ANNUAL ASSESSMENT REPORT FOR 2009-2010
October 1, 2010

Department/Program: **Chemistry**
Date Submitted: October 2010
Authors: *(Please list everyone involved in your department's annual assessment review.)*
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Student Learning Outcome (SLO)	**For each SLO, list two methodologies and the criteria for successful performance (such as a measurement, rubric or scale that indicates a baseline for competency).**				**Term Assessed (F09 or S10)**
	Methodology 1	***Criteria for Success***	***Methodology 2***	***Criteria for Success***	
1. Understand key concepts related to the physical and chemical properties of matter.	Embedded Assessment (direct)	All primary chemistry majors achieving "honors" or ACS level degree. Only secondary majors graduating with 32 hours of chemistry.	Nationally developed examinations (direct)	Average of 40 percentile on ACS DUCK exam	F09, S10
2. Communicate within and outside the chemical discipline.	Embedded assessment (direct)	In house poster session – 75% at ACS guidelines Plotting – 80% meeting ACS guidelines Drawing - 80% meeting ACS guidelines Lab reports – 80 % meeting ACS guidelines	Behavioral Observations (direct)	Presentations at URC – 70 % of undergraduate researchers Presentations at local meetings – 70 % of BSI students Presentations at national meetings - 70% of thesis authors Seminar – 70 % of presentations meet ACS guidelines	F09, S10

Student Learning Outcome (SLO)	For each SLO, list two methodologies and the criteria for successful performance (such as a measurement, rubric or scale that indicates a baseline for competency).				Term Assessed (F09 or S10)
	Methodology 1	***Criteria for Success***	***Methodology 2***	***Criteria for Success***	
3. Develop problem solving skills through experimentation and analysis.	Performance Appraisals (direct)	All graduates take a course that involves laboratory design and data analysis.	Embedded Assessment(direct)	Assessment of problem based on data analysis in CH courses with 50 % of students achieving better than 50% on embedded data analysis problems.	F09, S10
4. Appreciate the relationship between integrity, science, and society.	Peer evaluations (direct)	Thirty percent of majors participating in course with peer evaluation process: CH392, CH424, CH473, CH474, CH492,	Student Assessment of Science Interest (indirect)	Increase measure of science appreciation between pre and post test.	F09, S10

1. **Findings—***Summarize the findings from the assessment activities for each SLO that was assessed. Identify the SLO # and append supporting documentation such as rubrics, scales, pass rates, test scores, or other measurements used to assess each SLO.*

Understand key concepts related to the physical and chemical properties of matter.
Method 1: A full table to the courses our graduates have taken at Butler is given in Appendix 1.1. As a Department we are concerned with students graduating without sufficient course work in chemistry to work as a chemist. We are particularly concerned in cases where the chemistry major is the students only major. Over the last two years, we have compiled lists of what our graduating students actually take. This year, we observed that 4 of the 42 chemistry majors graduated with chemistry as their primary major and the minimum amount of chemistry. All other students either have more than 32 hours of chemistry or have additional majors. We have also determined that nearly all majors take the same three courses to reach 32 hours of chemistry after general and organic chemistry, CH321, CH332 and CH361. Work needs to be done to broaden the courses students are taking, only 14 of our 42 graduates enrolled in either physical chemistry course. Also, CH461 was renumbered to CH361 so the students are split between the two areas.

Method 2: Sixteen students completed the DUCK (Diagnostic of Undergraduate Chemical Knowledge) exam in the spring of 2010. The exam is written by the American Chemical Society and administered nationally. Full data is shown in Appendix 1.2. Butler students had a mean score of a 35.21 with the national mean of a 31.49. There have only been 644 students to submit their scores to the ACS for inclusion in the statistics. A score of a 35 corresponds to the 66th percentile nationally. Our initial goal for the DUCK exam was to have our graduating senior average at the 40th percentile. For the last two years we have surpassed that level scoring in the upper 60th percentile both years.

Communicate within and outside the chemical discipline.

Method 1: Please see Appendix 2.1a for complete table of presentations and outline of ACS presentation guidelines as described by The ACS Style Guide, Effective Communication of Scientific Information, 3rd ed. Edited by Anne M. Coghill and Lorrin R. Garson. For Fall 2009 posters should include: title, authors, abstract, data, discussion and conclusion. We evaluated twenty-two posters at the departmental poster session in the Fall with six falling short of the ACS guidelines. After discussion with alumni in the field of scientific communication it was suggested that references also be included in the evaluations of the posters. For the Spring 2010 posters should include: title, authors, abstract, data, discussion, conclusion and references. We evaluated 16 posters in the Spring with three failing short of the ACS guidelines. The posters represent the work of students in CH321, CH424, CH431, CH432, CH459, CH463, CH473, CH474 and undergraduate research projects.

For the current year, 40 of the 42 graduates successfully completed CH321. A description of the writing and communication aspect of the course is given in Appendix 2.1b.

Method 2: Please see Appendix 2.2a for complete table of undergraduate research students and 2.2b for presentations and publications for late 2009 to the present. Departmental seminar presentations are not included. Of the thirty-nine students that engaged in research, five of them were unable to present their work since it was not conducted at Butler, twelve of them are in the early stages of the projects and have not presented results but are continuing to work on the project or are preparing to present results in the next report period. All other students presented results at some location (URC, local or national chemistry meeting). All BSI students reported results at local meeting and or national meetings.

Develop problem solving skills through experimentation and analysis.
Method 1: The department has increased the number of courses that involve student designed experiments to include CH424, CH432, CH463, CH473, CH474, CH493 and CH494. For the 42 students graduating during the evaluation period, 29 had taken a course specifically designed to give experience in laboratory design and analysis, short of our goal of all students participating in a student designed laboratory experience. We are still struggling to provide more opportunities for students to engage in classes / experiences that involve student participation in the goals / methodology of the project. We are developing more options for student design earlier in our curriculum including CH321, typically taken at the freshmen or sophomore level and CH352, taken at the sophomore level. A full list of courses taken by our graduates can be found in Appendix 1.1.

Method 2: The Department has developed an assessment of laboratory knowledge for administration CH351 and CH352 which is required of all chemistry majors. Two version of the exam have been developed a short version out of 18 points and a longer version out of 28 points. The short version of the exam was administered at the end of CH351, the short and long version at the end of CH352 and at the beginning of CH432. At the end of CH351 the average score on the lab knowledge questions was a 7.6 out of 18. At the end of CH352, the average score was a 9.9 out of 18. With over 200 students taking the assessment we believe that there is significant improvement on the exam after CH352. More interesting for the Department is, the exam was given as a pretest for CH432. The average there was 13.9 out 28, very similar to the average at the end of CH352 which was a 13.3 out of 28. We do not know yet if that is an indicator that chemistry majors are simply in line with the average assessed for CH352, which includes other majors, if students choosing to pursue chemistry initially would have had higher scores and the scores reflect retention over time.

Appreciate the relationship between integrity, science, and society.
Method 1 Though student participation in peer evaluation in advanced laboratory have fallen short of our desired level, more students 21 of our 42 graduates took the Departmental seminar courses, CH392 or CH492. Both courses include peer evaluation of speakers in order to understand how scientific work is conducted and presented ethically.

Method 2: Based on the difficulty of using the SALG, designed for non science majors, we designed an appreciation instrument for our majors. Please see Appendix 4.2. The survey was given to incoming students in the fall of 2009 and graduating students in the spring of 2010. With as few of results that have been obtained, more years of data will be needed to determine if there are statistically valid trends.

2. **Use of Results—**W*hat programmatic changes, if any, were made in response to the findings? Reference the SLO #.*

For SLO #1, with response to the depth and detail in the course we have renumbers CH461 to CH361 to reflect that it is an introduction to field of biochemistry. For SLO #3, we have developed laboratories for CH351 and CH352 which reflect student choice to better support the idea of how experimentation is developed and conducted. In CH105 and CH106 we have developed question led laboratories which guide students to find the appropriate, safe experimental protocol, as opposed to a "cookbook" list of directions. For SLO # 4, we are requiring seminar for all students interested in Departmental Honors.

3. What **support services or resources** for faculty would help your department assess its SLOs better?
We would like help in using "Survey Monkey" or a similar tool to administer a student attitude survey.

4. What **revisions**, if any, to current SLOs did you make or are under consideration?
   We have adjusted the first method of assessment for SLO #1 to reflect the depth and breadth of courses that students are taking at Butler. We believe we need the information to better gauge what our students actually know.
   We have also just recently realized that our SLO's are void of ANY discussion of laboratory safety. We are currently working to determine how to better cover safety within our program, and assess what we are doing. Any changes will need to be reflected in the SLO's.

5. Map each of your program's SLOs to the University Learning Outcomes. Make annual updates only if your SLOs changed. For example:

Butler University students will:

1. Explore various ways of knowing in the humanities, social and natural sciences, quantitative and analytic reasoning, and creative arts. *(Know)*
2. Articulate and apply required content knowledge within their area(s) of study. *(Know)*
3. Find, understand, analyze, synthesize, evaluate and use information, employing technology as appropriate. *(Know)*
4. Explore a variety of cultures. *(Know)*
5. Recognize the relationship between the natural world and broader societal issues. *(Know)*
6. Communicate clearly and effectively. *(Do)*
7. Demonstrate collaborative behavior with others. *(Do)*
8. Practice ways and means of physical well-being. *(Do)*
9. Acquire the skills to make informed, rational and ethical choices. *(Do)*
10. Appreciate diverse cultures, ethnicities, religions and sexual orientations. *(Value)*
11. Share their talents with Butler and the greater community at large. *(Value)*
12. Be exposed to the value of lifelong learning. *(Value)*

Chemistry Student Learning Outcomes:	Butler University Learning Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand key concepts related to the physical and chemical properties of matter.	X	X	X									
2. Communicate within and outside the chemical discipline.						X	X					
3. Develop problem solving skills through hands-on experimentation and analysis.		X	X			X	X		X			
4. Appreciate the relationship between integrity, science, and society.					X		X				X	X

6a. Map each of your program's SLOs to the **curriculum** in which the learning occurs, indicating the extent to which the outcome is introduced (I) or refined (R). Make annual updates only if your SLOs changed.

	SLO 1	SLO 2	SLO 3	SLO 4
CH105	I		I	
CH106	I		I	
CH107	I	I	I	I
CH 321	I/R	I/R	R	
CH 332	I/R			I
CH 351	I/R	I	I	
CH 352	I/R	I	I	
CH392		I		
CH402/3				
CH 411/2				
CH 422	R			

CH 424	R	R	R	R
CH 431	R	R		R
CH 432	R	R	R	R
CH 459	R			
CH 361	R			R
CH 462	R			
CH 463	R	R	R	R
CH468	R	R	R	
CH 465	R			R
CH 471	R			
CH 472	R			
CH 473	R	R	R	R
CH 474	R	R	R	R
CH 491		R		
CH 492		R		
CH 493/4	R	R	R	R
CH 499	R	R	R	R

6b. **Learning/developmental opportunities for students outside the classroom—***If any SLO was addressed outside the classroom, explain where and how the learning/developmental opportunities were provided to students in your program? (i.e., internships, field experiences, visiting lectures, collaborative projects, and other creative ideas you may have employed.)*

NA

Appendix

1.1 Courses students take to fulfill major

1.2 DUCK data from American Chemical Society

2.1a ACS poster guidelines

2.1b CH321 data analysis guidelines

2.2a Student Research Summer 2009 through Spring 2010

2.2b Papers and Presentations 2009 through 2010

3.2 Scores on Organic Laboratory Exam

4.2 Student Opinion Survey

Appendix

1.1 Courses students take to fulfill major (General Chemistry is not included, as well as some rarely offered electives.)

321	332	351	352	361	392	422	424	431	432	459	461	462	463	465	471	472	473	474	492	493	494
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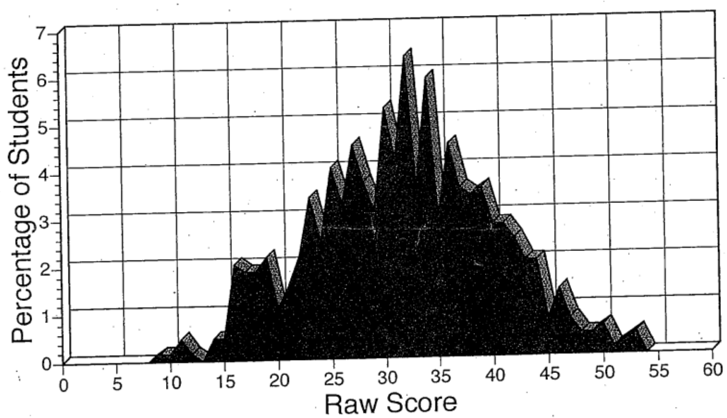
40	39	42	42	9	11	12	16	11	6	14	33	14	12	4	12	4	2	3	10	19	4

Appendix 1.2 DUCK Data

American Chemical Society Division of Chemical Education
Composite Norms – Diagnostic of Undergraduate Chemistry Knowledge

Score	Percentile	Score	Percentile	Score	Percentile
60	100	38	77	16	3
59	100	37	74	15	2
58	100	36	70	14	1
57	100	35	66	13	1
56	100	34	61	12	1
55	100	33	57	11	0
54	100	32	52	10	0
53	100	31	47	9	0
52	99	30	42	8	0
51	99	29	38	7	0
50	99	28	34	6	0
49	98	27	30	5	0
48	98	26	26	4	0
47	97	25	23	3	0
46	96	24	19	2	0
45	95	23	16	1	0
44	94	22	14	0	0
43	92	21	12	Mean	31.49
42	89	20	10	Std. deviation	8.37
41	87	19	9	Median	31.2
40	84	18	7	KR-21 reliability	0.80
39	81	17	5	Std error/meas	3.75

Based on the scores of 644 students in 36 universities and colleges.



Confidential

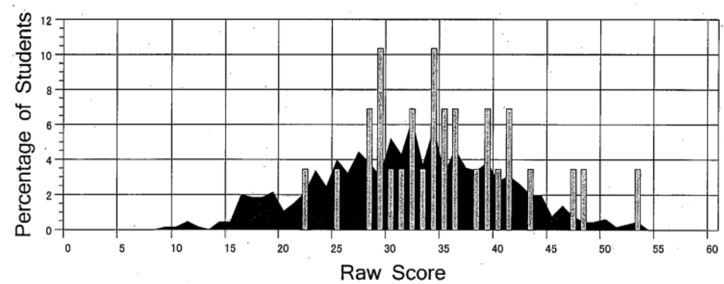
Report for Butler University
Diagnostic of Undergraduate Chemistry Knowledge Exam 2008 Form

National Totals

Mean	31.49
Standard Deviation	8.37
Median	31.2
KR 21	0.80
Standard Error	3.75

School Totals

Mean	35.21
Standard Deviation	7.02
Median	34
KR 21	0.72
Standard Error	3.74



Appendix 2.1a

American Chemical Society Poster Guidelines

For Fall 2009 posters should include: title, authors, abstract, data, discussion and conclusion. We evaluated twenty-two posters at the departmental poster session in the Fall with six falling short of the ACS guidelines. For the Spring 2010 posters should include: title, authors, abstract, data, discussion, conclusion and references. We evaluated 16 posters in the Spring with three failing short of the ACS guidelines.

Fall 2009

Requirement	Student Poster Number																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Title	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Authors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Abstract	✓	✓	x	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓
Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discussion	✓	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	✓	✓	✓	x	✓	✓	✓
Conclusion	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	✓	✓

Spring 2010

Requirement	Student Poster Number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Title	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Authors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Abstract	x	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓
Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discussion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓
Conclusion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓
References	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Appendix 2.1b

CH321: Analytical Chemistry I
Spring 2010

Instructor: Dr. Michael Samide
Office: Gallahue 317
Email: msamide@butler.edu
Office Phone: 940-9973
Office Hours:

Lecture: The scheduled lecture times for this course are 9:00 – 9:50 am MWRF.
Lab: You should be enrolled in one of two lab sections that meet W, R, or F at 1:00pm.

Texts: The required book for this course is "Quantitative Chemical Analysis" by D.C. Harris (7th Edition). Also, you should purchase a **tape-bound** lab notebook.

Departmental Goals: The department has identified 4 specific goals as it works to develop a competent chemist. These goals listed below are designed to cover all classes and can easily be implemented and assessed throughout the four-year undergraduate career. However, not every goal needs to be addressed in every class. In fact, we will touch upon each goal, but focus mainly on goals 1 through 3.

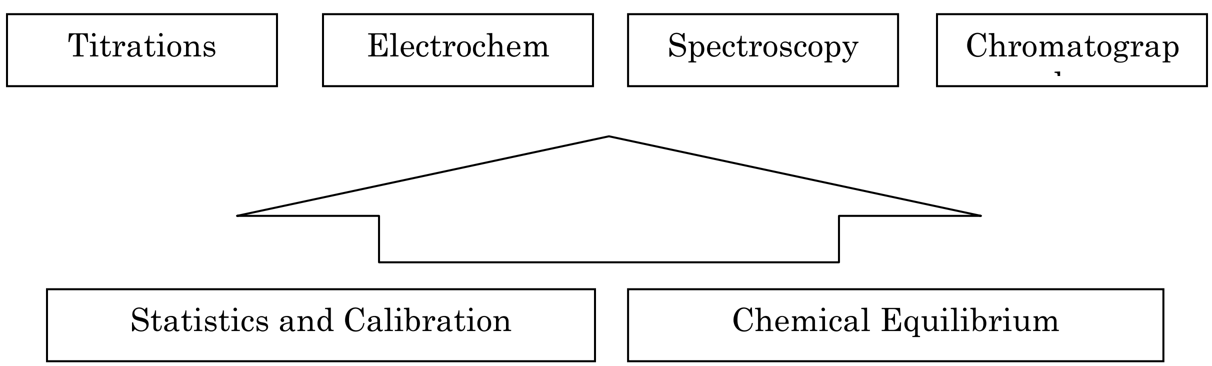
- Understand key concepts related to the physical and chemical properties of matter.
- Communicate within and outside the chemical discipline.
- Develop problem solving skills through experimentation and analysis.
- Appreciate the relationship between integrity, science, and society.

Specific Course Goals: Its difficult to describe the goals of this course in strictly science-oriented terms. Certainly you'll be learning specific concepts and specific techniques related to analytical chemistry and laboratory exploration, but more than that you'll be learning skills that reach beyond the boundaries of this course. My goal is to help you:

- understand chemistry and analytical chemistry
- learn how to think better
- process data more clearly and easily
- learn how to be confident in your work

If you approach this class with a positive attitude and are willing to learn and make mistakes and try things over and over again, then you'll enjoy this class. If this is just a course requirement to complete for graduation, then you should think about dropping this class...you won't enjoy yourself. And why are you paying so much money to be miserable!

Course Overview: This course deals with the fundamentals of analytical chemistry; these include statistics, equilibrium, electrochemistry, basic spectroscopy, and separations. It provides the basis for both qualitative and quantitative chemical analysis.
The lecture material in this course may seem somewhat disjointed, and in some respects it is. Below is a diagram that will help you understand how the major concepts are related.



In addition to the formal coursework, you will be learning specific skills that will benefit you in your chemistry career. These skills include: (1) critical thinking; (2) notebook/record keeping; (3) multitasking; (4) group work skills; (5) computer literacy with Excel and Word; and (6) good laboratory practice. Mastering these skills is just as important as learning about equilibria or instrumentation.

Course Structure: The amount of material we need to cover cannot be fully presented in the scheduled class time. To remedy this we have several options. The first is to focus primarily on equilibrium as this forms the basis for much analytical methodology. In doing this, however, we miss out on modern analytical techniques. This leads to the second option, which is to focus solely on modern analytical techniques. A major flaw with this approach is that it is difficult to

understand these techniques without a firm foundation of equilibrium. Our final option, which is the best one, is to touch on all aspects of equilibrium and instrumentation. To do this will require in-class participation along with at-home independent study. The following table outlines what we will be studying and when.

Analytical Chemistry and LAS: Can analytical chemistry really be considered part of a liberal arts education? Isn't it more of a skills class specific to the discipline of chemical analysis? Well, certainly there are aspects of the course that are very skills oriented. Examples of this are titration techniques and indicator selection, sample preparation, and quantitation. But really analytical chemistry isn't just about mastering techniques in order to complete a task...its not just technical training or following a recipe (put peg A into slot B). In addition to problem solving and critical thinking skills, analytical chemistry teaches one how to bridge various disciplines – environmental, biological, political – in order to discover how a system might work or what ramifications a process might have on other systems. Plus, there is a certain logical pattern of thinking that one learns from analytical chemistry that can apply to all areas of learning. So enjoy analytical chemistry and don't be afraid to dive into the subject and ask questions beginning with "What" and "How" and "Why". And don't be afraid to bring what you've learned in your other classes to CH321. The more we talk and discuss, the more we'll learn.

Attendance at the Butler Undergraduate Research Conference: It is important to play a role in the larger scientific community. Whether you plan on pursuing a career in medicine, chemistry, biology, or some other field, you will be called upon to attend professional meetings and think critically about the work being presented in your field. To help prepare you for this venture, you will be required to attend two different sessions in either chemistry, biology, pharmacy, or pre-health. You will be required to provide a synopsis of one seminar from each session

Learning the Material: You must find a way to motivate yourself to study continually (30-45 min/day, 2 to 3 days a week) if you want to be successful in this class. I recommend:

- You do problems from the end of each chapter
- You work together on the problem sets
- You come in and discuss the problem sets with me during office hours
- You create a second set of notes using your textbook

Exams: There will be four hour-long exams and one final exam given during the semester. The hour-long exams will consist of several questions, some of which will combine multiple concepts. They will be doable IF YOU ARE WELL PREPARED. If you wait until the night before an exam to begin studying, then you will most likely fail the exams. Each exam will be comprehensive and you must pass the final with a 50% or greater in order to pass the class. A grade of 49% or less on the final will result in an F for the course grade because you've demonstrated a lack of retention of the material presented during the semester. Once again, success on the exams goes back to continual study of the material for this course.

The date of each exam will be announced the week before it is administered and will coincide with the end of a particular section. This is done to avoid overlap in the material being tested in a particular exam.

Laboratory Work: Because it is important for you to practice what you will be learning in lecture, a portion of your class grade will come from the laboratory section. There will be 5 laboratory experiences during the semester, each designed to highlight a different topic and to give you experience with various methods of analysis. More details about the laboratory section will be given during the first week of classes.

In general, each lab grade will be determined on the basis of an evaluation of your work in three distinct areas:

(1) 5 points – laboratory notebook. I need to see your notebook at the end of each lab period. If it is not to my standards, you will lose points.

(2) 5 points – your attitude in the lab. Please do not complain when you need to do things over or when you need to do things at all...especially if you want me to write a letter of recommendation.

(3) 40 points – your lab reports. These must be typed and formatted appropriately. Report guides will be provided for select labs and posted on blackboard. If you do not follow the guidelines, do not expect high scores on the reports.

For the final laboratory exercise, you must present the results of your work at a departmental poster session at the end of the semester. You will be given a poster grading guide to help you in preparation of your poster.

Table 2: A laboratory schedule for the spring 2010 semester of CH321

Week	Topic	Week	Topic
Jan 11	Check-in and Writing Workshop	Mar 8	Spring Break
Jan 18	Acid titration	Mar 15	Method Comparison (Part 3)
Jan 25	Method Development (Part 1)	Mar 22	Special Projects
Feb 1	Method Development (Part 2)	Mar 2	Special Projects
Feb 8	Method Development (Part 3)	Apr 5	Special Projects
Feb 15	Method Comparison (Part 1)	Apr 12	Special Projects
Feb 22	Method Comparison (Part 2)	Apr 1	Check-out and Clean-up
Mar 1	Pittcon 2010		

Assessment: This semester I will ask you to participate in an online assessment of the learning goals for this class. The survey, done online, will require about 15 minutes to complete (probably less) and will not factor into your grade for this course.

Computer Literacy: Because this course counts toward your computer literacy requirement for graduation, we will spend a significant amount of time learning the proper (and sometimes advanced) used of PowerPoint, Word, and Excel. Your reports must be formatted appropriately and you must create an Excel workbook that can perform statistical comparisons and calculations.

Absences: There will be **no make-up** assignments. Legitimate excuses (doctor's note, religious holiday, documented family emergencies, and participation in sporting events) will be accepted and will earn you extra time to turn in your assignments. No other excuses will be tolerated.

Grades: In general I stick pretty closely to the grade scale shown in Table 4. I do occasionally give opportunities for extra credit, but this is rare. Gain points the old fashioned way...earn them! Listed in Table 3 are all of the assignments (and their associated point values) for which you will be responsible. Please put forward your best effort on each assignment.

Table 3: Graded assignments and their associated point values

Assignment	Point Value
URC summary	20
4 hour-long exams (100 pts per)	400
1 comprehensive final (200 points)	200
participation during lecture and discussions	50
Writing Workshop	25
laboratory work (50 pts per)	150
poster presentation	50
Excel sheet (20 pts)	20

Table 4: Grade scale for all semesters of CH321. Values in percent of total points.

Grade	%	Grade	%	Grade	%	Grade	%
A+	99-100	B+	88-89	C+	78-79	D	60-69
A	93-98	B	82-87	C	72-77	F	<59
A-	90-92	B-	80-81	C-	70-71		

Notice: It is the policy and practice of Butler University to make reasonable accommodations for students with properly documented disabilities. Written notification from Student Disability Services is required. If you are eligible to receive an accommodation and would like to request it for this course, please discuss it with me and allow two weeks notice. Otherwise it is not guaranteed that the accommodation can be given on a timely basis. If you have questions about Student Disability Services, you should contact Michele Atterson, JH 136, ext. 9305.

Health hazards: In our courses, laboratory attendance is a fundamental component to the understanding of concepts and techniques of performing chemistry. Additionally, the very nature of laboratory involves using chemical reagents, which can pose potential health risks. If you have concerns about your health, please have a discussion with your professor or *any* chemistry faculty member. Such concerns might include, but are not limited to: any condition that results in an immunodeficiency; persons considering conception; certain heart conditions; serious allergies; etc. Understand that any information shared will be kept entirely confidential. DO NOT HESITATE TO DISCUSS THIS WITH A CHEMISTRY FACULTY MEMBER AND/OR MICHELE ATTERSON (JH 136, x9308).

A Word about Cheating: It should go without stating that cheating is not tolerated in my classroom. Should you choose to cheat, then you really need to think about why you're here at Butler and the reasons you chose to get a post-secondary education.

The statement below was taken from the Butler student handbook and defines cheating. I do not tolerate cheating in my classes. It is disrespectful to you, to your fellow students and to me. Please do not cheat. If you are struggling, come and talk with me. I will do everything I can to help you. The first instance of cheating results in a zero for that assignment. The second instance results in a 0 for the class.

"Cheating includes receiving or giving help on papers, experiments, reports, compositions, projects or examinations without the instructor's permission. It also includes submitting part of or all of the completed assignment of another student as one's own work. Of special note and concern is the use of purchased research papers. It is a violation of the regulations of Butler University for a student to purchase a term paper. Cheating is also using unauthorized materials and aids, such as books, one's own notes or those of another, and calculators during an examination." – Student Handbook

Appendix 2.2a

Student Research Summer 2009 through Spring 2010

Urc	Mary	Andorfer	Effect of ionic strength upon cytochrome c absorption to the silica surface
At IUPUI	Maite	Bastyr	SREBP1 in the Regulation of Glycogen Synthase: Over-Expression in Hepatocytes Approach
Beginning	Maraya	Baumanis	Theory & Experimental investigations of hydrogen-bonding in cytosine analogue
NA	Kelli	Blackmore	phage display to identify peptides that could bind to target molecules
Department	Joel	Burnette	Development of a Microwave Assisted Multi-component Diels Alder Reaction for the Teaching
NA	Chase	Carroll	Eli Lilly- Discovery Chemistry & Research dept/synthetic work
Department	Katie	Cox	Study of Chiral Recognition by Ionic Liquids
URC	Rebecca	Davies	EDTA Preconcentration of Metals
Department	Breanna	Davis	The Effect of Using "Mastering Chemistry" and its Effect on Student Metacognition
Beginning	Grace	Douglas	Extraction of menthol from mentholated cigarettes
Beginning	Carissa	Fuller	Theory & Experimental investigations of hydrogen-bonding in cytosine analogue
Department	Laurel	Heckman	BSI - Chiral Recognition Study of a Bimolecular Process in a Chiral Ionic Liquid
ACS	Matt	Hedge	Enzymatic Characterization of Thermostable Esterases
Urc	Kyle	Holsinger	Formation of Amines by Microwave Irradiation
ACS	Crystal	Hon	Cop & Related Thermal Rearrangements
Deparment	Erica	Hunt	BSI - Synthesis of 2,6-Disubstituted Dihydropyrans
Beginning	Stephanie	Knezz	Extraction of Menthol from Mentolated Cigarettes
Beginning	Daniel	Kroupa	Study of Chiral Ionic Liquids
Beginning	Paula	LeBlanc	Theoretical investigation of the effects of solvent on Thermodynamic properties
Urc	Brian	Livingston	Characterization of ANS Gene Expression in Onion Cultivars
Na	Kelly	McKenna	Fluorescent Substrates for Esterase Activation
Butler	Alicia	Phelps	Heterocyclic Synthesis From 4-Hydroxy Pyridive
Department	Jacqueline	Pinaire	BSI - Synthesis of Substituted Hydroxycyclopentenones via Titanium Complexes
Beginning	Alex	Posar	Extraction of Menthol from cigarettes via liquid CO2
Beginning	Brianna	Richine	ATR spectroscopic analysis of cytochrome c absorption to surfaces
Departmental	Marc	Rosenthal	Polymerization of alcohols in Ionic Liquids investigated by FTIR
Beginning	Matthew	Sall	Synthesis of novel antibiotics
Beginning	Ted	Seger	PCR analysis of ANS alleles in onions
Beginning	Eric	Shoemaker	Study of Ionic Liquids
Beginning	Dustin	Stanton	Quantitation of Menthol in Mentholated Cigarettes
Department	Stephanie	Steele	BSI - Synthesis of Chiral 3,4 Dihydropyran
Beginning	Nathan	Tavenor	Immobilized enzymes on electrode surfaces
NA	Joshua	Taylor	Mitigation of Propyzamide's Soil Mobility via Application of a Polymer Coating
Departmental	Joshua	Taylor	Computational Chemistry
Deparment	Ariel	Tyring	Synthesis a Polymer bound Cu-H Species and Its Application to Hydrosilation

URC	Scott	Wentz	Carbene research for cyclopropanes
Acs	Leigh	Weston	TBD: Esterase Activity of Fracisella Tularensis
Department	Nishaat	Yunus	Developments in Monitoring Emerging Contaminates

Appendix 2.2b Papers and Publications late 2009 through 2010

Determination of Cytochrome cřs Affinity towards Various Chemically Modified Silica Surfaces via Attenuated Total Reflection Spectroscopy. Briana Richine. 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010 Sponsor: Geoffrey Hoops

Multiple Hydrogen Bonding Protype: Theory and Experimental. Paula LeBlanc. Butler 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010. Sponsor: Shannon Lieb

Dipole-Dipole Hydrogen Bond Polymerization Trends of Various Alcohols in differing Ionic Liquids Tracked using Fourier Transformation Infrared Spectroscopy. Marc Rosenthal. 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010. Sponsor: Joe Kirsch

Radiographic Measurements of Sulcus Angle, Patella Tendon Length, and Patella Height in Patients Suffering Patellar Dislocation and Controls. Morgan Cox. 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010. Sponsor: John Esteb

S**ynthesis of Substituted Hydroxycyclopentenones via Titanium Complexes**. Jacqueline Pinaire. 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010. Sponsor: Anne Wilson

Solid Supported Synthesis of Secondary Amines via Staudinger and Microwave-aza-Wittig Reactions. Kyle Holsinger. 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010. Sponsor: Paul Morgan

Microwave-assisted Claisen rearrangements. Crystal Hon. 21st Annual Undergraduate Research Conference, Butler University, Indianapolis, IN. April 2010. Sponsor: Anne Wilson

Hedge, Matthew; Johnson, Jeremy. **Determination of substrate specificity of two esterases from a thermally stable bacteria using fluorescence.** Abstracts of Papers, 240th ACS National Meeting, Boston, MA, United States, August 22-26, 2010 (2010), CHED-176. CODEN: 69NAQG AN 2010:1008763 CAPLUS

Weston, Leigh A.; Johnson, R. J. **Characterization of esterase activity from the bacteria, Francisella tularensis, the causative agent of tularemia.** Abstracts of Papers, 240th ACS National Meeting, Boston, MA, United States, August 22-26, 2010 (2010), CHED-162. CODEN: 69NAQG AN 2010:1008751 CAPLUS

Johnson, R. Jeremy; Hedge, Matt. **Characterization of latent fluorophore-esterase pairs for enzymatic assays and biological imaging.** Abstracts of Papers, 240th ACS National Meeting, Boston, MA, United States, August 22-26, 2010 (2010), BIOL-204. CODEN: 69NAQG AN 2010:1008213 CAPLUS

McNulty, LuAnne; Kohlbacher, Kris; Borin, Katie; Dodd, Bryan; Bishop, Jeni; Fuller, Lindsey; Wright, Zach. **Cyclic Alkenyl Boronic Half Acid Synthesis and Applications.** Journal of Organic Chemistry ACS ASAP. CODEN: JOCEAH ISSN:0022-3263. AN 2010:1000877 CAPLUS

Esteb, John J.; McNulty, LuAnne M.; Magers, John; Morgan, Paul; Wilson, Anne M. **Technology for the Organic Chemist: Three Exploratory Modules.** Journal of Chemical Education ACS ASAP. CODEN: JCEDA8 ISSN:0021-9584. AN 2010:949574 CAPLUS

McNulty, LuAnne M.; Clevenger, Chelsea; Kasparian, Mary. **Preparation and use of cyclic vinyl boronic acids.** Abstracts of Papers, 239th ACS National Meeting, San Francisco, CA, United States, March 21-25, 2010 (2010), ORGN-1092. CODEN: 69MML8 AN 2010:346353 CAPLUS

Hon, Crystal M.; Wilson, Anne M. **Microwave-assisted Claisen rearrangements.** Abstracts of Papers, 239th ACS National Meeting, San Francisco, CA, United States, March 21-25, 2010 (2010), ORGN-1079. CODEN: 69MML8 AN 2010:346340 CAPLUS

McNulty, LuAnne M.; Steele, Stephanie. **Disubstituted cyclic vinyl boronic acids and their application to dihydropyran synthesis.** Abstracts of Papers, 239th ACS National Meeting, San Francisco, CA, United States, March 21-25, 2010 (2010), ORGN-1072. CODEN: 69MML8 AN 2010:346333 CAPLUS

Wilson, Anne M.; O'Reilly, Stacy A.; Garringer, Sean M.; Hesse, Andrew J.; Magers, John R.; Pugh, Kristopher R. **Microwave synthesis of benchmark organo-iron complexes.** Abstracts of Papers, 239th ACS National Meeting, San Francisco, CA, United States, March 21-25, 2010 (2010), INOR-223. CODEN: 69MML8 AN 2010:343249 CAPLUS

Ding, Wendu; Cramer, Christopher J.; Truhlar, Donald G.; Marenich, Aleksandr V. **Methodological considerations for the prediction of dicarboxylic acid dissociation constants.** Abstracts of Papers, 239th ACS National Meeting, San Francisco, CA, United States, March 21-25, 2010 (2010), COMP-205. CODEN: 69MML8 AN 2010:341519 CAPLUS

Hopkins, Todd; Goldey, Matt. **Tb3+ and Eu3+ luminescence in imidazolium ionic liquids.** Journal of Alloys and Compounds (2009), 488(2), 615-618. CODEN: JALCEU ISSN:0925-8388. AN 2009:1489938 CAPLUS

Garringer, Sean M.; Hesse, Andrew J.; Magers, John R.; Pugh, Kristopher R.; O'Reilly, Stacy A.; Wilson, Anne M. **Microwave Synthesis of Benchmark Organo-Iron Complexes.** Organometallics (2009), 28(23), 6841-6844. CODEN: ORGND7 ISSN:0276-7333. CAN 152:12447 AN 2009:1371896 CAPLUS

Phelps, Alicia; Esteb, John J. **Synthesis of heterocyclic amines from 1,4-hydroxypyridine.** Abstracts of Papers, 238th ACS National Meeting, Washington, DC, United States, August 16-20, 2009 (2009), CHED-290. CODEN: 69LVCL AN 2009:981389 CAPLUS

Ding, Wendu; Esteb, John J. **Developing methodology for synthesis of substituted cyclohex-2-en-1-ols.** Abstracts of Papers, 238th ACS National Meeting, Washington, DC, United States, August 16-20, 2009 (2009), CHED-257. CODEN: 69LVCL AN 2009:981352 CAPLUS

Shinholt, Deven L.; Wilson, Anne M. **The use of liquid carbon dioxide to extract flavor compounds from common food sources; a qualitative analysis.** Journal of Undergraduate Chemistry Research (2009), 8(2), 63-66. CODEN: JUCRBV ISSN:1541-6003. CAN 152:310290 AN 2009:800048 CAPLUS

Esteb, John J.; Magers, John R.; McNulty, LuAnne; Morgan, Paul; Tindell, Kathryn; Wilson, Anne M. **A flexible solvolysis experiment for the undergraduate organic laboratory.** Journal of Chemical Education (2009), 86(7), 853-855. CODEN: JCEDA8 ISSN:0021-9584. CAN 151:508116 AN 2009:729803 CAPLUS

Esteb, John J.; Magers, John R.; McNulty, LuAnne; Morgan, Paul; Wilson, Anne M. **A simple SN2 reaction for the undergraduate organic laboratory.** Journal of Chemical Education (2009), 86(7), 850-852. CODEN: JCEDA8 ISSN:0021-9584. CAN 151:508115 AN 2009:729801 CAPLUS

Appendix 3.2Scores on Laboratory quiz

Course and semester	Score on form 1 (out of 18)	Sore on form 2 (out of 28)
CH351 F09	7.6	NA
CH352 S09	NA	13.3
CH352 S10	9.9	13.9
CH432 S09	NA	15.4
CH432 S10	NA	13.9

Appendix 4.2 Student Opinion Survey
(for incoming students n = 40, for graduating students n = 14)
1=Not confident/very unlikely
2=A little confident/unlikely
3=Somewhat confident/maybe
4=Highly confident/likely
5=Extremely confident/ highly likely

	first year average	graduate avearge
Discuss scientific concepts with my friends or family	2.73	4.21
Think critically about scientific findings I read about in the media	2.85	4.29
Determine what is -- and is not -- valid scientific evidence in the media	2.65	4.00
Make an argument using scientific evidence to friends or family	2.75	4.36
Determine the difference between science and “pseudo-science” in the media	1.93	4.36
Interpret tables and graphs	3.58	4.36
Understand mathematical and statistical formulas found in scientific texts	3.40	3.64
Find scientific journal articles using library/internet databases	2.63	4.14
Extract main points from a scientific article and develop a coherent summary	2.63	4.00
Give a presentation about a science topic to others	2.48	4.00
Obtain scientific data in a laboratory or field setting	2.95	4.07
Understand how scientific research is carried out	2.75	4.33
Pose questions that can be addressed by collecting and evaluating scientific evidence	2.73	3.93
Organize a systematic search for relevant data to answer a question	2.45	3.79
Write reports using scientific data as evidence	2.80	4.14
Work with others collaboratively on a scientific project	3.45	4.07
Apply scientific information to social concerns	2.68	4.21
Understand scientific processes behind important scientific issues in the media	2.55	4.29