Student Learning Assurance Report

AY 2011-2012

Report Date: Monday, November 12, 2012
School/College: Arts & Sciences
Department/Program: Chemistry
Person completing the Report: Lawrence Margerum

1. Overview Statement: Briefly summarize the student learning assurance activities that were undertaken this academic year, indicating:
    a. Interim Assessment: New Mission, Learning Goals, Learning Outcomes developed in late Fall 2011 as part of the department Academic Program Review (APR Report was not issued until late June 2012).
    b. Contributing: Giovanni Meloni <gmeloni@usfca.edu>, Claire Castro <castroc@usfca.edu>, Megan Bolitho <mebolitho@usfca.edu>, Tami Spector <spector@usfca.edu> Lawrence Margerum <margeruml@usfca.edu> Willie Melaugh <melaugh@usfca.edu>. Sabbatical Leave: Kim Summerhays, Jeff Curtis
2. Please Answers the Following Questions for Each of the Student Outcomes Assessed:
    a. What did you do? (Preliminary plan)

LO #1: Students will demonstrate their mastery of the four principle disciplines: analytical, organic, physical, and inorganic chemistry.

Direct measurements

- Nationally Normalized American Chemical Society (ACS) exams in Chem 113, 260, 420: Benchmark is the National Median (varies by exam).
- Embedded final exam questions: Chem 230/231 and 340 (benchmark > 60% correct). For Chem 350/351 (test of concepts during 350 and again in 351: Benchmark: 70% correct)

LO#2: Students will recognize and understand the concepts and skills learned in prerequisite courses at or before the start of the new course or laboratory

Direct measurements

- Required test/problem set of concepts at the beginning of the course: Benchmark established by instructor: pre-test: 60-70% or above and retake/corrections (generally >90% correct).

LO#4: Students will demonstrate effective scientific communications skills in both written and oral form. Students will be able to write reports and present results while following professional policies regarding intellectual property, plagiarism, and group work

Direct measurements

- Poster presentation rubric: Benchmark: “Meeting Standard” in 8 out of 10 categories.
- Oral presentation rubric: Benchmark: average of 3 over ten categories (scale of 1-4)
- Standardized Professional Lab Report format adopted in lower division courses: Benchmark 65%

    b. What did the faculty in the department or program learn?

Summarize your findings and conclusions as a result of the student learning assurance indicating strengths and weaknesses in student learning demonstrated by this evaluation.

LO #1: Students will demonstrate their mastery of the four principle disciplines: analytical, organic, physical, and inorganic chemistry.

ACS Standard Exams: General Chemistry, Analytical, Inorganic (on-going)

USF Chem 113 Assessment: Full year ACS exam for General (2007 Form)	National Averages	Spring 2008 (n=) Class of '11	Spring 2009 (n=78) Class of '12	Spring 2010 -03 (n=47) Class of '13	Spring 2011 -01 (n=41) Class of '14	Spring 2011 -02 (n=51)	Spring 2011 -03 (n=68)	Spring 2012 -01 (n= 85) Class of '15
Average score out of 70 MC	**39.4**		**35.4**	**36.5**	**34.2**	**36.1**	**32.5**	**35.6**
standard deviation	11.6		9.5	8.7	9.2	9.8	10.3	9.0
Median score	38.8			37.5	33.0	36.0	30.0	34.0
High score			59.0	61.0	55.0	55.0	61.0	57.0
Low score			15.0	24.0	18.0	15.0	18.0	13.0
% of national average			89.76%	92.60%	86.71%	91.53%	82.40%	90.15%
USF Chem 260 ACS exam for Analytical (2007 Form)	**National Averages :(n=707)**		**Spring 2010 (n=9) Class of '12**	**Spring 2011 (n=24, all) Class of '13**	**Spring 2012 (n=24, all) Class of '14**			
Average score out of 50 MC	**27.5**		**26.4**	**24.7**	**25.0**			
standard deviation	7.1		7.3	6.1	6.3			
Median score	26.7			24.0	25.8			
High score			36	35.0	35.0			
Low score			17	14.0	13.0			
% of national			95.93%	89.75%	90.8%			
USF Chem 420 ACS Exam (2002 Form)	**National Averages**	**Fall 2010 (n=9 majors) Class of '11**	**Fall 2011 (n=7) Class of '12**	**Fall 2012 (n= , all) Class of '13**	**Fall 2013 (n= , all) Class of '14**			
Average score out of 60 MC	**28.38**	**35.8**	**40.3**					
standard deviation	8.10	11.2	6.6					
Median score	28.1	33	40					
High score		58	53					
Low score		24	30					
% of national		126.15%	142.00%					

