

Department of Chemistry
Annual Assessment Report
2019/2020

Based on the Chemistry Department's Student Assessment Plan, the following learning goals and associated assessment measures were scheduled for assessment during the 2019/2020 academic year:

Learning Goal #3: develop critical thinking skills necessary to assess and assemble facts and data

- Direct Assessment Measures: senior capstone paper rubric (see Appendix C, rubric assessment "C" and "D"), student conference presentations
- Indirect Assessment Measures: Senior Survey (1. Likert Scale Question: I feel the Hendrix College Chemistry curriculum has taught me to critically evaluate the conclusions in popular and scientific articles; 2. Likert Scale Question: I feel the Hendrix College Chemistry curriculum has taught me to search and read the primary literature; 3. Likert Scale Question: I feel the Hendrix College Chemistry curriculum has taught me to evaluate scientific information assembled from disparate sources)

Learning Goal #5: communicate chemistry effectively in written and oral forms

- Direct Assessment Measures: senior capstone paper rubric (see Appendix C, rubric assessment "B", "C", "E", "F", and "G"), student conference presentations, grades from senior capstone presentations, and independent research papers
- Indirect Assessment Measures: Senior Survey (1. Likert Scale Question: I feel the Hendrix College Chemistry curriculum has taught me to write about science effectively as a laboratory report or a paper; 2. Likert Scale Question: I feel the Hendrix College Chemistry curriculum has taught me to communicate scientific information effectively as a poster or oral presentation)

While the learning goals above refer to a number of specific assessment tools, the Coronavirus pandemic has ultimately limited what tools we have available. That is, we were unable to use student conference presentations, grades from senior capstone presentations, and independent research papers due to cancelled conferences and necessary adjustments to course and capstone presentation requirements. The assessment below is limited to two measures that allow both direct and indirect assessment of LG #3 and #5: the capstone paper rubric and the senior survey – both attached to the end of this document.

Capstone Paper Rubric: A direct assessment of LG #3 and #5

Since the department has revised its capstone paper rubric during the 2019/2020 academic year, results are assessed by academic year below to compare results and assess usefulness of the revised rubric in grading consistencies. The most recent version of the paper rubric is attached.

Meeting Learning Goals: Six graduating senior chemistry majors were assessed on a four-point scale and were classified to have achieved the level of “Capstone” if the average for the learning goal was 3.50 or above, “Milestone” if it was between 2.50 and 3.49, and “Benchmark” if it was 2.49 or below:

	No. Students Achieving Capstone Level (%)	No. Students Achieving Milestone Level (%)	No. Students Achieving Benchmark Level (%)	No. Students Not Achieving Benchmark Level (%)
LG 3	3 (50 %)	1 (17 %)	2 (33 %)	0 (0 %)
LG 5	4 (67 %)	1 (17 %)	1 (17 %)	0 (0 %)

Based on our preliminary data, $\geq 50\%$ of our graduating seniors are achieving capstone level in both learning goals assessed this year. However, after reviewing the above data, the department determined that the data is too limited to draw real conclusions from since this is the first year we have added the learning goal assessment to the rubric. The plan is to continue to use the new paper rubric to collect more data from capstone papers next academic year in order to more accurately assess the sampled data. The department also used this assessment to consult with the Assessment Office regarding what “grade” could be considered capstone, milestone, or benchmark.

Effectiveness of Rubric: For the papers graded in Spring 2019, using the second version of the department rubric, the pooled standard deviation for the data was 0.179. For the papers graded in Spring 2020, using the third version of the department rubric, the pooled standard deviation was 0.0261 which is a significant decrease from last year, indicating that the rubric is having the desired effect of reducing the grading disparity between faculty. Data shown in Table 1 and 2 below.

Student	Grader One – Numerical Grade	Grader One – Letter Grade	Grader Two – Numerical Grade	Grader Two – Letter Grade
1	2.175	C+	1.800	C–
2	3.800	A–	3.620	A–
3	2.375	C+	2.795	B–
4	3.040	B	2.500	B–
5	2.930	B	2.900	B
6	2.180	C+	2.175	C+

Table 1: grades assigned to the senior Capstone papers in spring 2019 using the second version of the rubric

Student	Grader One – Numerical Grade	Grader One – Letter Grade	Grader Two – Numerical Grade	Grader Two – Letter Grade
1	2.340	C+	2.258	C+
2	2.785	B–	2.683	B–
3	3.583	A–	3.500	A–
4	3.875	A	3.793	A–
5	3.850	A	3.850	A
6	3.825	A–	3.696	A–

Table 2: grades assigned to the senior Capstone papers in spring 2020 using the third version of the rubric

Senior Survey: An indirect assessment of LG #3 and #5

Using the specific senior survey questions highlighted in the learning goals and assessment measures above, the department gathered results from senior surveys over the past six years (2014-2019) and we report them for individual years as well as cumulative in the table on the following page.

Learning Goal #3: The following Likert scale questions specific to LG#3 were assessed.

1. I feel Hendrix College Chemistry curriculum has taught me to: Search and read primary literature
 - a. 91% of student respondents (out of 35) either agreed or strongly agreed with this statement
2. I feel Hendrix College Chemistry curriculum has taught me to: Evaluate scientific information assembled from desperate sources
 - a. 89% of student respondents (out of 35) either agreed or strongly agreed with this statement

Learning Goal #5: The following Likert scale questions specific to LG#5 were assessed.

1. I feel Hendrix College Chemistry curriculum has taught me to: Write about science effectively as a laboratory report or a paper
 - a. 97% of student respondents (out of 35) either agreed or strongly agreed with this statement
2. I feel Hendrix College Chemistry curriculum has taught me to: Communicate scientific information effectively as a poster or oral presentation
 - a. 97% of student respondents (out of 35) either agreed or strongly agreed with this statement

Based on these results, the students believe we are successfully achieving both LG #3 and LG #5.

Summary of Assessment Meeting

Based on the data presented above, we find that the two data sets, including the senior survey results (2014-2019 data) and the results from the capstone paper rubric (2019/2020 AY only) are consistent and suggest that we are successfully achieving LG #3 and #5 within the Chemistry program at Hendrix.

Beginning next academic year, the Chemistry Department is implementing new curricula for the major, including a required senior seminar course that will concentrate directly on developing skills and knowledge directly related to LG#3 and #5. This initial data set provides a platform for assessing the successes of our newly revised major and will be used in future assessment discussions.

Next academic year (2020/2021), we intend to continue to follow our assessment cycle outlined in the department's student assessment plan as well as focused assessment discussions on the new CHEM 497 Senior Seminar course. Results will inform the department about whether or not the new required course is enhancing achievement of the department's learning goals.

Hendrix College Department of Chemistry
Senior Survey Results
2014-2019

I feel Hendrix College Chemistry curriculum has taught me to:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	NA	# of participants	% of total (4+5)
	1	2	3	4	5	6		
Cummulative Results (2014-2019)								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature	0	1	2	13	19	0	35	91.43
Evaluate scientific information assembled from desparate sources	0	0	4	13	18	0	35	88.57
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper	0	0	1	10	24	0	35	97.14
Communicate scientific information effectively as a poster or oral presentation	0	1	0	11	23	0	35	97.14
2019 Senior Survey								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature					3		3	
Evaluate scientific information assembled from desparate sources					3		3	
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper					3		3	
Communicate scientific information effectively as a poster or oral presentation				1	2		3	
2018 Senior Survey								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature					4		4	
Evaluate scientific information assembled from desparate sources					4		4	
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper					4		4	
Communicate scientific information effectively as a poster or oral presentation					4		4	
2017 Senior Survey								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature		1	1	2	1		5	
Evaluate scientific information assembled from desparate sources			3	2			5	
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper			1	3	1		5	
Communicate scientific information effectively as a poster or oral presentation		1		2	2		5	
2016 Senior Survey								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature				4	4		8	
Evaluate scientific information assembled from desparate sources				4	4		8	
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper				1	7		8	
Communicate scientific information effectively as a poster or oral presentation				2	6		8	
2015 Senior Survey								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature				4	2		6	
Evaluate scientific information assembled from desparate sources			1	1	4		6	
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper				2	4		6	
Communicate scientific information effectively as a poster or oral presentation				2	4		6	
2014 Senior Survey								
Learning Goal #3: Develop critical thinking skills necessary to assess and assemble facts and data								
Search and read primary literature			1	3	5		9	
Evaluate scientific information assembled from desparate sources				6	3		9	
Learning Goal #5: Communicate chemistry effectively in written and oral forms								
Write about science effectively as a laboratory report or a paper				4	5		9	
Communicate scientific information effectively as a poster or oral presentation				4	5		9	

Hendrix College Department of Chemistry Senior Capstone Paper Grading Rubric (2019/20)

Student Name: _____

Faculty Evaluator Name: _____

Reader (circle one): 1st 2nd

Grade: _____

	DLG	Grade	Poor (Grade D, 1.0)	Satisfactory (Grade C, 2.0)	Good (Grade B, 3.0)	Excellent (Grade A, 4.0)
A. Topic & Title (5 %)	N/A		<input type="checkbox"/> Topic is not relevant to the field of chemistry and is not based on recent research <input type="checkbox"/> Title is not engaging and does not reflect the paper content	<input type="checkbox"/> Topic is somewhat relevant to the field of chemistry and is based on some recent research <input type="checkbox"/> Title somewhat reflects the paper content	<input type="checkbox"/> Topic is relevant to the field of chemistry and is based on recent research <input type="checkbox"/> Title is interesting and largely reflects the paper content	<input type="checkbox"/> Topic is highly relevant to the field of chemistry and is based on recent research <input type="checkbox"/> Title is engaging and accurately reflects the paper content
B. Abstract (5 %)	5		<input type="checkbox"/> Abstract is not engaging and does not answer the "what," "why," "how," and "to what end" questions	<input type="checkbox"/> Abstract is somewhat engaging and answers some of the "what," "why," "how," and "to what end" questions	<input type="checkbox"/> Abstract is engaging and mostly answers the "what," "why," "how," and "to what end" questions	<input type="checkbox"/> Abstract is highly engaging, and answers all of the "what," "why," "how," and "to what end" questions
C. Introduction & Background Information (15 %)	1, 3, 5, 6		<input type="checkbox"/> Introduction does not provide adequate description of the relevant background information and no context for the topic	<input type="checkbox"/> Introduction provides a description of some of the relevant background information and provides some context for the topic	<input type="checkbox"/> Introduction provides a detailed description of the relevant background information and provides context for the topic	<input type="checkbox"/> Introduction provides a highly detailed description of the relevant background information and provides context for the topic
D. Analysis of Information & Scientific Understanding (25 %)	1, 3		<input type="checkbox"/> Paper contains little relevant material <input type="checkbox"/> No connections are made between information from different sources <input type="checkbox"/> Chemical information is not accurately explained to the reader	<input type="checkbox"/> Paper contains a description of some relevant material <input type="checkbox"/> Some connections are made between information from different sources <input type="checkbox"/> Chemical information is sometimes accurately explained to the reader	<input type="checkbox"/> Paper contains an accurate description of a good amount of relevant material <input type="checkbox"/> Good connections are made between information from different sources <input type="checkbox"/> Chemical information is usually accurately explained to the reader	<input type="checkbox"/> Paper contains an accurate description of a large amount of relevant material <input type="checkbox"/> Extensive connections are made between information from different sources <input type="checkbox"/> Chemical information is always accurately explained to the reader

	DLG	Grade	Poor (Grade D, 1.0)	Satisfactory (Grade C, 2.0)	Good (Grade B, 3.0)	Excellent (Grade A, 4.0)
E. Conclusion (5 %)	5, 6		<input type="checkbox"/> Conclusion does not summarize the information presented in the paper <input type="checkbox"/> Conclusion does not defend a position, and does not discuss possible future directions for the research	<input type="checkbox"/> Conclusion summarizes some of the information presented in the paper <input type="checkbox"/> Conclusion suggests a position, and/or discusses some possible future directions for the research	<input type="checkbox"/> Conclusion summarizes most of the information presented in the paper <input type="checkbox"/> Conclusion defends a position, and/or discusses some possible future directions for the research	<input type="checkbox"/> Conclusion accurately summarizes all of the information presented in the paper <input type="checkbox"/> Conclusion defends a position, and discusses possible future directions for the research
F. Paper Organization (15 %)	5		<input type="checkbox"/> Paper is disorganized and does not include informative headings and sub-headings <input type="checkbox"/> The guidelines on formatting and paper length are not met	<input type="checkbox"/> Paper is somewhat organized with some use of informative headings and sub-headings <input type="checkbox"/> Some of the guidelines on formatting and paper length are met	<input type="checkbox"/> Paper is organized with good use of informative headings and sub-headings <input type="checkbox"/> Most of the guidelines on formatting and paper length are met	<input type="checkbox"/> Paper is well-organized with extensive use of informative headings and sub-headings <input type="checkbox"/> All of the guidelines on formatting and paper length are met
G. Grammar & Syntax (15 %)	5		<input type="checkbox"/> Text is riddled with grammatical errors and shows no evidence of editing and proofreading <input type="checkbox"/> Sentence and paragraph structure are poor and show little organization <input type="checkbox"/> None of the relevant scientific terms and abbreviations are defined	<input type="checkbox"/> Text is grammatically correct some of the time and shows some evidence of editing and proofreading <input type="checkbox"/> Sentence and paragraph structure are sometimes clear and well-organized <input type="checkbox"/> Some of the relevant scientific terms and abbreviations are clearly defined	<input type="checkbox"/> Text is usually grammatically correct and shows evidence of editing and proofreading <input type="checkbox"/> Sentence and paragraph structure are clear and usually well-organized <input type="checkbox"/> Most of the relevant scientific terms and abbreviations are clearly defined	<input type="checkbox"/> Text is grammatically correct throughout and shows evidence of careful editing and proofreading <input type="checkbox"/> Sentence and paragraph structure are always clear and well-organized <input type="checkbox"/> All of the relevant scientific terms and abbreviations are clearly defined
H. Figures (5 %)	1		<input type="checkbox"/> Figures are not relevant, do not support the major points presented, and are not discussed within the text of the paper <input type="checkbox"/> None of the figures include descriptive captions and appropriate references	<input type="checkbox"/> Some of the figures are relevant, support the major points presented, and are discussed within the text of the paper <input type="checkbox"/> Some of the figures include descriptive captions and appropriate references	<input type="checkbox"/> Most of the figures are relevant, support the major points presented, and are discussed within the text of the paper <input type="checkbox"/> Most of the figures include descriptive captions and appropriate references	<input type="checkbox"/> All figures are relevant, support the major points presented, and are discussed within the text of the paper <input type="checkbox"/> All figures include descriptive captions and appropriate references

	DLG	Grade	Poor (Grade D, 1.0)	Satisfactory (Grade C, 2.0)	Good (Grade B, 3.0)	Excellent (Grade A, 4.0)
I. References (5 %)	1		<input type="checkbox"/> Paper indicates that literature search was not performed and appropriate peer-reviewed and primary literature sources are not used <input type="checkbox"/> References are absent and/or not correctly cited within text and bibliography	<input type="checkbox"/> Paper indicates that a literature search was performed and appropriate peer-reviewed, primary literature sources sometimes are used <input type="checkbox"/> References are sometimes correctly cited within text and bibliography	<input type="checkbox"/> Paper indicates that a broad literature search was performed and appropriate peer-reviewed, primary literature sources are mostly used <input type="checkbox"/> References are usually correctly cited within text and bibliography	<input type="checkbox"/> Paper indicates that an extensive literature search was performed and appropriate peer-reviewed, primary literature sources are used <input type="checkbox"/> References are always correctly cited within text and bibliography
J. Deadlines & Participation (5 %)	N/A		<input type="checkbox"/> Student met none of the deadlines and was not engaged with the reading and writing process <input type="checkbox"/> Feedback provided to the student was not incorporated in to the next version of the paper	<input type="checkbox"/> Student met some of the deadlines and was somewhat engaged with the reading and writing process <input type="checkbox"/> Feedback provided to the student was sometimes incorporated in to the next version of the paper	<input type="checkbox"/> Student met most of the deadlines and was engaged with the reading and writing process <input type="checkbox"/> Feedback provided to the student was usually incorporated in to the next version of the paper	<input type="checkbox"/> Student met all the deadlines and was fully engaged with the reading and writing process <input type="checkbox"/> Feedback provided to the student was always incorporated in to the next version of the paper

Paper Strengths:

Paper Weaknesses:

The purpose of this rubric is to provide grading consistency among the faculty, and to assess how well our students are doing at meeting the department learning goals (DLGs). The four learning goals of the Hendrix College Chemistry Department that are relevant to the Capstone paper are:

1. acquire the fact-based knowledge necessary to understand chemistry as citizens and practice it as scientists,
3. develop the critical thinking skills necessary to assemble facts and data,
5. communicate chemistry effectively in written and oral forms.
6. assess the ethical implications of their work and its impact on our society and environment.

Grade Calculation:

$$0.05 \times (A) \underline{\quad} + 0.05 \times (B) \underline{\quad} + 0.15 \times (C) \underline{\quad} + 0.25 \times (D) \underline{\quad} + 0.05 \times (E) \underline{\quad} + 0.15 \times (F) \underline{\quad} + 0.15 \times (G) \underline{\quad} \\ + 0.05 \times (H) \underline{\quad} + 0.05 \times (I) \underline{\quad} + 0.05 \times (J) \underline{\quad} = \underline{\quad}$$

A: 4.00 – 3.84, **A⁻:** 3.83 – 3.50, **B⁺:** 3.49 – 3.17, **B:** 3.16 – 2.84, **B⁻:** 2.83 – 2.50, **C⁺:** 2.49 – 2.17, **C:** 2.16 – 1.84, **C⁻:** 1.83 – 1.50, **D⁺:** 1.49 – 1.17, **D:** < 1.16

Question 1

Thank you for taking the time to complete this survey. We understand that this has been quite an unusual end to your senior year and we are heartbroken that we have lost the ability to celebrate properly with you on the most special occasion of your graduation. Please know that we are proud of each and every one of your accomplishments and the success of your senior year. Fear not, we will celebrate soon enough. Until then, please provide us with feedback regarding your education in the Department of Chemistry to help us continue to improve the education we provide to all chemistry majors.

Drs. Caro, Gron, Hales, Hatch, Kett, Dahlmann, Gunderson, Scott, Stoeckl; with Mrs. Bradley, and Mrs. Desrochers

Who were you when you arrived, and where are you going now?

Question 2

Did you enter Hendrix as a fresher?
[Answer 'No' if you were considered a transfer student.]

- (1) Yes
- (2) No

• Do Not Calculate Mean/Std.

Question 3

Did you come to Hendrix planning to major in science?

- (1) Yes
- (2) No

• Do Not Calculate Mean/Std.

Question 4

Did you come to Hendrix planning to major in chemistry?

- (1) Yes
- (2) No

• Do Not Calculate Mean/Std.

Question 5

What are your plans after graduation?

- (1) Unsure
- (2) Get a job now using my chemistry education
- (3) Get a job outside of science
- (4) Go on to graduate school in one of the physical sciences or mathematics
- (5) Go on to a health related professional school (medical, dental, nursing etc.)
- (6) Go on to an unrelated professional program (business, history, law, accounting, etc.)

If none of these options match your plans, please enter a response below:

• Do Not Calculate Mean/Std.

Question 6

Do you consider yourself to be underrepresented in the sciences?

- (1) Yes
- (2) No

• Do Not Calculate Mean/Std.

Question 7

Please indicate your response to the following:

	(5) Strongly agree	(4) Agree	(3) Neither agree nor disagree	(2) Disagree	(1) Strongly disagree
The Department of Chemistry is supportive of the academic growth of all students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Reversed Options

Question 8

I feel that the Hendrix College Chemistry curriculum has given me an opportunity to develop a strong background in:

	(5) Strongly agree	(4) Agree	(3) Neither agree nor disagree	(2) Disagree	(1) Strongly disagree	(0) N/A
Organic Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analytical Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biological Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inorganic Chemistry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laboratory Procedures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laboratory Safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Reversed Options

Question 9

I feel that the Hendrix College Chemistry curriculum has taught me to:

	(5) Strongly agree	(4) Agree	(3) Neither agree nor disagree	(2) Disagree	(1) Strongly disagree	(0) N/A
Acquire knowledge necessary to practice chemistry as a scientist.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Critically evaluate the conclusions in popular and scientific articles.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Search and read the primary literature.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evaluate scientific information assembled from disparate sources.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Design and execute an experiment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write about science effectively as a poster or oral presentation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work in a group to accomplish science.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understand what 'green chemistry' is.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consider chemical hazards as part of experimental design.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Appreciate the importance and practice of chemical ethics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Reversed Options

Question 10

Consider the Hendrix College Chemistry Program Overall

I perceived the strength of the overall program to be:

Question 11

I would suggest the following improvements to the overall program:

Question 12

I gained the following insights from the overall program: