

Chemistry
FELO Data for 1d and 1e: FA2021-SP2022

Learning Outcome: FELO 1d. Critical Thinking

Students will be able to examine, critique and synthesize information in order to arrive at reasoned conclusions.

Outcome Measure: This outcome will be measured yearly via direct, summative assessment using CHE 1002 Signature Assignment: “Eggs & Critical Thinking Assessment”.

Students are assessed on their ability to:

1. Explain: When presented with a problem / issue, are you able to clearly explain the problem, delivering the relevant information necessary to reflect your understanding of the problem?
2. Investigate: When working with the problem / issue, are you able to select and interpret / evaluate the information and develop an analysis or synthesis?
3. Evaluate: As you work with the problem / issue, are you able to methodically analyze your own assumptions, and the information provided by others, to present an informed position / analysis on the problem / issue?
4. Hypothesize: When asked to form a hypothesis, do you consider the complexities of the issue, acknowledge given facts, and present a perspective for further investigation?
5. Draw Conclusions: Are you able to place evidence and perspective to the problem / issue and your investigation of the situation and present logical consequences / implications / conclusions?

Criteria for Success: At least 70% of the students will score at an average of level 3 or higher on the AACU critical thinking rubric (in each of the 5 categories).

Longitudinal Data:

	3 or higher on the AACU critical thinking rubric		
	Summer 2020	Spring 2021	Spring 2022
Number of students	n=26	n=17	n = 20
category 1 (Explain)	89%	56%	79%
category 2 (Investigate)	100%	61%	95%
category 3 (Evaluate)	81%	44%	84%
category 4 (Hypothesis)	69%	78%	100%
category 5 (Draw Conclusions)	93%	89%	95%

Conclusions Drawn from Data: The students in CHE 1002 met the criteria for critical thinking in all 5 categories in the Spring 2022.

Changes to be Made Based on Data: We will continue to use these questions for summative assessment and try to collect more data before trying to make changes because it is quite challenging to draw reliable conclusion from only two data points. However, one change we hope to make it make sure this is offered at a time that allows for students to perform well.

Rubric Used: The following critical thinking value rubric was used.

Criteria	Ratings					Pts
1- Explanation of issues	4.0 pts Capstone Issue/problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	3.0 pts Milestone 3 Issue/problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	2.0 pts Milestone 2 Issue/problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	1.0 pts Benchmark Issue/problem to be considered critically is stated without clarification or description.	0.0 pts No Marks	4.0 pts
2-Evidence/ Investigate	4.0 pts Capstone Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	3.0 pts Milestone 3 Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	2.0 pts Milestone 2 Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning.	1.0 pts Benchmark Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question.	0.0 pts No Marks	4.0 pts

<p>3-Influence of context and assumptions/ Evaluate</p>	<table border="1"> <tr> <td data-bbox="367 305 745 605"> <p>4.0 pts Capstone Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.</p> </td> <td data-bbox="745 305 1018 605"> <p>3.0 pts Milestone 3 Identifies own and others' assumptions and several relevant contexts when presenting a position.</p> </td> <td data-bbox="1018 305 1381 605"> <p>2.0 pts Milestone 2 Questions some assumptions. Identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own (or vice versa).</p> </td> <td data-bbox="1381 305 1745 605"> <p>1.0 pts Benchmark Shows an emerging awareness of present assumptions (sometimes labels assertions as assumptions). Begins to identify some contexts when presenting a position.</p> </td> <td data-bbox="1745 305 1866 605"> <p>0.0 pts No Marks</p> </td> </tr> </table>					<p>4.0 pts Capstone Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.</p>	<p>3.0 pts Milestone 3 Identifies own and others' assumptions and several relevant contexts when presenting a position.</p>	<p>2.0 pts Milestone 2 Questions some assumptions. Identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own (or vice versa).</p>	<p>1.0 pts Benchmark Shows an emerging awareness of present assumptions (sometimes labels assertions as assumptions). Begins to identify some contexts when presenting a position.</p>	<p>0.0 pts No Marks</p>	<p>4.0 pts</p>
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<p>4-Student's position (perspective, thesis/hypothesis)/ Hypothesize</p>	<table border="1"> <tr> <td data-bbox="367 800 806 1133"> <p>4.0 pts Capstone Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position (perspective, thesis/hypothesis) are acknowledged. Others' points of view are synthesized within position (perspective, thesis/hypothesis).</p> </td> <td data-bbox="806 800 1176 1133"> <p>3.0 pts Milestone 3 Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Others' points of view are acknowledged within position (perspective, thesis/hypothesis).</p> </td> <td data-bbox="1176 800 1461 1133"> <p>2.0 pts Milestone 2 Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.</p> </td> <td data-bbox="1461 800 1747 1133"> <p>1.0 pts Benchmark Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.</p> </td> <td data-bbox="1747 800 1866 1133"> <p>0.0 pts No Marks</p> </td> </tr> </table>					<p>4.0 pts Capstone Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position (perspective, thesis/hypothesis) are acknowledged. Others' points of view are synthesized within position (perspective, thesis/hypothesis).</p>	<p>3.0 pts Milestone 3 Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Others' points of view are acknowledged within position (perspective, thesis/hypothesis).</p>	<p>2.0 pts Milestone 2 Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.</p>	<p>1.0 pts Benchmark Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.</p>	<p>0.0 pts No Marks</p>	<p>4.0 pts</p>
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5- Conclusions and related outcomes (implications and consequences)/ Draw conclusions						4.0 pts
	4.0 pts Capstone Conclusions and related outcomes (consequences and implications) are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order.	3.0 pts Milestone 3 Conclusion is logically tied to a range of information, including opposing viewpoints; related outcomes (consequences and implications) are identified clearly.	2.0 pts Milestone 2 Conclusion is logically tied to information (because information is chosen to fit the desired conclusion); some related outcomes (consequences and implications) are identified clearly.	1.0 pts Benchmark Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.	0.0 pts No Marks	

Learning Outcome: FELO 1e. Quantitative Reasoning

Students will be able to solve problems that are quantitative in nature.

Outcome Measure: Problems on the final exam that are quantitative in nature.

CHE101 / 1001 Chemistry and Society

CHE103 / 1003 Introduction to General, Organic, and Biological Chemistry

CHE152 / 1052 General Chemistry I

PSC110 Physical Science (chemistry portion)

PSC111 / 1014 Physical Science for Teachers (chemistry portion)

Criteria for Success: At least 70% of students will score 3 or higher.

Longitudinal Data:

CHE1001 (formerly CHE101)

		Assessment Data for FELO 1e. Quantitative Reasoning								
		Spring 2018	Fall 2018	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022
Number of students		n=19	n=20	n=20	n=19	n=20	n=18	n=19	N/A	n=20
Percentage		57.9%	50.0%	55.0%	47.4%	75.0%	77.8%	55.0%	Course not offered	70%

CHE1003 (formerly CHE103)

		Assessment Data for FELO 1e. Quantitative Reasoning									
		Fall 2017	Spring 2018	Fall 2018	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022
Number of students		n=30	n=20	n=40	NA	n=29	n=20	n=33	n=19	n= 34	N/A
Percentage		86.7%	65.0%	90.0%	NA	89.7%	90.0	90.9%	47.4%	82.9%	Not assessed

*No assessment data for FELO 1e in CHE103 Spring 2019 and Spring 2022, due to changes made to final exam.

CHE1052 (formerly CHE152)

Assessment Data for FELO 1e. Quantitative Reasoning								
	Fall 2014	Fall 2015	Fall 2016	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021
Number of students	n=40	n=48	n=55	n=51	n=52	n=48	n=47	n= 45
Percentage	80.0%	79.2%	89.1%	84.3%	96.2%	83.0%	76.6%	32.6%

PSC1014 (formerly PSC110 & PSC111)

Assessment Data for FELO 1e. Quantitative Reasoning									
	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021
Number of students	n=20	n=20	n=20	n=18	n=20	n=19	n=20	n=20	n=19
Percentage	55.0%	95.0%	95.0%	94.4%	90.0%	63.2%	85.0%	70.0%	78.9%

Conclusions Drawn from Data: FELO 1e (quantitative reasoning) is assessed in 4 of our 5 chemistry FE courses. For General Chemistry I (CHE 1052), our criteria for success were not met. In fact, it was the lowest score we ever obtained (32.6% instead of 84% average). We think this can be attributed to two factors: 1- we used multiple choice questions instead of short answers for the first time which did not allow for partial credits and 2- with students having had a mostly online high school senior experience due to COVID-19, there were less prepared for this course. We will keep monitoring this over the next few years and adjust our assessment method accordingly. More specifically, we will most likely switch back to using short answers for this assessment.

Chemistry and Society (CHE 1001) was not offered in the Fall 2021 because we did not have an instructor to teach it. About 15 students were added to CHE 1003 and others decided to take another course. When the course was offered in the Spring 2022 the criteria for success was met. Regarding PSC 1014 and CHE 1003, the criteria for success were met 79% and 83% of the time respectively which is good. It is worth noting that due to a change in the final exam for CHE 1003 (spring 2022), no data were collected.

Changes to be Made Based on Data: The chemistry department has met during the Spring 2021 to discuss how we assess our FE courses and have come up with an agreed upon set of questions for each course. Moving forward, these questions will be used consistently regardless of the instructor so that we can collect consistent data. We also have agreed to use short answers, when possible, in order to offer partial credits. This will also be true for CHE 1003 where we have now decided to use the widely used ACS exam to which we add a few assessment questions.

Rubric Used: The following scale was used.

	4	3	2	1
% of points earned on quantitative problems	80 – 100%	60 – 79%	40 – 59%	39% or lower