an increase in learning for each objective.

Figure 1: Pre- and post lab assessment results for CH 222 course.



The student's average score on question 2 and 3 increased from 2.9 to 3.6 and 2.5 to 3.4 respectively, indicating significant gains in the knowledge of the fuels.

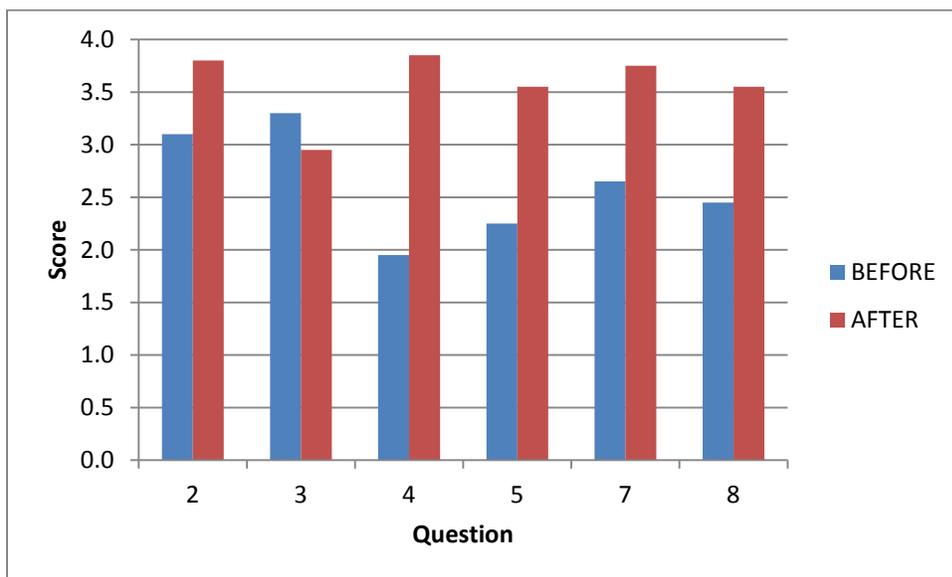
The student's increased knowledge and awareness regarding the impacts of the alternative fuels on the environment and the community is shown in improved average scored scores in questions 4 and 5. Student's average score for question 5 indicates that the student awareness regarding the impacts of the alternative fuels in the community increased as a result of this activity from 1.7 to 2.4, but it is still developing.

Questions 7 and 8 provided students with an opportunity to rate their awareness regarding the alternative fuels and their impacts on the environment and the community. Increased average scores for both questions mean that the students found this activity useful towards their attainment of the course outcome. Results from question 11 on the post lab further support this conclusion.

Combining both sections for CH 243, students significantly increased their overall average score of 2.6 on the pre-lab assignment to an overall average of 3.6 on the post-lab assignment. A closer look at each individual question (Fig 2) demonstrates an increase in learning for each objective except for the question 3.

Possible reason for this discrepancy is the difference in the amount of space available for answering that question on the post lab assignment on some of the post lab activity sheets due to the different formatting of the document used by different instructors.

Figure 2: Pre- and post lab assessment results for CH 243 course.



The average scores for CH 243 students are higher than the average scores for the CH 222 students. This is expected since CH 243 students completed a full year of general chemistry prior to organic chemistry. CH 243 students also spent 2 laboratory periods investigating biodiesel compared to only one week of laboratory investigation for CH 222 students.

4. Identify any changes that should, as a result of this assessment, be implemented to help improve students' attainment of outcomes. (These may include, but are not limited to, changes in curriculum, content, materials, instruction, pedagogy etc).

Self Reflection

The SAC feels that this assignment should be used in all of our courses with the changes mentioned below. When given the opportunity to self reflect our students demonstrated that they could engage in this activity. In fact, they scored very high on our rubric. In addition, the students thought the process was meaningful to their learning experience and were able to see the usefulness of this process outside of chemistry. Once the assignment and the rubric have been changed they will be made available to all chemistry faculty on the SAC groups page. The SAC will issue a strong recommendation both at the Fall SAC meeting and via an email in the fall to use the new tool.

Environment and Community Responsibility

As a result of assessing core outcomes the biodiesel lab was implemented for the first time on all three campuses, even though it has been used on Sylvania campus for the last 7 years. Since the overall comparison of scores before and after the laboratory activity clearly boosts student mastery of the outcome the SAC feels that this laboratory experiment should become part of the curriculum permanently.

5. Reflect on the effectiveness of this assessment tool and assessment process. Please describe any changes to assessment methodology that would lead to more meaningful results if this assessment were to be repeated (or adapted to another outcome). Is there a different kind of assessment tool or process that the SAC would like to use for this outcome in the future? If the assessment tool and processes does not need to be revised, please indicate this.

Self Reflection

A. The SAC feels the major shortcoming of this assessment was the lack of data collected. Although the SAC chairs sent out numerous reminder emails, after the planning for the assessment at the Fall SAC meeting, the data was still not collected to the level or completeness desired. The SAC will need to discuss how to ensure better participation in the process at the Fall SAC meeting.

B. The SAC is going to change the questions in section 1 of the tool. The questions in the second section will be used to form a new set of questions for the first section. They will ask the students the same questions, but in the past tense about an exam in a previous class of any kind. This will allow us to develop a baseline for the students coming into our classes. We could not be sure if our assignment helped them score well on the rubric or if this was previous knowledge they had coming into the class.

C. The SAC believes the rubric should be changed and improved. The section on relevance should be split into a “Meaningful to the Student” section and “Relevance”. We felt it would be better to split these as we felt we were analyzing two different things from their reports. First, did the student think the assignment was meaningful and second, did the student believe the experience was relevant to their attainment of the course outcomes.

Environment and Community Responsibility

A. The SAC originally planned to implement this assessment tool in CH 222, CH 242 and CH 106 classes. Only limited data was obtained for CH 106 class (1 class, 5 students.) The SAC will need to discuss how to ensure better participation in the process at the Fall SAC meeting.

B. As mentioned earlier the last questions in the post lab assignment required normalization among the faculty performing the analysis. The scoring rubric needs to be modified in order to provide more detailed description of the grading criteria for that question.

C. Questions 9 and 10 on the post lab assignment will be eliminated because the questions were poorly designed.

D. For the future assessments all the documents will be distributed as a pdf in order to avoid any discrepancy in the formatting of the assessment tool.

Appendix 1

Pre-Exam Metacognitive Assessment

I. Process Skills

1. Plan an exam study session with at least one other person. Report the names, date, time and location you will meet for your study session.
2. Explain your plan for studying for the first exam. For example, what materials will you study? (i.e. Concept Tests, Quiz, Homework, etc). What priority will you give to each? When will you study for the exam?

II. Metacognition: Reflection on Learning

1. As you study for the upcoming exam, I want you to answer this conceptually. What do you think are the 2 most important concepts about all the material we have studied so far?
2. “Muddiest Points” – Identify the 2 main concepts you are still unclear about (can be conceptual or mathematical/algorithmical in origin). That is, what will you have to study the most to do well on the exam?

Post-Exam 1 Metacognitive Assessment

Consider your performance on Exam 1.

1. Using grammatically correct sentences answer either a or b below:
 - a. If you did not do as well as you would have liked, propose *at least* 2-3 main things (NOT chemistry concepts) that you feel might have prevented you from doing as well as you wanted. For example, you might suggest that you did not have enough time to study; you did not study efficiently; you studied the wrong material; you didn't know what to study; you did not understand the lectures; you never asked for help; etc. The idea is for you to target the barriers you perceive for doing well on the exam.
 - b. If you did do as well as (or better than!) you expected, propose *at least* 2-3 main things (NOT chemistry concepts) that you felt enabled you to do well. For example, you might suggest that you attended every lecture; you studied immediately after class; you formed study groups; etc. Target those things that you feel promoted your learning of the material and you found successful.
2. Consider how you will change/improve your study habits to prepare for the next exam. How will you alter your study habits to improve (if necessary) or maintain (if applicable) your level of performance. Please propose *at least* 2-3 things that will help to enable you to do well on the next exam.
3. Did you use the skills you had in place for studying for this exam? List two skills that you need to develop to improve your performance on the next exam.

Post Exam 2 Metacognitive Assessment

Consider your performance on Exam 2. Using grammatically correct sentences answer the following questions.

1. How did your assessment of your study plan for exam 1 change or influence your study plan/habit for exam 2? Was it successful and why or why not?
2. Consider how you will change/improve your study habits to prepare for the next exam. How will you alter your study habits to improve (if necessary) or maintain (if applicable) your level of performance. Please propose *at least* 2-3 things that will help to enable you to do well on the next exam.
3. As a result of assessing (and adjusting) your study habits, have you carried these skills over to other courses or life skills.

Appendix 2

Assessment goal: Can students effectively self-reflect?

	Beginning	Developing	Accomplished	Exemplary
	1	2	3	4
Clarity	Language is unclear and confusing throughout; many grammatical, spelling and punctuation errors. May not be concise.	There are frequent lapses in clarity; several grammatical, spelling and punctuation errors. Somewhat concise.	Minor, infrequent lapses in clarity; few grammatical, spelling and punctuation errors. Fairly concise.	Language is clear and expressive; proper grammar, spelling, punctuation; good sentence and paragraph structure. Concise.
Relevance	Most of the reflection is irrelevant to student and/or course learning goals.	Student makes attempts to demonstrate relevance, but the relevance is unclear to the reader.	The learning experience being reflected upon is relevant and meaningful to student and course learning goals. May contain some irrelevant information.	The learning experience being reflected upon is relevant and meaningful to student and course learning goals.
Analysis	Reflection does not move beyond description of the learning experience(s).	Student makes attempts at applying the learning experience to understanding of self, others, and/or course concepts but fails to demonstrate depth of analysis.	The reflection demonstrates that the student attempts to analyze the learning experience but analysis lacks depth.	The reflection moves beyond simple description of the learning experience to an analysis of how the experience contributed to student understanding of self, others, and/or course concepts.
Assessment experience outside subject matter.	No attempt to demonstrate connections to other classes/life experiences.	There is little attempt to demonstrate connections to other classes/life experiences.	There is some attempt to demonstrate connections to other classes/life experiences.	The reflection clearly demonstrates connections to other classes/life experiences.
Self-Criticism	The reflection does not demonstrate the ability of the student to take responsibility for their own learning.	The reflection demonstrates the ability of the student to take little responsibility for their own learning.	The reflection demonstrates the ability of the student to take some responsibility for their own learning.	The reflection clearly demonstrates the ability of the student to take responsibility for their own learning.

Appendix 3

Community and Environmental Responsibility

Prelab questions:

1. Have you ever considered what common fuels move cars, buses, and trucks?

YES NO

2. List five fuels and their origin?

1. _____
2. _____
3. _____
4. _____
5. _____

3. List three advantages and three disadvantages of using biodiesel.

4. Name three ways the environment is impacted by using biodiesel vs conventional fuel?

5. Name three ways the community is impacted by using biodiesel vs conventional fuel?

6. What transportation fuel do you most commonly use?

7. How would you rate your awareness regarding alternative fuels impacts on the environment?

(Score 1 as low and 5 as high)

1 2 3 4 5

8. How would you rate your awareness regarding alternative fuels impacts on the community?

(Score 1 as low and 5 as high)

1 2 3 4 5

Appendix 4

Community and Environmental Responsibility

Post lab questions

1. Have you ever considered what common fuels move cars, buses, and trucks?

YES NO

2. List five fuels and their origin? (You must cite your source.)

1. _____ (Ref. _____)
2. _____ (Ref. _____)
3. _____ (Ref. _____)
4. _____ (Ref. _____)
5. _____ (Ref. _____)

3. List three advantages and three disadvantages of using biodiesel.

4. Name three ways the environment is impacted by using biodiesel vs conventional fuel?

5. Name three ways the community is impacted by using biodiesel vs conventional fuel?

6. What transportation fuel do you most commonly use?

7. How would you rate your awareness regarding alternative fuels impacts on the environment?

(Score 1 as low and 5 as high)

1 2 3 4 5

8. How would you rate your awareness regarding alternative fuels impacts on the community?

(Score 1 as low and 5 as high)

1 2 3 4 5

9. As an outcome of this experiment (prelab through postlab) has your thinking about the use of this fuel changed? Explain.

10. Will your daily routine change based on your participation in this laboratory? If yes how?

11. Has this lab improved your ability to analyze alternative fuel issues?

(Score 1 as low and 5 as high)

1 2 3 4 5

12. Choose an alternative fuel from your above list (do not choose biodiesel). What information would you need to know to make an informed decision about personally utilizing that fuel?

Appendix 5

SCORING: ENVIRONMENT/COMMUNITY

1 beginning	2 developing	3 accomplished	4 exemplary
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Question 1	Consideration of fuels	no 0	yes 1		
Question 2	listing fuels	0-1	2	3 if 5 fuels listed w/o origins	4+ fuels + origins
Question 3	# of advantages /disadvantages	0-1	2-3	4	5+
Question 4	# of impacts on the environment	0	1	2	3
Question 5	# of impacts on the community	0	1	2	3
Question 7	Awareness of impacts on Environment (score)				
Question 8	Awareness of impacts on community (score)				
Question 9	Thinking changed (Y or N)				
Question 10	Daily routine changed (Y or N)				
Question 11	Ability to analyze AF issues (score)				
Question 12	Can students identify necessary criteria to make an informed decision?	0-1	2	3	4