**Course Outcomes Guide**

**Course/Program Title:** **CHM 101** **Date: May 2019**
**Introductory College Chemistry**

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**Expected Learning Outcomes**

1. Apply fundamental mathematical skills, scientific notation, and significant figures to chemical concepts and data.
2. Communicate chemical information using symbols, formulas, equations and appropriate IUPAC nomenclature.
3. Organize and evaluate numerical measurements using dimensional analysis to setup and solve problems
4. Make connections between abstract theories of chemistry to the real world.
5. Use technology to make laboratory measurements, analyze and present data, and collect relevant information.
6. Work collaboratively with other to accomplish a task.
7. Apply learned course material and critical thinking in further science courses, such as Human Anatomy and Physiology.
8. Access, process, analyze and synthesize scientific information.

**Assessment (**How do or will students demonstrate achievement of each outcome? Please attach a copy of your assessment electronically.)

1. Regular exams with combination of multiple-choice, short answer, problem solving and essay.
2. Online homework assignments.
3. Written laboratory reports with a grading rubric.
4. Common written laboratory mid-term and final exams.
5. In-house common final exam.

**Validation (**What methods have you used or will you use to validate your assessment?)

A common assessment used in CHM 101 is a 50 multiple choice questions developed by Veronica Stein, Nancy Thorpe, Cindy Dove and Judy Peisen. This exam covers material from the first eleven chapter of the book, *Foundations of College Chemistry, 14$^{th}$ edition*, by Hein & Arena . This exam is counted as 2/3 of their final exam grade score, with the remaining 1/3 are questions written by the instructor of that section. The other assessment developed for CHM 101 is a grading rubric for dimensional analysis type problems.

**Results** (What do your assessment data show? If you have not yet assessed student achievement of your learning outcomes, when is assessment planned?)

The scores for the common final exam for the Fall and Spring semesters appear to be improving for all instructors, whereas the Summer classes have a higher mean. Overall, all sections over the years have stayed fairly steady. Our weakest areas seem to be in problem-solving, the use of dimensional analysis, chemical nomenclature, and equation writing. Data Table 1 charts progress for different aspects of the course. Starting fall 2013 we have started collecting data from all instructors using the Einstein database. One thing that seems to be consistent is that the scores for the spring semester are always lower than the fall semester. It would be interesting to see if this is a trend across all science courses and all courses on campus.

**Follow Up: (**How have you used or how will you use the data to improve student learning?)

Over the past seven years the scores for the common exam seem to remain fairly constant for all instructors. There appears to be slight fluctuations in scores over the years and for each instructor, but overall the mean and median scores have remained the same. Each instructor receives a question by question analysis of the exam and instructors have used this analysis to work on their areas of weakness. More emphasis has been put on dimensional analysis and problem solving techniques. Work is continuing for all of the above, with minor changes in teaching styles and techniques to further improve student retention and success. Additional training of adjunct professors for subject matter and procedures have been held.

We are planning on switching to a new textbook starting Fall 2017, and using an ACS exam for the common final exam. This national exam will replace our in-house common exam that we have been using for many years.

Overall, CHM101 students still seem to struggle with dimensional analysis and math-related problem solving skills. Fall 2017 we plan to incorporate several math review modules developed by the staff at the LSC into the beginning of the course. They will be completed in the LSC and counted as a homework assignment.

The general education assessment was first used in fall 2012 and revised for spring 2013. The results are fairly consistent with our common final exam scores. This assessment focuses on Learning Outcome 8 and indicates students do well with the access and process of data, but need work with analysis and synthesis of data.

The laboratory mid-term and final exams have not been revised in a few years, so we are planning on looking at them this coming year to make sure they are properly assessing our students.

An Honors section of CHM101 is planned for Fall 2014, but so far there are zero students enrolled. For this course we plan to introduce more critical thinking type questions that the knowledge learned to real-life problems. So far we have not had any honor students in any section of CHM101.

Improvements need to be made for data collection for all adjuncts and a properly functioning database that we can obtain data from. We are getting better at collecting and reporting data, but there are still gaps in the data tables below.

**Budget Justification** (What resources are necessary to improve student learning?)

Purchase of approximately 150 ACS exams to be used as the common final exam in all sections of the course.

## Science Gen Ed Course __ CHM101 – Introductory College Chemistry

| General Education Outcomes for Science | Explain how your course achieves each outcome |
|---|---|
| Relate a basic core of scientific principles to an open-ended framework | **Course SLO's – 1,2,3,4,7<br>Problem-based homework assignments<br>Problem solving on exams<br>Common final exam<br>Inquiry-based group work |
| Demonstrate observational and analytical skills in a structured situation | SLO's – 1,3,4,5,6,7<br>Problem-based homework assignments<br>Various worksheets<br>Inquiry-based group work<br>Quiz and test questions for both lecture and laboratory<br>Laboratory work<br>Common final exam |
| Formulate conclusions based on observations and information | SLO's - 2,3,4,5,6<br>Written laboratory report with post lab questions<br>Inquiry-based group work reports<br>Quiz and exam questions for both lecture and laboratory<br>Various worksheets |
| Use technology to access scientific information, generate and analyze empirical data, and solve problems | SLO's – 2,3,5,6<br>Use of Moodle for course assignments<br>On-line homework system<br>Use of various websites for gathering information or practice Graphing<br>Use of various electronic equipment in laboratory, such as balances and spectrophotometers |

****STUDENT LEARNING OUTCOMES FOR CHM101:**

**At the completion of this course, students should be able to:**

1. Apply fundamental mathematical skills, scientific notation, and significant figures to chemical concepts and data.
2. Communicate chemical information using symbols, formulas, equations and appropriate IUPAC nomenclature.
3. Organize and evaluate numerical measurements using dimensional analysis to setup and solve problems
4. Make connections between abstract theories of chemistry to the real world.
5. Use technology to make laboratory measurements, analyze and present data, and collect relevant information.
6. Work collaboratively with other to accomplish a task.
7. Apply learned course material and critical thinking in further science courses, such as Human Anatomy and Physiology.

Data Table 1.

**Course: CHM 101 SLOA Data Faculty Team: N. Thorpe (Data is for Thorpe's sections only through FA12)**

| | SU 2009 | FA 2009 | SP 2010 | SU 2010 | FA 2010 | SP 2011 | SU 2011 | FA 2011 | SP 2012 | SU 2012 | FA 2012 | ~SP 2013 | SU 2013 | FA 2013 | SP 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # Active students | | 57 | 72 | | 58 | 56 | | 69 | 72 | 32 | 64 | 89 | 36 | 104 | 126 |
| %W | | 8.8 | 6.9 | | 10.3 | 3.6 | | 21.7 | 11.1 | 9.4 | 8.6 | 8.4 | 0 | 16.3 | 7.0 |
| *% walk-away Fs No final exam/grade = F | | 7.7 | 6.9 | | 15.4 | 24.1 | | 14.8 | 18.8 | 3.1 | 12.5 | 10.0 | 0 | 3.8 | 14.1 |
| % Success (A,B,C) | | 75.0 | 62.7 | | 80.8 | 59.3 | | 74.1 | 68.8 | 87.5 | 57.8 | 49.7 | 97.2 | 68.6 | 72.7 |
| Mean Common Lab Practical Score | | | | | | | | | | | 69.4 | 58.7 | | 71.0 | 67.1 |
| Common Comprehensive Final Exam Score | | 67.5 | 63.3 | | 74.0 | 72.0 | | 73.0 | 69.9 | | 66.9 | 64.7 | | 65.8 | 68.27 |
| Gen Ed Assessment (for all sections of the course) | | | | | | | | | | | n=79 62.5% | n=86 65.0% | | n=69 69.0% | n=86 76.0% |
| Mean course grade | | 74.8 | 72.7 | | 74.1 | 72.9 | | 71.3 | 74.2 | | 66.2 | 66.8 | | 75.1 | 73.4 |
| Item Analysis **Weakest Content Areas** | | | | | | | | | | | ** | *** | | | |

*% Walk-away Fs = Did not take the final exam and received a grade of F.

~ Data for SP13 combines N. Thorpe and K. Wilson, FA13 and beyond data is average from all instructors teaching the course.

**Content Areas**

**Dimensional analysis, formula and equation writing

***Ion formation, weighted average problem and empirical formula identification, understanding potential energy, Lewis structures, bonding.

Data Table 2 continued.

**Course: CHM 101 SLOA Data Faculty Team: N. Thorpe and Adjuncts**

| | SU 2014 | FA 2014 | SP 2015 | SU 2015 | FA 2015 | SP 2016 | SU 2016 | FA 2016 | SP 2017 | SU 2017 | FA 2017 | SP 2018 | SU 2018 | FA 2018 | SP 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # Active students | 35 | 107 | 104 | 44 | 134 | 117 | 33 | 149 | 129 | 40 | 170 | 121 | | 75 | 62 |
| %W | 5.1 | 4.9 | 3.8 | 0 | 11.2 | 5.1 | 3 | 8.7 | 4.7 | 5.0 | 7.6 | 2.5 | | | |
| *% walk-away Fs No final exam/grade = F | 5.1 | 5.0 | 12.7 | | | | | | | | | | | | |
| % Success (A,B,C) | 89.7 | 80.5 | 68.0 | 84.1 | 66.2 | 66.4 | 93.9 | 70.9 | 68.2 | 80.0 | 60.4 | 71.9 | | | |
| Mean Lab Score | | 78.7 | 73.2 | | 80.8 | 77.2 | | | | | | | | | |
| Common Comprehensive Final Exam Score | | 67.9 | 63.1 | 66.7 | 70.8 | 70.9 | 74.4 | 67.4 | 62.9 | | 65.6ǂ | 65.3ǂ | 73.0ǂ | 62.6ǂ | 69.0ǂ |
| Gen Ed Assessment (for all sections of the course) | | 71.8 | 66.5 | 72.0 | 69.8 | 66.5 | 71.2 | 74.9 | 66.2 | | 65.6ǂ | 70.7ǂ | 68.3ǂ | 67.2ǂ | 74.2ǂ |
| Item Analysis **Weakest Content Areas** | | * ** | * ** *** | | * ** *** | * ** *** | | * ** *** | * ** *** | | | | | | |

*% Walk-away Fs = Did not take the final exam and received a grade of F.

**Content Areas**

* Writing chemical formulas and equations

**Dimensional analysis, formula and equation writing

***Ion formation, weighted average problem and empirical formula identification, Lewis structures, bonding.

ǂ Data for FA2017 based on 80 students; SP2018 based on 83 students; SU2018 based on 18 students; FA2018 based on 75 students; SP2019 based on 62 students.