

Subject Area Committee Name: **Chemistry**

Outcome Being Assessed: **Quantitative Literacy**

Contact Person

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This form is for the initial assessment of a core outcome.

- Refer to the help document for guidance in filling-out this report. If this document does not address your question/concern, contact [Nora Stevens](#) to arrange for coaching assistance.
- Please attach all rubrics/assignments/etc. to your report submissions.
- **Subject Line of Email:** Assessment Report Form (or ARF) for <your SAC name> (Example: ARF for MTH)
- **File name:** SACInitials_ARF_2018 (Example: MTH_ARF_2018)
- SACs are encouraged to share this report with their LAC coach for feedback before submitting.
- Make all submissions to learningassessment@pcc.edu.

Due Dates:

- **Planning Sections of LAC Assessment or Reassessment Reports: November 27th, 2017**
- **Completed LAC Assessment or Reassessment Reports: June 16th, 2018**

Please Verify This Before Beginning this Report:

X This project is not the second stage of the assess/reassess process (if this is a follow-up, re-assessment project, use the LAC Re-assessment Report Form LDC. Available [here](#).)

1. Outcome

1A. PCC Core Outcome: **Quantitative Literacy**

1B. How does your discipline interpret the outcome you are assessing?

Quantitative literacy encompasses the interpretation and manipulation of quantitative data.

1C. Briefly describe how this outcome is/might be important/useful to your students.

Students taking chemistry classes are typically pursuing careers in science, engineering, or health disciplines. All of these share the need to work with numbers and measurements.

2. Project Description

2A. Assessment Context

Check and complete all the applicable items:

Course-based assessment.

Course names and number(s): **General Chemistry II: CH222**

Type of assessment (e.g., essay, exam, speech, project, etc.): **questions on an exam**

Are there course outcomes that align with this aspect of the core outcome being investigated? Yes No

If yes, include the course outcome(s) from the relevant CCOG(s):

This is the Course Outcome:

Demonstrate an emerging understanding of chemical principles and collaborative skills to effectively solve problems encountered in general chemistry using appropriate computational and reasoning skills.

These are the three specific course objectives we have decided to assess:

1. Given a balanced chemical equation and a table of standard enthalpies of formation, bond dissociation energies, or standard enthalpy of atom combination, calculate the standard enthalpy change associated with the reaction. (Benchmark 85%)

2. Given the ideal gas constant and any three of the four following data (volume, pressure, temperature, and amount), calculate the fourth. (Benchmark 85%)

3. Given the molecular structure of several compounds, put them in increasing order of physical properties such as boiling point, melting point and vapor pressure. (Benchmark 85%)

X Common/embedded assignment in all relevant course sections. An embedded assignment is one that is already included as an element in the course as usually taught. Please attach the activity in an appendix. If the activity cannot be shared, indicate the type of assignment (e.g., essay, exam, speech, project, etc.): **Questions shared on everyone's final exams.**

Common – but not embedded - assignment used in all relevant course sections. Please attach the activity in an appendix. If the activity cannot be shared, indicate the type of assignment (e.g., essay, exam, speech, project, etc.):

Practicum/Clinical work. Please attach the activity/checklist/etc. in an appendix. If this cannot be shared, indicate the type of assessment (e.g., supervisor checklist, interview, essay, exam, speech, project, etc.):

External certification exam. Please attach sample questions for the relevant portions of the exam in an appendix (provided that publically revealing this information will not compromise test security). Also, briefly describe how the results of this exam are broken down in a way that leads to nuanced information about the aspect of the core outcome that is being investigated.

SAC-created, non-course assessment. Please attach the assessment in an appendix. If the assessment cannot be shared, indicate the type of assignment (e.g., essay, exam, speech, project, etc.):

Portfolio. Please attach sample instructions/activities/etc. for the relevant portions of the portfolio submission in an appendix. Briefly describe how the results of this assessment are broken down in a way that leads to nuanced information about the aspect of the core outcome that is being investigated:

Survey

Interview

Other. Please attach the activity/assessment in an appendix. If the activity cannot be shared, please briefly describe:

In the event publicly sharing your assessment documents will compromise future assessments or uses of the assignment, do not attach the actual assignment/document. Instead, please give as much detail about the activity as possible in an appendix.