For Fall 2011 (USF Chem 420 in GREY): The average was well above the national benchmark.
For Spring 2012: (USF Chem 113 in PURPLE): The average score was 90% of the national benchmark and virtually unchanged across the years in this course since 2009 (not all sections reported results each year).
For Spring 2012 (USF Chem 260 in GREEN): Here the average was within 90% of the benchmark and the average score has not changed across different instructors 2009-2012

Conclusion: We are tracking which questions Chem 113 or Chem 260 student do especially poorly on and will give more emphasis to these in future:

ACS Exam Spring 11 Question#	Chem 113 LOWEST SCORES on Grey Exam <35% correct or (< 25%)	Course content
4	identify longest emission wavelength	Chem 111
7 (< 25%)	electron config of Pb(II)	both?
11	id smallest bond angle from formula	Chem 111
16	empirical formula from mass CHO	Chem 111
20	%yield of reaction	Chem 111

ACS Exam Spring 11 Question#	Chem 113 LOWEST SCORES on Grey Exam <35% correct or (< 25%)	Course content
29	Calc new P from new T (in oC) given moles/constant V	Chem 111
32	Vol needed to get 0.5 mol X from 1.92 M MX2	Chem 111
33	concept freezing point/vapor P of salt water	Chem 111
44	concept equilibrium constant given diagrams vs. time	Chem 113
47	pick pKa from titration curve	Chem 113
48	pH water at 60oC given Kw	Chem 113
49	pH of salt solution (KBr)	Chem 113
50	identify buffer	Chem 113
51	calc pH of buffer given acid/base/Ka	Chem 113
56	calc Eox from Ered (2 moles)	Chem 113
58	id anode reaction in water electrolysis	Chem 113
63	id oxidation number in coordination complex	Chem 113
68	pick glassware to measure 25.00 mL	Lab
69	given data pick precision/accuracy	Lab

Chem 260: Topics ACS exam Less than 50% correct*= NOT a good question*	Notes (Margerum)
pH amphiprotic (needed to memorize 1/2(pK1+pK2)-NOT a good question*	give equation
matrix effect for standard addition	
charge balance H3PO4 (not completely covered)	emphasize next time
identify correct equation. ans E=K-0.05916pH (just memorizing)*	derive equation from Nernst and [H+]
pick quartz cell for 230 nm	give cells in lab and measure absorbance cut-offs
F test/t-test combined question	F-test not common, spent a lot of time on t-test
choose correct indicator for a weak acid titration	link color change to pKa of indicator
longer wavelength for emission vs. absorbance in a molecule	advanced topic
Ksp calculation for MX3 with [X-]	
buffer capacity (not covered)*	
why use lamda max in Beer's Law	
Calculate [base] given Kb and pH	no excuse
Use confidence interval correctly	no excuse
Find pH for [B2-] given Ka1, Ka2	no excuse
apply Nernst (not given equation)*	give Nernst equation?
reducing/oxidizing power ranking	more practice on terms
schematic for UV-vis instrument	not emphasized
Identify systematic error leading to high values	no excuse
Use/identify reverse phase column HPLC (2 questions)	introduce HPLC experiment? $$

Our students fall well within the national averages on all of these standardized exams until the Chem 420 Inorganic course where they far exceed the average. With limited numbers of students we do not have a valid conclusion other than there is a 1.5 year gap between Chem 260 and Chem 420 in which some students drop the major and others get better.

Organic Chemistry 230, Fall 2011 Final exam questions (Castro)

Fall 2011 Chem 230 (benchmark >60%)						
Type of Problem	**Possible points**	**Ave.**	**% correct**	**High score**	**Low score**	**NOTES**
predict the products	38.0	21.0	**55.3%**	38.0	10.0	below mark
mechanism	10.0	5.8	**58.0%**	10.0	2.0	at the mark

Fall 2011 Chem 230 (benchmark >60%)						
Type of Problem	**Possible points**	**Ave.**	**% correct**	**High score**	**Low score**	**NOTES**
spectral interpretation	10.0	8.3	**83.0%**	10.0	5.0	above the mark

Conclusion: We are meeting the benchmark for all students (not just majors) except for predicting the products for an organic reaction. This area will get more attention.

Organic Chemistry 231 Spring 2012 Final exam questions

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Section 01 S12:(Spector)

MECH DISTRIBUTION	
SCORE	COUNT
8	13
7	7
6	6
5	1
4	2
3	4
2	1
1	3
0	4

Average 66%

SYNTH DISTRIBUTION	
SCORE	COUNT
12	6
11	3
10	2
9	10
8	2
6	3
5	5
3	3
1	1
0	6

Average 58%

NMR DISTRIBUTION	
SCORE	COUNT
0	1
1	2
2	1
3	12
4	0
5	0
6	2
7	4
8	2
9	1
10	16

Average 65%

Hybridization of nitrogen atoms

BASICS DISTRIBUTION	
SCORE	COUNT
0	6
2	32
4	3

Average 46%

Section 02 S12 (Marsden)

MECH DISTRIBUTION	
SCORE	COUNT
8	34
7.5	1
6	5
5	1
4	2
3	3

Average 90%

SYNTH DISTRIBUTION	
SCORE	COUNT
0	12
1	5
2	2
3	6
4	3
5	2
6	9
7	3
8	4

NMR DISTRIBUTION	
SCORE	COUNT
1	1
2	5
3	4
4	4
5	5
6	1
7	5
8	3
9	2
10	16

Hybridization of nitrogen atoms

BASICS DISTRIBUTION	
SCORE	COUNT
0	11
2	22
4	13

Average 50%

			Average 42.5%							
						Average 67%				

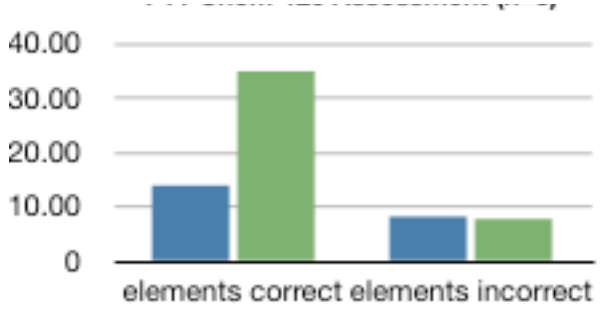
SECTION 1 (Spector): For three of the problems, more than half of the students greater than or equal to 50% correct. The benchmark of >60% average was meet or exceeded within experimental error except the concept of hybridization ('Basics Distribution') in a complex system, We tracked students who did well on the mechanism problem and they also did well on the synthesis and NMR (both above benchmark), indicating that they have a good grasp of sophomore level organic chemistry as a whole. Synthesis is generally the most difficult skill for students to master and this is borne out by the relatively lower average (58%) on this problem. A complete understanding of orbitals, hydrbization and the impact of delocalization/resonance is still not clear to many students by the end of the year; we cover these topics many times throughout the year but the shear abstraction of orbitals still seems to stymie them. It is not clear how to rectify this issue at this point other than to have each lecture professor on board about emphasis on connecting these topics in lecture/problems.
SECTION 2 (adjunct P. Marsden): The students excelled when it came to providing a mechanism for a reaction.The students performed above benchmark with simple NMR containing identical isopropyl moieties, a group commonly drilled into their heads. Students were asked to assign the hybridization of the nitrogen atoms in DMAP, and then clearly state which orbital the lone pairs resided in foreach nitrogen atom. Some students got one of the orbitals correct, and some got it completely correct for 50% score overall.

Chem 260 (Margerum): Lab Practical Knowledge and writing conclusion. Individual work. Identify unknown.

Chem 260: Analytical (Margerum)	**2010: ACS small scale lab assessment C.9**	**2012 ACS small scale Lab C.9 (50 pts), n=24**
Raw points	100	50
%Average score	73.20%	78.00%
standard deviation	19.9	12
Median score		41
High score	100	53
Low score	42	18
> 70% correct (benchmark)	55%	54%
> 90%	33%	46%
> 60%	66%	71%
NOTES C.9: Devise and carry out experiment to get pKa of unknown weak acid. Describe method (Rubric grading)		This was the third different lab practical given. The first was done in groups with TA help. The second was done alone, but answers compared with others. The 3rd was no talking and isolated stations to reduce imitation of methods.

Conclusions: We increased the number of Lab Practicals in 2012 and this did improve performance overall. There are two sets of students in 2012. Almost half had >90% correct (11 out of 24). They follow directions, create a procedure, repeat the experiment and come to a written conclusion. They understand what they are doing on a fairly simple task with many way to solve it. Of the remaining 13 students that score below 90% correct, 8 students out of 24 had less than 60% correct even after two other lab practicals (so that format and expectations would be clear). It is unclear how to help these students other than to see if exam grades mirror lab grades and advise them out of the major. In speaking with students who struggled it was clear that a poor understanding of the concpet and the open ended nature of what to do resulted in confusion and wasting time. At least 4 of the 8 students did not continue in the major due to poor grades overall (LDM).

Chem 420 Inorganic Chemistry, F2011 (Margerum).



Fill in a blank periodic table of 104 elements (10 minutes; in class, no text). Need correct location and element symbol for correct mark. We are collecting data to create a benchmark.
Pretest Low = 5 elements correct; High = 30 correct (ave 22 elements attempted)
Post course Low = 17 elements correct; High = 51correct (ave 42 elements attempted)
*Post course average gain: of 2 times more correct elements (14 vs. 35)

LO#2: Students will recognize and understand the concepts and skills learned in prerequisite courses at or before the start of the new course or laboratory
-this is a new LO agreed to in late fall 2011. Limited results as this was not in place for most courses.

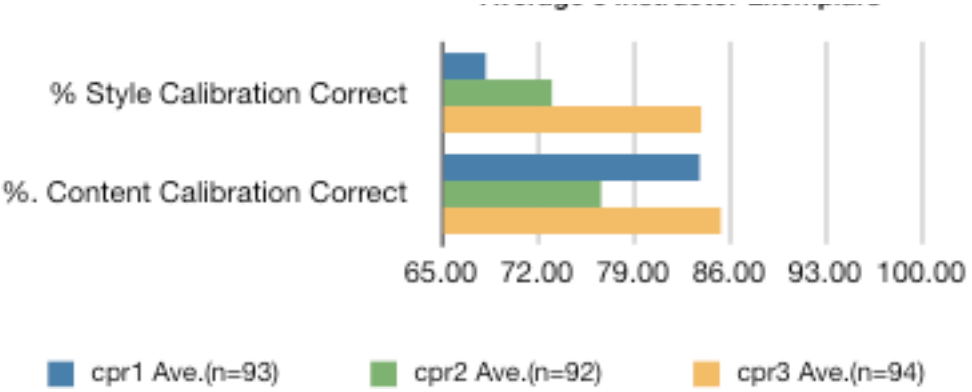
Chem 260 S12 (Margerum, pre-req is General Chemistry 113 knowledge)
Take home review problems set (honesty pledge to complete without help, but using textbooks)

Chem 420 F11 (Margerum): 30 Point problem set (take home) to assess knowledge (General, Analytical and Physical course material)

Conclusion: Our expectations for a Chem 260 take home review problem set with points assigned were higher than the results (77% average, but 17% below 60% correct). It seemed clear that students did not use resources even though the directions stated that they could. We need to rethink how to meet this LO and what the consequences should be (how to repeat or master the work).

LO#4: Students will demonstrate effective scientific communications skills in both written and oral form. Students will be able to write reports and present results while following professional policies regarding intellectual property, plagiarism, and group work

Chem 111: Calibrated Peer Review (CPR) Writing (3 assignments as part of lab-Meloni, Margerum)
cpr 1:interpret atomic absorption/emission
cpr2: describe atomic spectroscopy (AAS) operation
cpr3: interpret AAS results, mini-formal lab report



Grade: Text=20%
Calibrations=30
Peer Reviews=30
Self Assessment=20

The data show that students improve overall %Points by cpr3 primarily through improvement in %Calibration Style correct (and Deviation from instructor gets smaller).

Chem 420: Science Poster Presentation (Margerum)

FALL 2011: Poster Rubrics (40 points) across 10 categories	Raw Rubric scores by six evaluators out of 40						Average % (Benchmark 75%)	notes
group 1:	35	33	28	38	31	31	81.67%	exceed benchmark
group 2:	32	34	33	35	28	29	79.58%	exceed benchmark ;below on 'generate hypothesis and test it'
group 3:	29	33	29	28	27		73.00%	slightly below (weakest students were paired); below on data presentation, hypothesis,

Conclusion: A first time test of the Science Fair Approach to a lab project (come up with testable hypothesis, etc...). It was very clear that all groups had trouble with clearly stating the hypothesis and their method of testing it (even though all of them handed in a hypothesis). There was a disconnect or time issue in creating the Poster with attention to this detail. Even the best students struggled with this assignment at the end of the semester and it should be repeated earlier in the curriculum (AND possibly as the first experiment in Chem 420).

c. What will be done differently as a result of what was learned (Conclusion)?

Discuss how courses and/or curricula will be changed to improve student learning as a result of the evaluation. Include a discussion of how the faculty will help students overcome their weaknesses and improve their strengths.

Please see the Conclusion section under each of the results above.

d. What student learning improvement initiatives did you implement as a result of what was learned from this Year's student learning assurance report?

Discuss how courses and/or curricula were changed to improve student learning as a result of the Year's student learning assurance. Include a discussion of how the faculty has helped students overcome their learning weaknesses and improve their strengths.

Chem 111: For Fall 2012 Dr. Margerum will team up with the Learning Center (Kim Rutledge) and a USF alumnus (Dr. Joe Leonetti) to run a trial Peer Led Team Learning (PLTL) program. Student leaders are trained and paid to facilitate a working group of 6-8 students doing instructor generated worksheets that emphasize the process of problem solving.

Chem 111/113 will be separated into a 3-unit Lecture course and a 1-unit Lab course with separate grades for F13. The reasons are two-fold. First, the Chem 111 exams/grade are more predictive of success in Organic Chem 230 and we will hold the prerequisite at C or higher. The second reason to separate lab is to have students take the lab more seriously (especially preparation and testing).
Organic Chemistry will emphasize a better understanding of mechanisms (practice in and outside of class).
Analytical Chemistry will continue to use more practical exams and identification of unknowns in lab to build 'thinking on your feet' skills.
All courses will do testing of prerequisite knowledge as part of the first assignments.

We also learned that we needed new Learning Outcomes as the old ones were not giving us good information to use and implement. The Chemistry Department completed a self-study with new Mission, Learning Goals and Outcome in Jan. 2012 for the APR visit of April 2012.

3. Attach a copy of the components of the department/program student learning assurance plan that have been modified since its initial submission:
    c. Program Mission
    d. Program Learning Goals
    e. Program Learning Outcomes
    f. Program Learning Rubrics aligned with outcomes
    g. Curriculum map that shows the courses that pertain to the outcome

        *Attached as a separate document.

Please return to: Office of Student Learning Assurance by Oct 30.

Please send your replies as Word attachment (to: wmurry@usfca.edu).

If you have any questions, please contact: William Murry, Director of Student Learning Assurance (wmurry@usfca.edu or x5486).