

Assessment Report for the Chemistry Department May 2018 -2019

Attachments: Chem Dept Senior Capstone Paper Expectations (Rubric)
Chem Dept SAP 19

2018 Fall Faculty Conference Rubric Exercise The Chemistry Department chose to focus on creating a new rubric for our senior Capstone paper to:

- improve communal understanding of a successful paper (faculty and students);
- increase grading consistency across the faculty (1/2 the Department is within their first 3 years); and
- create a tool for assessing whether our students are meeting the learning goals of the Department.

This work became the primary assessment work of the 2018-2019 academic year.

At this point, the capstone paper grading rubric has now gone through three versions (final version is attached), and implementation of the rubric resulted in a statistically significant improvement in the grading consistency across the Department. Our thanks to P. Kett who lead this work.

Rubric process (in brief) The Department Moodle page has a detailed description of the process, initial and final rubrics, numbers, and data analysis of this work should anyone be interested (22-pages, not included herein).

1. In our August exercise, we started with a rubric used for many years by a senior department member and two non-A capstone papers from the previous year. Pairs of faculty compared their grades. Consistency was poor (Table I) and frustration was high due to a lack of clarity of the initial rubric.
 - For the geeky few – we used a pooled standard deviation (s-pooled) analysis of the difference in the grades (0-4 points) which yielded a standard deviation of 0.654 for the difference in the grades. We used this as a benchmark for later work.

Table I Initial assessment of two 2017-2018 capstone paper grades with Rubric #1.			
Paper One – Letter Grade	Paper One – Numerical Grade	Paper Two – Letter Grade	Paper Two – Numerical Grade
B–	2.67	C–	1.67
B–	2.67	D/F	0.50
C+	2.33	B–	2.67
B+	3.33	C	2.00
		C–	1.67

2. Based on discussion, a new rubric was created, discussed, and revised in January. This revised (second) rubric was used to grade the 2019 capstone papers.
3. Our May assessment meeting focused on the success of the second rubric – very good (Table II)! The s-pooled for this data is 0.179 (notably smaller than the s-pooled of 0.654 when using the first version of the rubric). This suggests that the second rubric helped to ensure more consistent grading across the faculty. Using an F-test, this change in standard deviation from 0.654 to 0.179 is statistically significant ($P < 0.05$). This indicates that the new rubric improved grading consistency among the faculty.

Table II Assessment of the 2018-2019 capstone paper grades with Rubric #2.				
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+

- A faculty survey (n = 7) found the new rubric clear and easy to use (Table III) though there were a few residual weaknesses in point distribution and categories that were discussed in the assessment meeting and addressed leading to the final (3rd) version of the Chemistry Capstone rubric. (attached).

Table III Faculty Assessment of Capstone Rubric #2 (0-5 pt; 5 = agree completely)								
Faculty member number =	1	2	3	4	5	6	7	Mean
The rubric was easy to use	5	5	4	5	4	4	4	4.43
The rubric helped to facilitate a discussion between the two graders	5	5	3	2	3	5	5	4.00
The rubric made the grading process more efficient	5	5	3	4	4	3	5	4.14
The rubric helped the graders come to a consensus on a grade for the paper	4	5	3	4	5	4	4	4.14
The statements on the rubric were clear and unambiguous	4	4	4	4	4	4	4	4.00
There was consistency in the statements written for each category (excellent, good, satisfactory, poor)	5	5	4	4	5	4	5	4.57
It was straightforward to decide the most appropriate category (excellent, good, satisfactory, poor) for each item (topic, abstract, conclusion etc.)	4	4	4	4	2	4	4	3.71
The grade calculated from the rubric was a fair representation of the standard of the paper	4	4	4	4	4	4	5	4.14

Student Assessment Plan The posted Student Assessment Plan (SAP) is current. At present the learning goals and assessment tools remain the same though we will need to reassess since our department is so young. Please find attached a slightly updated version of our SAP attached with a new curriculum map on the last page.

Response to Targeted Feedback At our summer retreat in August 2018, we returned to the question of math skills (MATH ACT score) and success in General Chemistry (CHEM110, CHEM 120). In 2013-2014, Professor Lars Seme (Math Professor at Hendrix) did a regression analysis on student data from CHEM110 or CHEM120 between the Fall of 2004 and Spring 2013 where MATH ACT scores were also available. The old regression analysis showed:

- CHEM110: Low chance of getting a “C” in CHEM110 if the student’s MATH ACT was less than 24.
- Small improvement if students took MATH120 before or with CHEM110.

Chem 110 Present: This initial analysis resulted in new student advisor training in 2014-2015. The CNSA advice was “If your Math ACT is 24 – please take Math 120 concurrent with Chem 110; if your Math ACT of 23 or less, please delay Chem110 until foundational skills are stronger.”