2B. How will you score/measure/quantify student performance?

Rubric (used when student performance is on a continuum - if available, attach as an appendix – if in development, attach to the completed report that is submitted in June)

Checklist (used when presence/absence rather than quality is being evaluated - if available, attach as an appendix – if in development, attach to the completed report that is submitted in June)

Trend Analysis (often used to understand the ways in which students are, and are not, meeting expectations; trend analysis can complement rubrics and checklist)

Objective Scoring (e.g., Scantron-scored examinations)

Other – briefly describe:

2C. Type of assessment (select one per column)

Quantitative

Qualitative

Direct Assessment

Indirect Assessment

If you selected 'Indirect Assessment', please share your rationale:

Qualitative Measures: projects that analyze in-depth, non-numerical data via observer impression rather than via quantitative analysis. Generally, qualitative measures are used in exploratory, pilot projects rather than in true assessments of student attainment. Note that the **use of a numerical rubric is considered quantitative analysis**, even if the artifacts under consideration are not based on quantitative calculations (e.g. an essay scored by a rubric counts as quantitative in the context of assessment).

Indirect assessments (e.g., surveys, focus groups, etc.) do not use measures of direct student work output. These types of assessments are also not able to truly document student attainment.

2D. Check any of the following that were used by your SAC to create or select the assessment/scoring criteria/instruments used in this project:

Committee or subcommittee of the SAC collaborated in its creation

- Standardized assessment
- Collaboration with external stakeholders (e.g., advisory board, transfer institution/program)
- Theoretical model (e.g., Bloom's Taxonomy)
- Aligned the assessment with standards from a professional body (for example, The American Psychological Association Undergraduate Guidelines, etc.)
- Aligned the benchmark with the Associate's Degree-level expectations of the Degree Qualifications Profile
- Aligned the benchmark to within-discipline post-requisite course(s)
- Aligned the benchmark to out-of-discipline post-requisite course(s)
- Other (briefly explain: _____)

2E. In which quarter will student artifacts (samples of student work) be collected? If student artifacts will be collected in more than one term, check all that apply.

- Fall Winter Spring Other (e.g., if work is collected between terms)

2F. What student group do you want to generalize the results of your assessment to? For example, if you are assessing performance in a course, the student group you want to generalize to is 'all students taking this course.'

All students taking CH222.

2G. There is no single, recommended assessment strategy. Each SAC is tasked with choosing appropriate methods for their purposes. Which best describes the purpose of this project?

To measure established outcomes and/or drive programmatic change

- To participate in the Multi-State Collaborative for Learning Outcomes Assessment
- Preliminary/Exploratory investigation

If you selected 'Preliminary/Exploratory' (most often a 'pilot study'), briefly describe why you opted to do a pilot study, along with your rationale for selecting your sampling method:

2H. Which will you measure?

the population (all relevant students – e.g., all students enrolled in all currently-offered sections of the course)

a sample (a subset of students)

If you are using a sample, select all of the following that describe your sample/sampling strategy (refer to the Help Guide for assistance):

- Random Sample** (student work selected completely randomly from all relevant students)
- Systematic Sample** (student work selected through an arbitrary pattern, e.g., 'start at student 7 on the roster and then select every 5th student following'; repeating this in all relevant course sections)
- Stratified Sample** (more complex, consult with an LAC coach if you need assistance)
- Cluster Sample** (students are selected randomly from meaningful, naturally-occurring groupings (e.g., SES, placement exam scores, etc.))
- Voluntary Response Sample** (students submit their work/responses through voluntary submission – e.g., via a survey)
- Opportunity/Convenience Sample** (only a few instructors are participating in a project taught via multiple sections, so, only those instructors' students are included)

The last three options in bolded red have a high risk of introducing bias. If your SAC is using one or more of these sample/sampling strategies, please share your rationale:

2I. Briefly describe the procedure you will use to select your sample (**including a description of the procedures used to ensure student and instructor anonymity**).

N/A.

2J. Follow this link to determine how many artifacts (samples of student work) you should include in your assessment: <http://www.raosoft.com/samplesize.html> (see screen shot below).

Start with the number of students you estimate will be enrolled in the course(s) from which you will draw the sample – that is your “population.” Enter the other numbers as indicated in the screenshot. The sample size calculator will tell you how many artifacts you need to collect. Enter that number below:

N/A

Sample size calculator

What margin of error can you accept?
5% is a common choice

What confidence level do you need?
Typical choices are 90%, 95%, or 99%

What is the population size?
If you don't know, use 20000

What is the response distribution?
Leave this as 50%

Your recommended sample size is

10 %

90 %

105

50 %

42

The margin of error is the amount of error that you can tolerate. If 90% of respondents answer yes, while 10% answer no, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55. Lower margin of error requires a larger sample size. **Use 10% and 90% in these boxes.**

The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer yes would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone. Higher confidence level requires a larger sample size. **Enter the total number of students currently enrolled in all sections of the courses you are assessing here.**

How many people are there to choose your random sample from? The sample size does not change for populations larger than 20,000.

For each question, what do you expect the results will be? If the sample is skewed highly one way or the other, the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under **More information** if this is confusing. **Measure this many students.**

This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey.

3. Project Mechanics

3A. Does your project utilize a rubric for scoring? Yes No

If 'No', proceed to section B. If 'Yes', complete the following:

Which method of ensuring consistent scoring (inter-rater reliability) will your SAC use for this project?

Agreement – the percentage of raters giving each artifact the same/similar score in a norming session; ideally, that will be 75% agreement or greater.

If you are using agreement, describe your plan for plan for conducting the “norming” or “calibrating” session:

Consensus - all raters score **all** artifacts and reach agreement on each score

Consistency – raters' scores are correlated: this captures relative standing of the performance ratings - but not precise agreement. Briefly describe your plan:

Notes: the agreement method is the most frequently used for assessment, but the **calculation of inter-rater reliability is also among the more challenging issues** within assessment as a whole. If your SAC is unfamiliar with norming procedures, contact your assessment coach, or if you don't know who your coach is, contact LAC Vice Chair [Chris Brooks](#) to arrange for coaching help for your SAC's norming session.

The consistency method is not generally recommended; see the help guide for details.

3B. Have performance benchmarks been specified?

The fundamental measure in educational assessment is the number of students who complete the work at the expected/required level. We are calling this SAC-determined performance expectation the 'benchmark.'

Yes

No

If yes, briefly describe your performance benchmarks, being as specific as possible (if needed, attach as an appendix):

The benchmarks for the three learning objectives being assessed have been set to 85% by the Chemistry SAC.

If no, what is the purpose of this assessment? (For example, this assessment will provide information that will lead to developing benchmarks in the future; or, this assessment will lead to areas for more detailed study; etc.)

3C. The purpose of this assessment is to have SAC-wide evaluation of student work, not to evaluate a particular instructor or student. Before evaluation, remove student-identifying information (and, when possible remove instructor-identifying information). Please share your process for ensuring that all identifying information has been removed.

We will run scantrons from the final exams and download the results into an Excell spreadsheet. Neither the names nor the sections they came from will be include in the spreadsheet. All analysis will be done using the data in the spreadsheet.

3D. Will you be coding your data/artifacts in order to compare student sub-groups?

Yes **No**

If yes, select one of the boxes below:

- student's total earned hours previous coursework completed ethnicity other

Briefly describe your coding plan and rationale (and if you selected 'other', identify the sub-groups you will be coding for):

*3E. Ideally, student work is **evaluated** by both full-time and adjunct faculty, even if students being assessed are taught by only full-time and/or adjunct faculty. Further, more than one rater is needed to ensure inter-rater reliability. If you feel only one rater is feasible for your SAC, please consult with an LAC coach prior to submitting your plan/conducting your assessment.*

Who will be assessing student work for this project? Check all that apply.

- PCC Adjunct Faculty within the program/discipline
 PCC FT Faculty within the program/discipline
 PCC Faculty outside the program/discipline
 Program Advisory Board Members
 Non-PCC Faculty
 External Supervisors
 Other:

End of Planning Section – Complete the remainder of this report after your assessment project is complete.

Beginning of End-of-Year Reporting Section – complete the following sections after your assessment project is complete.

4. *Changes to the Assessment Plan*

Were there changes to your project since you submitted the planning section of this report? **Yes** **No**

If so, note the changes below:

We intended to sample the full population, but one campus inadvertently did not participate in the assessment.

5. *Narrative*

Broadly, what did your SAC learn from the assessment of the core outcome under consideration this year?

The SAC selected three course specific objectives from CH222 to assess and decided upon a multiple choice question to assess each of these course specific objectives. These questions were placed on CH222 final exams across the district as the first three questions on the test. Unfortunately, the 85% benchmark set by the SAC was not achieved on any of the questions. The following is what the SAC learned from each of the questions.

Question #1 (Thermodynamics): This question received the most correct answers, and incorrect answers were fairly evenly distributed among the remaining multiple-choice options. The lack of a predominant wrong answer suggests math errors or students guessing because they did not know how to approach the problem.

Question#2 (Vapor Pressure): This was really a multi-component question: students had to evaluate which of three compounds had the highest intermolecular forces, and then match the compound with the highest intermolecular forces with the vapor pressure curve that showed the lowest vapor pressure. The SAC subcommittee identified four reasons students might have chosen an incorrect answer: 1) inability to

identify which compound was capable of hydrogen bonding 2) inability to correlate high intermolecular forces with low vapor pressure 3) inability to answer a question that involves multiple steps, even when they can perform the individual steps 4) a tendency to incorrectly associate the middle structure with the middle vapor pressure curve. For reassessment, this question should be subdivided into two questions to help determine the cause for the incorrect answers.

Question #3 (Ideal Gas Law): This question received the fewest correct responses. The predominant incorrect answers were due to either not switching the temperatures from Celsius to Kelvin or from arranging the equation relating temperatures and pressures incorrectly. Both these mistakes stem from a “plug and chug” approach to answering questions. The subcommittee also identified that this question was not a true ideal gas law question, and thus was an imperfect assessment of the course specific learning objective.

6. Results of the Analysis of Assessment Project Data

6A. Quantitative Summary of Sample/Population

How many students were enrolled in all sections of the course(s) you assessed this year? 206

(If you did not assess in a course, report the number of students that are in the group you intend to generalize your results to.)

How many students did you actually assess in this project? 122

Did you use a recommended sample size (see the Sample Size Calculator linked to in section 2J)? Yes No

If you did not use a recommended sample size in your assessment, briefly explain why:

6B. Did your project utilize a rubric for scoring? Yes X No

If 'No', proceed to section C. If 'Yes', complete the following:

How was inter-rater reliability assured? (If help is needed calculating inter-rater reliability, please contact your SAC's LAC coach.)

- Agreement** – the percentage of raters giving each artifact the same/similar score in a norming session
- Consensus** - all raters score all artifacts and reach agreement on each score
- Consistency** – raters' scores are correlated: this captures relative standing of the performance ratings - but not precise agreement
- Inter-rater reliability was not assured.**

If you utilized agreement or consistency measures of inter-rater reliability, report the level here:

N/A

6C. Brief Summary of Benchmark Achievement (frequencies and/or averages)

1. *If you used frequencies of benchmark achievement, report those here. For example, "46 students attained or exceeded the benchmark level in written communication and 15 did not." If necessary, provide detailed results in an appendix.*
2. *If you used percentages of the total to identify the degree of benchmark attainment in this project, report those here. For example, "75% of 61 students attained or exceeded the benchmark level over-all in written communication."*

The benchmark set by the SAC for all three questions was 85%. The benchmark was not reached on any of the questions.

On question 1, 81.97% of students answered correctly.

On question 2, 62.10% of students answered correctly.

On question 3, 51.22% of students answered correctly.

6D. If possible, attach a more detailed description or analysis of your results (e.g., rubric scores, trend analyses, etc.) as an appendix to this document. Appendix attached? X Yes No

6E. Do the results of this project suggest that academic changes might be beneficial to your students (changes in curriculum, content, materials, instruction, pedagogy etc.)? X Yes No

If you answered 'Yes,' briefly describe the changes to improve student learning below. If you answered 'No', detail why no changes are called for.

More formative assessments during the term would help students see errors that they are making and correct them before the final exam.

Also, it is possible that the SAC should consider more realistic benchmarks for the assessments.

In some cases, better question choice would also help us assess the course specific objectives properly.

If you are planning changes, when will these changes be fully implemented?

After review of this report by the LAC, the SAC will discuss changes during our Fall 2018 meeting.

6F. Has all identifying information been removed from your documents? (Information includes student/instructor/supervisor names/identification numbers, names of external placement sites, etc.) X Yes No

7. SAC Response to the Assessment Project Results

7A. Assessment Tools & Processes: Indicate how well each of the following worked for your assessment:

Tools (rubrics, test items, questionnaires, etc.):

X very well *some small problems/limitations to fix* *notable problems/limitations to fix* *completely inadequate/failure*

Please comment briefly on any changes to assessment tools that would lead to more meaningful results if this assessment were to be repeated (or adapted to another outcome).

Question 2 should be reconsidered for the reassessment. The skills assessed by the question could be broken into two separate questions: identification of what species have hydrogen bonds, and the correlation between high intermolecular forces and low vapor pressure.

Question 3 should be changed to an actual ideal gas law question.

Processes (faculty involvement, sampling, norming, inter-rater reliability, etc.):

X very well *some small problems/limitations to fix* *notable problems/limitations to fix* *tools completely inadequate/failure*

Please comment briefly on any changes to assessment process that would lead to more meaningful results if this assessment were to be repeated (or adapted to another outcome).

8. Follow-Up Plan

8A. How will the changes detailed in this report be shared with all FT/PT faculty in your SAC? (select all that apply)

- | | | |
|---|---|--|
| <input type="checkbox"/> <i>email</i> | <input type="checkbox"/> <i>phone call</i> | <input type="checkbox"/> <i>workshop</i> |
| <input type="checkbox"/> <i>campus mail</i> | <input checked="" type="checkbox"/> <i>face-to-face meeting</i> | <input type="checkbox"/> <i>other</i> |
| <input type="checkbox"/> <i>no changes to share</i> | | |

If 'other,' please describe briefly below.

8B. Is further collaboration/training required to properly implement the identified changes? Yes No

If 'Yes,' briefly detail your plan/schedule below.

8C. Re-assessment is a critical part of the overall assessment process. This is especially important if academic changes have been implemented. How will you assess the effectiveness of the changes you plan to make?

follow-up project in next year's annual report

on-going informal assessment

in a future assessment project

other

If 'other,' please describe briefly below.

8D. SACs are learning how to create and manage meaningful assessments in their courses. This development may require SAC discussion to support the assessment process (e.g., awareness, buy-in, communication, etc.). Please briefly describe any successful developments within your SAC that support the quality assessment of student learning. If challenges remain, these can also be shared.

The SAC benefited from a greatly streamlined assessment process this year. This assessment was more reasonable in scope (it had a much narrower focus) than past assessments; this allowed a thought-provoking discussion and analysis of each question on the assessment by the assessment subcommittee. This was the first time that the Chemistry SAC used a subcommittee to analyze the assessment data and write the assessment report. Also, to increase buy-in from the SAC, all members were asked to submit questions for the assessment and to participate in a small subcommittee breakout group to choose the questions during the fall SAC meeting.