We investigated the effects of this change in advice using Chem110/120 grades from 2010-2017 (2010 – 2013 before the new CNSA advice, and 2014-2017 after the new CNSA advice). Where are we now and the effect of new advice: (full data sets are posted on the Departmental Moodle page)

1. **First, Chem110 grades distribution is reasonably consistent over the years, regardless of advice.** The averages are very consistent as seen here (Table 1a), though the 2017 grade distribution is skewed a little high in the A-range. The grade patterns are surprisingly consistent considering the great changes in staffing over the last 8 years. There is no difference between the grade distribution in 2010-2013 and 2014-2017. (Eight different faculty have taught Chem110 in eight years.)

Table 1a Grade Distribution of All First-time Chem110 Students (%) 2010-2017						
	A	B	C	D	F	W
2017	32	35	18	7	1	8
average	29	36	22	6	1	6
st.dev	2.2	2.8	3.8	1.8	0.7	2.3

2. Yes, a **Math ACT of 23 or less still correlates with a poor outcome in Chem110.** About ~50% of those students (<23 MATH ACT) completed the semester with a grade of DFW.

Table 2a Final Chem110 grades against Math ACT (1070 total records)					
Math ACT	> 25	25	24	23	< 23
n	788	89	74	38	81
%W	2.5	3.4	8.1	28.9	25.9
%D&F	3.9	10.1	12.2	18.4	19.8
%DFW	6.5	13.5	20.3	47.4	45.7

3. New advising advice is working (delay Chem110, if MATH ACT is <24).
 - a. **Fewer students are starting CHEM110 with a weak math background.** Since 2014-2015, a greater % of low ACT students start CHEM110 after their first year. In 2014-2017, 19 % of all students delayed at least a year (<23 ACT) while previously the average was 9%.

Table 3a. MATH ACT Distribution 2010-2017 of non-freshmen taking Chem110 for the first time (%)

	Records with Math ACT (n)	> 24	24	23 & less
2017	32	59	0	40
2016	33	61	15	24
2015	21	57	14	29
2014	33	79	12	9
2013	30	80	7	13
2012	25	84	12	4
2011	34	94	0	6
2010	30	67	0	33

- b. **Students delaying CHEM 110 are more successful than predicted by ACT.** The students delaying Chem110 by one year typically have lower MATH ACT scores, so while the resulting test scores have about 30% fewer “A”s; these students have a much higher proportion of “Bs” and “Cs” than their Math ACT would predict.

Table 3b. Grade Distribution (%) 2010-2017 for non-freshmen taking Chem 110 for the first time.

	Records with Math ACT (n)	A	B	C	DF	W
2017	32	19	31	34	9	6
2016	33	15	42	30	9	3
2015	21	10	43	43	0	5
2014	33	21	39	27	6	6
2013	30	27	40	20	7	7
2012	25	32	36	24	8	0
2011	34	32	50	12	3	3
2010	30	13	47	27	10	3

- c. **Fewer students are getting D&F grades.** But we are not reducing the overall poor outcomes of WDF, only converting D&F to a W. We get students out of Chem110 faster. Data differences are statistically significant at the 75% confidence level.

Table 3c. Comparison of Negative Outcomes for CHEM 110, %			
	Averages	Std dev	75% CI $t=0.752$
% DF 2014-2017	6.0	1.5	0.55
% DF 2010-2013	7.8	1.4	0.52
% DFW 2014-2017	13	1.6	
% DFW 2010 - 2013	13	3.3	

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 three 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,
2. develop the problem-solving skills necessary to apply chemistry to real-world situations,
3. develop the critical thinking skills necessary to assemble facts and data,
4. develop the communication skills necessary to convey information about chemistry to others,
5. communicate chemistry effectively in written and oral forms.

Grade Calculation:

$$0.05 \times (A) \underline{\hspace{1cm}} + 0.05 \times (B) \underline{\hspace{1cm}} + 0.15 \times (C) \underline{\hspace{1cm}} + 0.25 \times (D) \underline{\hspace{1cm}} + 0.05 \times (E) \underline{\hspace{1cm}} + 0.15 \times (F) \underline{\hspace{1cm}} + 0.15 \times (G) \underline{\hspace{1cm}} + 0.05 \times (H) \underline{\hspace{1cm}} + 0.05 \times (I) \underline{\hspace{1cm}} + 0.05 \times (J) \underline{\hspace{1cm}} = \underline{\hspace{2cm}}$$

$$\mathbf{A}: 4.00 - 3.84, \mathbf{A}^-: 3.83 - 3.50, \mathbf{B}^+: 3.49 - 3.17, \mathbf{B}: 3.16 - 2.84, \mathbf{B}^-: 2.83 - 2.50, \mathbf{C}^+: 2.49 - 2.17, \mathbf{C}: 2.16 - 1.84, \mathbf{C}^-: 1.83 - 1.50, \mathbf{D}^+: 1.49 - 1.17, \mathbf{D}: \leq 1.16$$

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		<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		<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: