ASSESSMENT PLAN
CHEMISTRY / BIOCHEMISTRY

Background: Chemistry and Biochemistry serve only a few majors (two majors in 2013, one in 2014), and has two major constituencies: (1) Biology majors who are required to take four semesters of chemistry with laboratory (the core two-year sequence: CHEM111, 112, 221, 222, 223, and 224), and (2) students in the Health Professions (Nursing, OTA, Exercise Science) who are required to take CHEM113. Two potential constituencies are: (3) non-science majors fulfilling General Education requirements, and (4) Forensic Science majors. However, enrollments for CHEM101 had been low, and the course has not run since Spring 2013. Similarly, the Forensic Science major is only growing as of last year. As a result, courses above the 200-level and required for the major do not run regularly (CHEM341 Physical Chemistry and CHEM350/351: Forensic Instrumental Analysis). Since Biochemistry can count towards the Biology major, we anticipate continuing to offer CHEM431: Biochemistry I and CHEM342: Biochemistry II on a regular basis.

Chemistry relies heavily on adjunct instruction. Staffing CHEM111, 112, 223, 224, and 113 rely on one full-time chemist and at least two adjuncts per semester. Since 2012, the strategy for adjunct hiring has been to attract highly motivated and successful chemists with interest in gaining teaching experience. Because teaching at Trinity serves as a stepping-stone to careers in teaching for these chemists, turnover in adjuncts is high.

Mission statement (from the Catalog, modified): The Chemistry/Biochemistry Program gives students a solid foundation in analytical, organic, and physical chemistry, and emphasizes the central roles that chemistry plays in biology, forensics, and the global environment. The biochemistry major provides additional insight into the relationship of chemistry to living organisms. Throughout the programs in chemistry and biochemistry, students acquire the knowledge and skills necessary to be successful in fields in which women are still underrepresented, and they gain the opportunity to explore options such as graduate school, medical school, or employment in the industrial and non-profit sectors.

Goals and objectives: Chemistry and Biochemistry seek to establish basic knowledge, skills, and values in the two-year sequence (CHEM111, 112, 221, 222, 223, and 224). CHEM113 is taken in isolation, however, so objectives for this course are limited in scope. In courses beyond the 200-level, faculty work closely with majors in upper-level courses to reach competencies at the highest level of Bloom's Taxonomy of Cognitive Operations, "creating," through independent projects.

Knowledge: Goals 1 and 8. Fundamental *knowledge* essential for Chemistry majors are basics in "stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria, and kinetics."[1] Our programs teach these concepts in CHEM111-112, and aim to reinforce them in subsequent foundation and in-depth courses that illustrate applications in analytical chemistry (including forensic instrumental analysis), organic chemistry, physical chemistry, and biochemistry, combined with further concepts and depth appropriate to each sub-field. The overall course sequence introduces (but does not give in-depth) knowledge that all Chemistry and Biochemistry majors should have in her toolkit: standard laboratory techniques and practices, fluency in computer technology and software, and familiarity with modern chemical/biochemical instrumentation.

[1] Undergraduate Professional Education in Chemistry: ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs (2008), Section 5.2.

Skills and values: Goals 2-7. Thinking like a Chemist/Biochemist requires not only knowledge in fundamental concepts and in the subfields of chemistry, but also *skills and values*. The six[2] listed in the ACS Guidelines for Undergraduate Programs are ones that we aim to develop in the core two-year sequence:

- Problem-solving. Ability to unpack complex problems, identify appropriate concepts and tools, create strategies that combine multiple tools, develop hypotheses and ways to test them, and analyze data.
- Scientific literacy. Understanding scientific articles, abilities to evaluate articles and find appropriate resources in the chemical literature. Familiarity with scientific literature, enthusiasm for current developments in the field, awareness of chemistry/biochemistry opportunities and trends in the current workforce.
- Communication. Presenting scientific evidence, articulating logical arguments and meaningful conclusions. Professional writing, visuals, and oral presentation.
- Laboratory safety. Prioritizing human health and well being, treating chemicals and instrumentation with respect. Knowledge of laboratory safety rules, MSDS, and how to respond to emergencies; safety awareness and potential hazard identification.
- Ethics. Aiming for thorough understanding, maintaining the Honor Code, reporting scientific data truthfully, and presenting ideas honestly.
- Team work. Working with diverse groups of individuals in collaborative problem solving.

Increasing the number of students in core Chemistry courses. We aim to build individual student knowledge, skills, and values, but also the number of students who achieve our departmental goals. Enrollments and grades show a quarter of the students in CHEM111 leaving the course with a grade of C- or lower (Figure 1). Over the past five years, 30% who take CHEM111 did not continue with CHEM112. To increase the number of students majoring in Chemistry/Biochemistry and continuing towards the career trajectories as outlined in our mission statement, efforts will also focus on (1) using assessment to *increase retention* in gateway Chemistry courses, and (2) helping majors use their knowledge, skills, and values to enter and succeed in *research/pre-professional internships* or experiences.

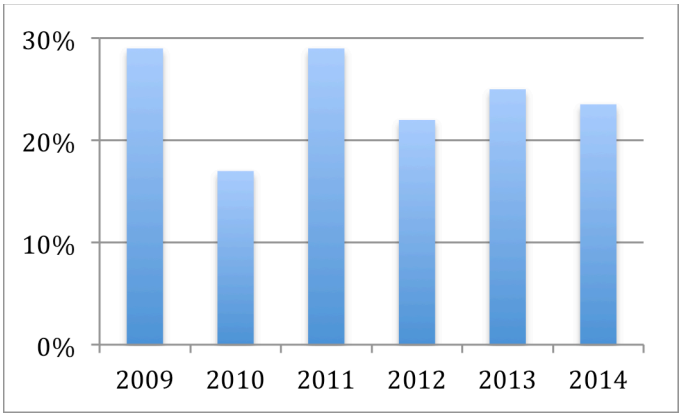

Figure 1. CHEM111 students receiving a grade of C- or below, as percentage of class. Average class size was 15 students, ranging from 6 in Fall 2010 to 21 in 2011.

Course map: The course map on the following pages aligns departmental goals with courses in the sequence for the Chemistry and Biochemistry majors.

[2] *Ibid*, Section 7.y

COURSE MAP (IN-PROGRESS) **CHEMISTRY / BIOCHEMISTRY**

DEPARTMENTAL GOAL	CHEM 111	CHEM 112	CHEM 221/222	CHEM 341	CHEM 431	NCSM 499
1a. Mastery in fundamental concepts in Chemistry: stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria, and kinetics.	Understand stoichiometry, describe basic atomic and molecular structure.	Understand thermodynamics, equilibrium and kinetics.	Describe molecular structure at a higher level.	Understand thermodynamics, equilibrium, and kinetics more deeply.		
1b. Deeper understanding of fundamentals through **application in key subfields**: analytical chemistry (including forensic instrumental analysis), organic chemistry, physical chemistry, and biochemistry.			Apply principles of molecular structure, thermodynamics, and kinetics to solving problems.	Apply stoichiometry and principles of molecular structure.	Apply stoichiometry and principles of molecular structure, thermodynamics, and kinetics.	Apply stoichiometry and principles of molecular structure, thermodynamics, and kinetics.
2. Problem solving skills: unpack complex problems, identify appropriate concepts and tools, create and justify strategies that combine multiple tools, develop hypotheses and ways to test them, and analyze data.	Solve stoichiometry and unit-conversion problems. Apply rules to predict simple molecular structure. Solve laboratory independent group projects.	Solve quantitative problems in thermodynamics, equilibrium, kinetics.	Solve problems in structure. Synthesize data to identify unknowns.	Solve quantitative problems in thermodynamics, equilibrium, kinetics.	Solve problems in biochemistry that address molecular structure, thermodynamics, equilibrium, kinetics.	Research proposal: Identify a scientific problem that needs solving, propose and design experiments to solve.
3. Scientific literacy: understand scientific writing and communication, evaluate articles, locate appropriate resources in the chemical literature.	Read assigned articles. Locate articles on assigned topics.	Read assigned articles. Locate articles on assigned topics.	Read and present articles from the literature.	Read, digest, and present articles from the literature. Locate related articles and use them to inform student understanding.	Read, digest, and present articles from the literature. Locate related articles and use them to inform student understanding.	Review literature.
4. Communication skills: present scientific evidence, articulate logical arguments and meaningful conclusions.	Prepare homework and write-ups for laboratory. Prepare and deliver oral presentation in group.	Prepare homework and write-ups for laboratory. Write rudimentary portions of laboratory report. Prepare and	Prepare homework and write-ups for laboratory. Write full laboratory report. Keep laboratory notebook.	Prepare homework and take-home exams. Prepare and deliver oral presentation in group.	Prepare homework and take-home exams. Keep laboratory notebook. Write full laboratory report. Prepare	Write and present individual research proposal.

		deliver oral presentation in group.	Prepare and deliver short oral presentations.		and deliver short oral presentations.	
5. Good habits in **ethics** and scientific honesty: aim for thorough understanding, maintain the Honor Code, report scientific data truthfully, and present ideas honestly.	Sign Honor Code on every exam.	Sign Honor Code on every exam.	Sign Honor Code on every exam.	Sign Honor Code on every exam.	Sign Honor Code on every exam.	
6. Laboratory safety: prioritize human health and well being, treat chemicals and instrumentation with respect.	Address safety issues relevant to each upcoming laboratory experiment.	Address safety issues relevant to each upcoming laboratory experiment.	Address, look-up, and/or review safety issues relevant to each upcoming laboratory experiment.		Address, look-up, and/or review safety issues relevant to each upcoming laboratory experiment.	
7. Team work: Work with diverse groups of individuals in collaborative problem solving.	Work in groups for laboratory exercises and in-class work.	Work in groups for laboratory exercises and in-class work.	Work in groups for laboratory exercises and in-class work.	Work in groups for literature project.	Work in groups for laboratory exercises and in-class work.	
8. Chemistry/biochemistry tool-kit: standard laboratory techniques, fluency in computer technology, and familiarity with modern instrumentation.		Choose appropriate glassware. Prepare volumetric solutions. Conduct titration. Generate and plot graphs.	Draw chemical structures using computer software. Conduct syntheses and purification. Interpret spectra.	Learn about modern instrumentation from literature project. Generate and plot graphs.	Use modern instrumentation for biochemistry.	Identify techniques appropriate for answering research proposal question.

Learning outcomes chosen for assessment: Three areas of focus are (1) knowledge retention in stoichiometry and thermodynamics, (2) problem solving, and (3) safety.

Proposed assessment tools and plans: Because the majority of students in Chemistry are in the core two-year sequence and because we are interested in retention in entry-level courses, assessment focuses on the core two-year sequence and Biochemistry.

Departmental survey. In 2013-14, all classes took a survey (Appendix, A-1) at the same time as the final exam. To assess *knowledge*, the survey featured multiple-choice questions on stoichiometry and thermodynamics, and a short-answer question on safety. For *skills*, the survey asked for student perceptions of (1) how successfully Chemistry courses have prepared them in the six skill areas, and (2) how valuable each skill is for their future success. In 2014-15, we modified the survey to include student perception of their mastery in fundamental knowledge (Appendix, A-3).

Knowledge assessment over the core two-year sequence. Students will receive credit for taking an online test at the beginning of the semester, and for taking it again at the end. The pre-test will paint picture of incoming students' knowledge, understanding, and problem-solving abilities in stoichiometry, atomic and molecular structure, thermodynamics, equilibrium, and kinetics. One use will be correlating results of the pre-test to retention and student success in CHEM11.

The platform for this online test will be the same as for their homework. For the first time, the core two-year sequence and 113 will use the online platform by Sapling Learning to administer online questions that give students instant feedback on incorrect answers and opportunities for trying again. Not only will the platform allow for pre- and post-testing, but we will use it for daily homework. Homework scores on Sapling prior to class will give quick feedback to instructors as well, without any delay from grading. Instructors should be able to identify common deficiencies or misunderstandings more easily, and adjust their teaching accordingly.

To supplement data from online pre- and post-tests, the Department will also collect data on exam performance, for questions pertaining to stoichiometry and thermodynamics. In the core two-year sequence, the Department will include questions that test these two key concepts at the first three level's of Bloom's Taxonomy: remembering, understanding, and applying (see Appendix A-5 for examples).

Rubrics for skills and values assessment. We will develop specific assignments and rubrics to assess student skills in two areas, starting in 2014-15.

- Problem solving. We will adapt a rubric to assess problem-solving abilities from the Chemical Education literature[3] for use in written answers (Appendix, A-6). Instructors will apply the rubric to at least one problem on every exam.
- Safety. At least once a semester, the Chemical Hygiene Officer will record laboratory observations to check instructor and student adherence to laboratory safety measures (Appendix, A-8). Instructors will also keep a record of student answers on safety-related questions on pre-lab quizzes, and in Organic Chemistry (CHEM223/224) check for safety-related preparation with MSDS information for reagents used.

Initial assessment results: This initial assessment is only for a subset of Goal 1, Mastery in Fundamental Concepts: Stoichiometry.

[3] S.E. Shadle, E.C. Brown, M.H. Towns, and D.L. Warner, "A Rubric for Assessing Students' Experimental Problem-Solving Ability." *J. Chem. Ed.,* 89 2012: 319

Departmental survey. The 2013-14 survey results (Table 1) indicate poor understanding of stoichiometry after taking CHEM113 and a lack of retention in students going from CHEM111 to CHEM112. The majority of students in CHEM113 (79% of survey respondents) incorrectly identified the stoichiometry statement in the survey as true. In the survey, CHEM111 had better success in stoichiometry knowledge, with only 25% of survey respondents identifying it incorrectly as true. What was alarming, however, was an apparent decrease in knowledge retention. The CHEM112 population surveyed were the same students as those given the survey previously in CHEM111, yet a smaller number (6 versus 8) and lower percentage of students (50% versus 67% of respondents) correctly identified the stoichiometry statement as false. Data are not yet available the second half of 2014-15, yet the initial data (Table 2) are somewhat encouraging, with a strong increase in the number of correct responses for CHEM113.

Table 1. Departmental survey results on stoichiometry question in 2013-14.

	CHEM113	CHEM111	CHEM112	CHEM221	CHEM223	CHEM431
Enrollment	16	16	13	11	11	6
Reponses	14	12	12	5	11	6
Correct responses	3	9	6	3	7	2
Correct responses (%)	21%	75%	50%	60%	64%	33%

Table 2. Departmental survey results on stoichiometry question in 2014-15.

	CHEM 113	CHEM 111	CHEM 112	CHEM 221	CHEM 222	CHEM 431	CHEM 341
Enrollment	15	17		14		5	8
Reponses	13	14		14		5	8
Correct responses	10	9		11		2	6
Correct responses (%)	77%	65%		79%		40%	75%

Embedded exam questions. Exam data for two classes provide isolated checks, for comparison to the departmental surveys. For CHEM113 in Fall 2013, as in the departmental survey, exams showed poor progress and retention on stoichiometry problems designed to test the distinction between mass versus mole ratios. The average score on this kind of problem remained steady at 50-60% on the first, second, and final exams. Only 4 out of 16 students showed improvement in performance on this kind of problem on the final; 8 out of 16 had lower performance on the final than on previous exams. For CHEM111 in Fall 2014, exams showed steadier improvement, suggesting better retention and understanding than the departmental survey indicates. The number of correct responses on a "remembering stoichiometry" problem increased from 4 on the first exam to 14 and 12 on the second and final exams respectively. Similarly, the average score on an "understanding stoichiometry" problem increased from 57% on the first exam to 81% on the final.

How the data inform curricular revision

1. Knowledge retention. Continuing to track student knowledge and retention will assess teaching methods through the two-year core sequence, specifically the use of Sapling Learning online homework daily to help students prepare for class, similar to a flipped classroom.

2. Problem solving. The problem solving rubric has already changed how faculty teach in first-year Chemistry. In class, students have become accustomed to faculty going through the steps of collecting useful information, building strategy, and executing the problem. The rubric emphasizes the importance of demonstrating the process of problem solving and how to tackle a problem. Chemistry plans to continue developing the rubric, in conjunction with the Mathematics Department, so that students at Trinity develop habits in problem solving. A fourth area to be added to the rubric is assessing the answer and determining whether or not the answer makes sense.

3. Safety. The requirement for a safety check every semester will keep safety in the forefront for faculty.

APPENDIX

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CHEMISTRY DEPARTMENT SURVEY

Fall 2013 / Spring 2014

The Chemistry Department would appreciate your honest feedback and answers to these questions. Your answers will be analyzed anonymously. Full credit towards the course grade will be given to students who complete both sides of the survey, and return it to their instructor.

	1	2	3	4	5
Chemistry courses develop my **problem-solving skills**. After taking Chemistry, I am better able to solve complex problems.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses develop my **scientific literacy**. After taking Chemistry, I am able to understand scientific articles better.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses teach **laboratory safety**. After taking Chemistry, I am more aware of laboratory hazards and know how to act safely in the lab.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses develop **communication skills**. After taking Chemistry, I am better able to present scientific information in a meaningful and appropriate way.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses develop **team skills**. During my Chemistry course, I gained useful experience in working with groups.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses emphasize **ethics and scientific honesty**. After taking Chemistry, I pay more attention to Trinity's Honor Code on exams and when reporting data the laboratory.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Problem-solving skills that I develop at Trinity will be useful for my eventual career and professional success.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Scientific literacy and the ability to find appropriate references / journal articles will be useful for my eventual career and professional success.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
I am a strong believer in **laboratory safety**. I know what kinds of accidents can happen in a scientific laboratory, and I prioritize safe and proper handling of chemicals.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Communication skills are important for anyone pursuing a future in Chemistry or any science.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Team skills are important for anyone pursuing a future in Chemistry or any science.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Ethics and scientific honesty are important for anyone pursuing a future in Chemistry or any science.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree

Circle all that apply. The Chemistry course(s) I took at Trinity this semester was/were:

CHEM101 *CHEM111* *CHEM113* *CHEM221* *CHEM222*

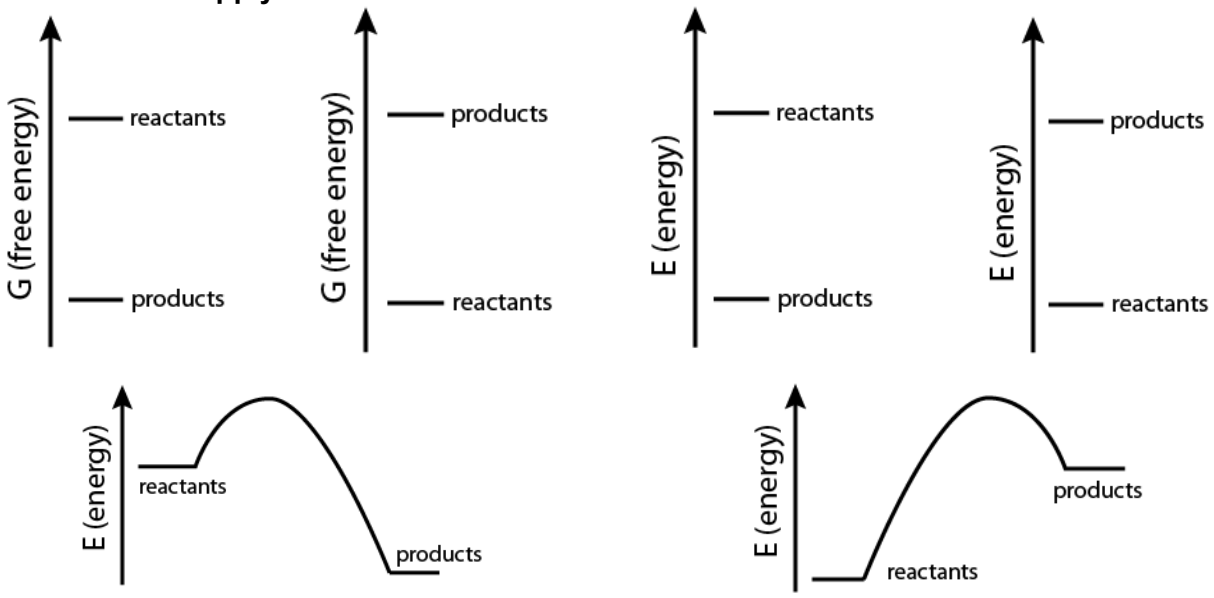
The balanced chemical equation for the oxidation of hydrogen gas is

$$2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$$

This means that two grams of hydrogen gas are needed to react with one gram of oxygen. Is this statement true or false? **Circle ONE answer from the choices given.**

True *False* *I can't determine this without a periodic table.* *We did not learn how to do this kind of problem in my Chemistry course(s).*

Which of the following represent a case where the **products are more stable** than the reactants? **Circle ALL that apply:**



Complete the following three statements.

The most important thing I learned in this semester's Chemistry course was:
Chemistry is important for:
Three rules of safety in a Chemistry laboratory are:

CHEMISTRY/BIOCHEMISTRY DEPARTMENT SURVEY

Fall 2014 / Spring 2015

Your answers will be analyzed anonymously. Full credit towards the course grade will be given to students who **complete both sides of the survey**, leave no problems blank, and return it to their instructor.

	1	2	3	4	5
Chemistry courses develop my **problem-solving skills**. After taking Chemistry, I am better able to solve complex problems.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses develop my **scientific literacy**. After taking Chemistry, I am able to understand scientific articles better.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses teach **laboratory safety**. After taking Chemistry, I am more aware of laboratory hazards and know how to act safely in the lab.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses develop **communication skills**. After taking Chemistry, I am better able to present scientific information in a meaningful and appropriate way.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses develop **team skills**. During my Chemistry course, I gained useful experience in working with groups.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Chemistry courses emphasize **ethics and scientific honesty**. After taking Chemistry, I pay more attention to Trinity's Honor Code on exams and when reporting data the laboratory.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Problem-solving skills that I develop at Trinity will be useful for my eventual career and professional success.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Scientific literacy and the ability to find appropriate references / journal articles will be useful for my eventual career and professional success.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
I am a strong believer in **laboratory safety**. I know what kinds of accidents can happen in a scientific laboratory, and I prioritize safe and proper handling of chemicals.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Communication skills are important for anyone pursuing a future in Chemistry or any science.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Team skills are important for anyone pursuing a future in Chemistry or any science.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree
Ethics and scientific honesty are important for anyone pursuing a future in Chemistry or any science.	Disagree strongly	Mostly disagree	Neither agree nor disagree	Mostly agree	Strongly agree

Given a periodic table, I can write **electron configurations** for atoms and atomic ions.	**1** Disagree strongly	**2** Mostly disagree	**3** Neither (neutral)	**4** Mostly agree	**5** Strongly agree
I can draw **Lewis structures** for simple molecules and ions.	**1** Disagree strongly	**2** Mostly disagree	**3** Neither (neutral)	**4** Mostly agree	**5** Strongly agree
I can do **stoichiometry** problems.	**1** Disagree strongly	**2** Mostly disagree	**3** Neither (neutral)	**4** Mostly agree	**5** Strongly agree
I can use an energy-level diagram to predict the **thermodynamics** of a reaction.	**1** Disagree strongly	**2** Mostly disagree	**3** Neither (neutral)	**4** Mostly agree	**5** Strongly agree

The balanced chemical equation for the oxidation of hydrogen gas

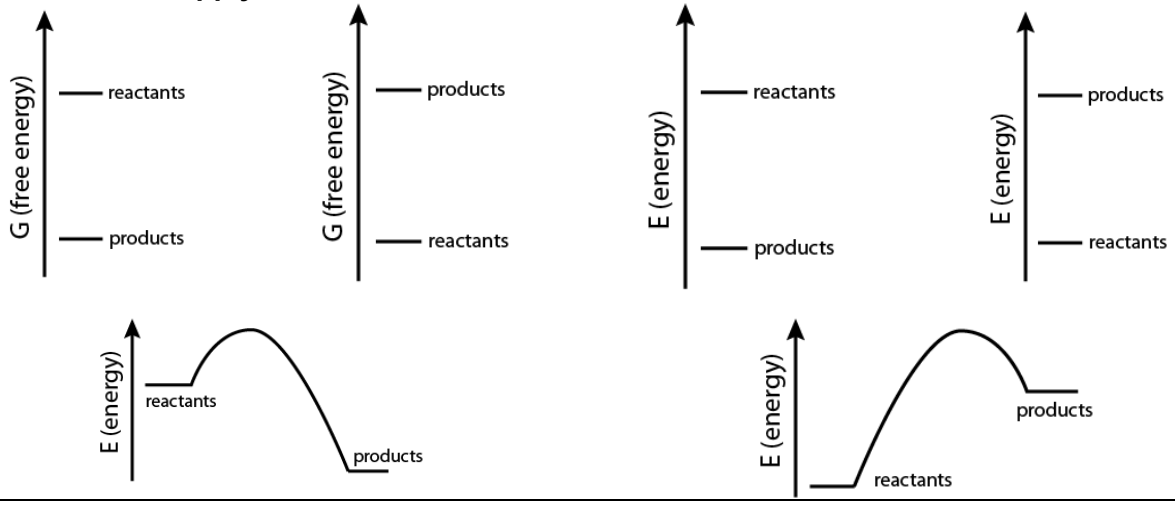
$$2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$$

tells us that two grams of hydrogen gas are needed to react with one gram of oxygen.

Is this statement true or false? **Circle ONE answer from the choices given.**

True *False* *I can't determine this without a periodic table.* *We did not learn how to do this kind of problem in my Chemistry course(s).*

Which of the following represent a case where the **products are more stable** than the reactants? **Circle ALL that apply:**



Complete the following three statements.

The most important thing I learned in this semester's Chemistry course was:
Chemistry is important for:
Three rules of safety in a Chemistry laboratory are:

EXAMPLE EMBEDDED EXAM QUESTIONS

The Department will include similar questions on exams throughout the core two-year Chemistry sequence, adapted for the particular topic.

Stoichiometry questions

Bloom's Taxonomy level: Remembering

Consider the following balanced chemical equation.

$$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$$

For each statement, indicate whether it is true or false.

a) For every mole of propane (C_3H_8) that reacts, three moles of carbon dioxide (CO_2) are formed.

b) For every gram of propane (C_3H_8) that reacts, three grams of carbon dioxide (CO_2) are formed.

Bloom's Taxonomy level: Understanding

Using a periodic table, determine how many grams of CO_2 can form from the reaction of 88 grams of propane. The molar mass of C_3H_8 is 44 g/mol. Show your reasoning.

Bloom's Taxonomy level: Applying

Propanol (C_3H_8O) also reacts with oxygen gas in the reaction

$$C_3H_8O(g) + 9/2\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$$

Which would generate more carbon dioxide, 88 grams of propanol or 88 grams of propane? Show your reasoning.

Thermodynamics questions

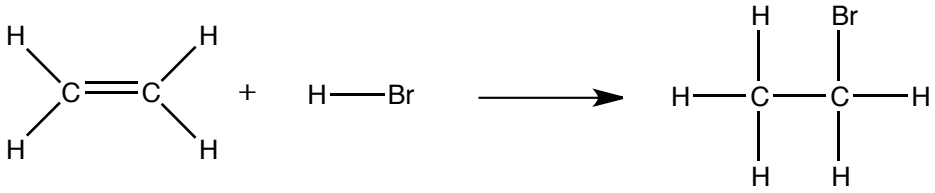
Bloom's Taxonomy level: Remembering

Complete the sentence by circling one choice in each underlined selection: A spontaneous reaction is one that has a natural tendency to favor the formation of products. Spontaneous reactions are indicated by ΔG° > / < / = 0 and K > / < / = 1.

Bloom's Taxonomy level: Understanding

Use tabulated bond enthalpies to estimate the enthalpy of reaction (ΔH°) for

$$C_2H_4(g) + HBr(g) \rightarrow CH_3CH_2Br(g)$$



Bloom's Taxonomy level: Applying

Is the reaction above ever spontaneous? If so, under what conditions? Give a complete justification for your answer that assesses the two key factors that contribute to spontaneity.

PROBLEM SOLVING ASSESSMENT

Adaptation of rubric in Figure A1 for use in grading complex problems on one selected problem on each exam.

Criterion 1. Identifies the important or relevant features of the problem. Assess student's ability to collect useful facts and relevant relationships.				
1	2	3	4	5
Does not attempt to identify important aspects of the problem.	Begins to identify a few important features. May appear to be guessing or include irrelevant considerations.	Identifies some of the important features of the problem. May include an equal number of irrelevant considerations or lack rationale.	Identifies most of the important features of the problem, but lacking a thorough consideration of all essentials.	Clearly demonstrates an understanding of the problem, addresses all important aspects necessary for solving the problem.
Criterion 2. Formulates a strategy. Assess student's ability to develop a logical strategy and to justify reasoning.				
1	2	3	4	5
Does not attempt to formulate a strategy.	Begins to develop a strategy but without justification.	Develops a strategy that goes mostly through completion and includes justification.	Develops a strategy that goes through to completion. Lacks complete justification.	Strategy goes through to completion. Justification complete and includes caveats.
Criterion 3. Executes strategy successfully. Assess student's ability to use the strategy to produce a plausible solution.				
1	2	3	4	5
Barely begins to execute strategy.	Begins to execute strategy but leaves answer incomplete.	Strategy executed according to plan or mostly so. Conclusion may not make sense or may not be physically plausible.	Strategy executed thoroughly but result not completely correct. If result is physically not plausible, student recognizes the shortcoming.	Strategy executed successfully with plausible and convincing result.

Rubric for grading homework problems

Grading on homework problems will be based on a combination of correctness, clarity, insight, and effort on the following scale.

5 Problem entirely correct. Evidence for serious and thoughtful effort to solve it. Clear and complete reasoning, including annotation where it helps clarify. Logical steps. May include insight and interpretation of answer.

4 Problem not quite correct. Evidence for a serious and thoughtful effort at solving it. Includes reasoning, annotation, and/or some insight.

3 All parts of problem attempted in full. May show misconceptions or lack evidence of logical thinking.

2 Rudimentary outline of information with only a cursory attempt at finding an approach.

1 Answer contains minimal information, indicating no real attempt.

Criterion 1. Identifies the important or relevant features of the problem. For each practicum question, students will be provided a problem. This dimension is related to student identification of the important issues that must be considered in order to solve the presented problem.			
Emerging		*Developing*	*Mastering*
1	2	3	4
Does not attempt to or fails to identify the important aspects of the problem… clueless.	Identifies a small percentage of the important features of the problem to be solved.	Identifies some of the important features of the problem.	Clearly demonstrates an understanding of the problem, addressing important aspects of the problem that must be considered.
Criterion 2. In formulating a strategy for the solution of the problem, student presents a complete justification or explanation for the strategy. This dimension focuses on the ability of the student to back up the choice of strategies with appropriate reasoning and factual, procedural, or conceptual knowledge. This dimension also deals with the completeness of one's strategy.			
Emerging		*Developing*	*Mastering*
1	2	3	4
Strategy is incomplete and/or lacks justification.	Justification is provided for most or all components of the strategy, but the reasoning is limited to the most basic information.	Provides a complete explanation with reasons for choosing the components of the strategy.	Includes all reasons for choosing the components of the strategy, and also includes caveats and reasons not to choose alternative strategies.
Criterion 3. Provides an effective strategy that is likely to work to solve the chemical problem. This dimension focuses on the correctness of the strategy a student chooses to address the problem: would it work? This strategy also deals with student identification of reasons it may not work.			
Emerging		*Developing*	*Mastering*
1	2	3	4
The data to be collected will provide limited information for solving the stated problem.	The data to be collected are likely to provide insight into the stated problem, but the results will be less than definitive. Student appears to have made some unstated assumptions.	Data to be collected are likely to yield definitive results, leading to an unambiguous answer to the stated question.	Data to be collected are likely to yield definitive results, leading to an unambiguous answer to the stated question. In addition, answer includes information about why the strategy may not work. Answer may also indicate back-up strategies that could be employed.

Figure A1. Rubric developed by S.E. Shadle *et al*., taken from "A Rubric for Assessing Students' Experimental Problem-Solving Ability."

SAFETY AND LABORATORY RULES FOR CHEMISTRY LABORATORIES AT TRINITY WASHINGTON UNIVERSITY

1. APPROVED SAFETY GOGGLES MUST BE WORN AT ALL TIMES.
2. NO FOOD, DRINKS, OR SMOKING ARE ALLOWED.
3. SHOES AND APPROPRIATE CLOTHING MUST BE WORN. No bare feet, sandals, open-toed shoes, shorts, or short skirts are allowed.
4. LONG HAIR MUST BE TIED BACK.
5. WORK IS PERMITTED ONLY DURING SCHEDULED LABORATORY PERIODS. Work is not permitted in other laboratory periods unless space is available and written permission is obtained from your instructor.
6. NO OPEN FLAMES ARE ALLOWED except as directed by the instructor.
7. KNOW THE LOCATION OF FIRE EXTINGUISHERS, SAFETY EQUIPMENT, AND THE NEAREST EXIT.
8. NO UNAUTHORIZED EXPERIMENTS MAY BE PERFORMED.
9. DO NOT USE BROKEN OR CRACKED GLASSWARE. Check glassware before using it.
10. NEVER TASTE OR SMELL CHEMICALS.
11. AVOID CONTACT OF CHEMICALS WITH SKIN. The use of rubber gloves is recommended.
12. DISPOSE OF CHEMICAL WASTE AS DIRECTED BY INSTRUCTOR.
13. CLEAN YOUR WORK AREA AND PUT AWAY ALL EQUIPMENT AND GLASSWARE BEFORE LEAVING. Make sure equipment is put away in the correct locker – your personal locker or the common locker.
14. PUT PAPER TRASH AND BROKEN GLASS IN PROPER TRASH CONTAINERS.
15. KEEP INSTRUMENT ROOM CLEAN AND FREE OF PAPER.

Starting in Spring 2015, once a semester there will be a random safety check for each laboratory class using the following rubric:

CHEMISTRY/BIOCHEMISTRY DEPARTMENT SAFETY CHECK

Course: _____
Semester/year: _____
Date: _____

	YES	NO	Comments:
Instructor is wearing safety glasses or goggles.* .			
Students are wearing safety glasses or goggles.*			
Instructor is wearing appropriate attire. Long hair is tied back.			
Students are wearing appropriate attire. Long hair is tied back.			
There is no food or drink in the laboratory.			
Chemical waste is properly labeled.			
Laboratory hygiene: The lab is clean. All samples are properly labeled. The balance area and other bench areas are clean.			

*Splash goggles are required when handling concentrated acids and bases.

PROGRAM FACULTY AND COURSES TAUGHT

Full-time faculty
Dr. Anette Casiano-Negroni, Visiting Assistant Professor (Spring 2014)
Dr. Shizuka Hsieh, Associate Professor
Dr. Patrice Moss, Clare Boothe Luce Assistant Professor

Adjunct faculty
Dr. Anette Casiano-Negroni (Fall 2013)
Dr. Thomas Clark
Dr. George Parris
Ms. Courtney Thomas
Dr. Catherine Volle

CHEM teaching schedule for 2013-14, 2014-15

	101	111	112	113	221/223	222/224	341	431	432
2013-14	Parris Hsieh*	Casiano Casiano*	Casiano Casiano*	Hsieh Casiano*	Parris Parris*	Casiano Casiano*	NA	Moss	Moss
2014-15	NA	Hsieh Thomas*	Hsieh Thomas*	Volle Volle*	Clark Clark*	Clark Clark*	Hsieh	Moss Moss*	Moss

*Laboratory portion of the course.

Anette Casiano-Negroni, Ph.D.
136 Michigan Avenue NE, Ste. 44R
Washington, DC 20017
Phone: 734-717-9655, Email: acasianonegroni@gmail.com

Education

PhD, Chemistry/ Biochemistry **2010**
University of Michigan, Ann Arbor, MI
Thesis title: NMR studies of RNA Conformational Dynamics Induced by Metal Cations and Paromomycin.

M.Sc. Chemistry **2007**
University of Michigan, Ann Arbor, MI

B.Sc., *Magna Cum Laude*, Chemistry **2004**
University of Puerto Rico, Rio Piedras Campus

Teaching Experience

Adjunct Faculty, Stratford University, Baltimore Campus, MD **2013-present**

- Currently teach general science classes (SCI110) for undergraduate students. This class is a compendium of physics, chemistry and biology.
- Set up and organize Moodle shells for all my class sections. The Moodle shell is design for students to have access to class materials including the lecture presentations, Homework assignments, participate in weekly Online Forums, and follow their grade book, among others.
- Prepare lesson plans, lecture presentations, quizzes, exams, and homework. Grade all assignments and hold general science tutoring hours.

Graduate Student Instructor, University of Michigan, Ann Arbor MI **2006-2010**

- Taught undergraduate physical chemistry discussion class (Chem 230) and undergraduate general chemistry laboratory (Chem 125/126).
  Held office hours, discussion and laboratory sessions. Graded reports and exams. Prepared the lesson plan and quizzes for the Chem 230 discussion sections.
- Trained undergraduate and graduate students in Hashim Al-Hashimi Laboratory.
  Taught students basic laboratory techniques, synthesis of ribonucleic acid (RNA) samples, how to carry out Nuclear Magnetic Resonance (NMR) experiments and analysis of NMR data.

Research Experience

Research Scientist, Nymirum Inc, Ann Arbor MI **2011-2012**

- Developed and carried out different biochemical/biophysical experiments to study small molecule binding to RNA.
  Biochemistry/Biophysical experiments: Fluorescence Polarization experiments of small molecule binding to RNA target, Luminescence experiments using Luciferase assay, Gel electrophoresis and quantitative analysis of gel bands, enzyme reactions, Isothermal Calorimetry (ITC) experiments and determination of melting temperature of RNA using Ultra Violet melting and Real Time Polymerase Chain Reaction (RT-qPCR) experiments.

Ribonucleic acid sample preparation: determination of the RNA sequence to be studied, DNA annealing, RNA in vitro transcription and purification of the sample.

Nuclear Magnetic Resonance: Use of Varian 600MHz NMR spectrometer. Performed NMR experiments of RNA and analysis of NMR data using Sparky, NMR Draw, NMRView software.

- Managed and monitored the daily laboratory activities which included ordering laboratory materials, overseeing lab equipment. Wrote laboratory procedures and trained two laboratory technicians.
- Performed literature search to design new biochemical/biophysical experiments, to help in the analysis of data, to learn about new drug targets, and to stay current with literature.

Post-doctoral Research Scientist, Nymirum Inc, Ann Arbor MI **2010-2011**

- Developed and carried out different biochemical/biophysical experiments to study small molecule binding to RNA.

  Ribonucleic acid sample preparation: determination of the RNA sequence to be studied, DNA annealing, RNA in vitro transcription and purification of the sample.

  Nuclear Magnetic Resonance: Use of Varian 600MHz NMR spectrometer. Performed NMR experiments of RNA and analysis of NMR data using Sparky, NMR Draw, NMRView software.

Graduate Research Assistant, University of Michigan, Ann Arbor MI **2004-2010**

Prof. Hashim M. Al-Hashimi's Laboratory

- Studied the conformational dynamics of bacterial A-site rRNA and its aminoglycoside resistance using nuclear magnetic resonance.
- Studied the global structure and dynamics of HIV-1 TAR RNA at different Na^+ and Mg^{2+} ions concentrations using a combination of NMR Residual Dipolar couplings, metal chemical shift mapping and electrostatic calculations.
- Performed the following experiments to conduct both research projects:
  Ribonucleic acid sample preparation: determination of the RNA sequence to be studied, DNA annealing, RNA in vitro transcription and purification of the sample.

  Gel electrophoresis and quantitative analysis of gel bands. Experiment to study metal ions and small molecule binding to RNA molecules.

  Nuclear Magnetic Resonance: Use of Bruker 600MHz NMR spectrometer. Performed NMR experiments of RNA relaxation, assignments, ^{13}C dispersion and residual dipolar coupling. Performed RNA binding experiments using NMR. Carried out analysis of NMR data using Sparky, NMR Draw, NMRView software.

Undergraduate Research Scholar, University of Puerto Rico, Rio Piedras, PR **2002-2004**

Prof. José A. Lasalde's Laboratory

- As a Laboratory researcher assistant, my duties included: preparing solutions, running gels, transforming PCR products and linearizing DNA samples.
- Conducted research on beta-M4 domain of the Torpedo California acetylcholine receptor, to elucidate the secondary structure-function of this lipid expose domain.

Summer Research Scholar SROP, University of Michigan, Ann Arbor MI **2002/2003**

Prof. Carol Fierke's Laboratory

- As a Laboratory researcher assistant, my duties included: preparing solutions, running gels, transforming PCR products, protein expression/purification, and performing enzyme reactions.

- In collaboration with John Heish and Jeremy Day, the RNase P enzyme from bovine mitochondria was purified using a DEAE-Sepharose column and showed that this enzyme specifically cleaves mitochondrial pre-tRNA substrates.
- In collaboration with Andrea Stoddard, we mutated the amino acid (Threonine 199) that forms a hydrogen bond with the metal site of the carbonic anhydrase II, and observed the effects of these mutations on the selectivity and specificity for metal ions.

Publications

1. Dethoff E.A.; Petzold, K.; Chigh, J.; **Casiano-Negroni, A.**; Al-Hashimi, H.M. Visualizing transient low-populated structures of RNA. Nature, 2012, vol. 491, pp: 724-728.
2. Koutmou, K.S.; **Casiano-Negroni, A.**; Getz, M. M.; Pazicni, S.; Andrews, A. J.; Penner-Hahn, J. E.; Al-Hashimi, H. M.; and Fierke, C. A. NMR and XAS reveal an inner-sphere metal binding site in the P4 helix of the metallo-ribozyme ribonuclease P. Proceedings of the National Academies of Sciences USA, 2010, vol. 107, pp: 2479-2484
3. Hansen, L.A.; Nikolove, N.E.; **Casiano-Negroni, A.**; Al-Hashimi, M.H. Characterizing μs-ms Exchange in Labeled and Unlabeled Nucleic Acids by Carbon $R_{1\rho}$ NMR. Journal of the American Chemical Society. Journal of the American Chemical Society, 2009, vol. 131, pp: 3818-3819
4. Díaz-De Leon, R; Otero-Cruz, J.D; Torres-Nuñez, D.A; **Casiano, A.**; Lasalde-Dominicci, J.A. Tryptophan-scanning of the Acetylcholine Receptor's βM4 Transmembrane Domain. Channels, 2008, vol. 2, pp: 1-10.
5. **Casiano-Negroni, A.;** Sun, X; Al-Hashimi, H.M. Probing Na^+ induced changes in the HIV-1 TAR Conformational Dynamics using NMR Residual Dipolar Couplings: New Insights into the Role of Counterions Ions and Electrostatic Interactions in Adaptive Recognition. Biochemistry, 2007, vol. 46, pp: 6525-35
6. Getz, M.; Sun, X; **Casiano-Negroni, A.;** Zhang, Q.; Al-Hashimi, H.M. NMR Studies of RNA Dynamics and Structural Plasticity using NMR Residual Dipolar Couplings. Biopolymers, 2007, vol. 86, pp: 384-402

Computer Skills

- Expert in using Moodle learning software for general science classes.
- Proficient in Adobe Illustrator, Adobe Photoshop, Image J, Origin, MAC Software, Microsoft Office Software.
- Familiar with Linux, Insight II (Accelerys), Charmm (Molecular Dynamic simulation program), Pymol molecular modeling program, GRASP (computing electrostatic potential maps), Python program.

Awards

Alfred P. Sloan Foundation Fellow 2005-2010
University of Michigan, Rackham Science Award 2004-2009
National Science Foundation –Alliances of Graduate Education and Professoriate Travel Grants 2009
University of Michigan –Rackham Travel Grants 2007-2008
2nd Prize (Graduate Research Poster Presentation: Michigan RNA Meeting, Detroit, MI) 2006

Language Proficiency

Primary languages: English and Spanish

Thomas D. Clark, Ph.D.

447 College Parkway
Rockville, MD 20850

Phone: (571) 235-8301
Email: thomasclark.bioorganic@gmail.com

General

Profile: Organic and Physical Organic chemist with more than two decades experience teaching, conducting research, and communicating through publications and oral presentations for specialists and non-specialists.

Citizenship: USA

EDUCATION

Harvard University	**1998–2001**	**Postdoctoral Fellow** Advisor: Professor George M. Whitesides Research: microfabrication using self-assembly; mm-scale models of protein folding
The Scripps Research Institute	**1992–1998**	**Ph.D. in Chemistry** Advisor: Professor M. Reza Ghadiri Thesis Cyclic Peptide Nanotubes: Self-Assembly, Reactivity, and Functional Applications
Boston University	**1988–1992**	**B.A. in Chemistry; Minor in Biology** Advisor Professor James S. Panek Research: synthetic organic chemistry

KNOWLEDGE, SKILLS, AND ABILITIES

- Expert knowledge of Organic, Physical Organic, and Biological and Chemistry
- Strong knowledge of Physics and Mathematics
- Expertise in written and oral communication and explanation of technical concepts
- Eagerness and ability to quickly master new skills and concepts

TEACHING AND OTHER TECHNICAL EXPERIENCE

2006–2012 **National Research Council Postdoctoral Advisor**
- Mentored four NRC Postdoctoral Fellows.

2003-2011 **Undergraduate Research Mentor, Naval Research Laboratory**
- Mentored three undergraduate students during summer and winter breaks.

2000 **Teaching Fellow, Harvard University**
- Taught a weekly discussion section for Professor Whitesides' physical organic chemistry course.

2000 **Technical Consultant, World Book Publishing**
- Served as a technical consultant for the article "Machines by the Spoonful" in *Science Year 2001*.

1999 **Undergraduate Research Mentor, Harvard University**
- Mentored one undergraduate summer intern for 10 weeks.

1990-1992 **Teaching assistant, Boston University**
- Taught three general chemistry and one introductory biology lab courses.

1990-1991 **Technical Support Representative, du Pont NEN Research Products**
- Provided telephone technical support for biotechnology research products.

RESEARCH POSITIONS

2001–2014 **Research Chemist, Naval Research Laboratory**
- Led interdisciplinary research teams, including briefing and interviewing research team members and reporting technical results from researcher team members in written research highlights and articles, and in oral presentations for non-specialist program managers.
- Designed and synthesized peptide nanobiostructures for applications.
- Developed surface chemistry for sensing and self-assembly.

1998–2001 **Postdoctoral Fellow, Harvard University**

- Developed methods for fabrication of ordered 2- and 3-D arrays via self-assembly of μm-sized components.
- Designed mm-sized objects which fold to mimic the 3-D structures of natural proteins.

1992–1998 **Graduate Student, The Scripps Research Institute**

- Designed and characterized highly active transmembrane ion channels formed by cyclic β-peptides.
- Demonstrated olefin metathesis for covalently stabilizing noncovalent peptide nanotube assemblies.
- Synthesized and characterized a variety of cyclic peptides that self-assemble in solution to form hollow cylindrical structures.

1992 **Research Assistant, Cytomed, Inc., Cambridge, MA**

- Prepared intermediates for small molecule anti-inflammatory agents.

1991–1992 **Undergraduate Research, Boston University**

- Demonstrated Ireland-Claisen rearrangement of optically active (*Z*)-vinylsilanes.
- Demonstrated nucleophilic addition of optically active allylsilanes to activated imines.

HONORS AND AWARDS

1999–2001 **National Institutes of Health Postdoctoral Fellowship**, National Institutes of Health, USA.

1993–1996 **National Science Foundation Predoctoral Fellowship**, National Science Foundation, USA.

1992 **Bachelor of Arts, Cum Laude with Distinction in Chemistry**, Boston University, Boston MA.

1992 **ACS Undergraduate Research Award**, Boston University, Department of Chemistry.

1992 **American Institute of Chemists Undergraduate Research Award**, American Institute of Chemists Foundation.

1992 **Golden Key National Honor Society**, Boston University.

1991 **James Flack Norris Summer Undergraduate Research Scholarship**, Northeast Section of the American Chemical Society.

PUBLICATIONS

1. **T. D. Clark,*** K. P. Fears, D. E. Barlow, M. K. Kolel-Veetil "Reversible intramolecular folding of linearly polymerized, cyclic-peptide-based polymers into individual nanorod structures" *In preparation*.
2. K. P. Fears, S. J. Photiadis, J. L. Kulp III, and **T. D. Clark*** "Synthesis and Characterization of Cyclic Peptides that are β-Helical in Trifluoroethanol" *J. Pept. Sci.* **2014**, *20*, 366–374.
3. K. P. Fears, **T. D. Clark***, and D. Y. Petrovykh* "Residue-Dependent Adsorption of Model Oligopeptides on Gold" *J. Am. Chem. Soc.* **2013**, *135*, 15040–15052.
4. K. P. Fears, D. Y. Petrovykh,* and **T. D. Clark*** "Evaluating protocols and analytical methods for peptide adsorption experiments" *Biointerphases* **2013**, *8* (20).
5. K. P. Fears,* D. Y.Petrovykh, S. J. Photiadis, **T. D. Clark**,* "Circular Dichroism Analysis of Cyclic β-Helical Peptides Adsorbed on Planar Fused Quartz" *Langmuir* **2013**, *29*, 10095–10101.
6. N. D. Bassim, W. J. Dressick, K. P. Fears, R. M. Stroud, **T. D. Clark**, D. Y. Petrovykh* "Layer-by-Layer Assembly of Heterogeneous Modular Nanocomposites" *J. Phys. Chem C.* **2012**, *116* , 1694–1701.
7. J. L. Kulp III, J. C. Owrutsky, D. Y. Petrovykh, K. P. Fears, R. Lombardi, L. A. Nafie, and **T. D. Clark*** "Vibrational Circular Dichroism Spectroscopy of Homologous Cyclic Peptides Designed to Fold into β Helices of Opposite Chirality" *Biointerphases* **2011**, *6*, 1–7.
8. N. Bernstein,* J. L. Kulp III, M. A. Cato, Jr., and **T. D Clark*** "Simulations of nanocylinders self-assembled from cyclic β-tripeptides" *J. Phys. Chem. A.* **2010**, *114*, 11948–11952.
9. J. L. Kulp III and **T. D. Clark*** "Engineering a β-helical D,L Peptide for Folding in Polar Media" *Chem. Eur. J.* **2009**, *15*, 11867–11877.
10. D. Y. Petrovykh,* J. C. Smith, **T. D. Clark**, R. Stine, L. A. Baker, L. J. Whitman "Self-Assembled Monolayers of Alkanethiols on InAs," *Langmuir* **2009**, *25*, 12185–12194.

11. **T. D. Clark**,* M. Sastry, C. Brown, and G. Wagner, "Solid-phase synthesis of backbone-cyclized β-helical peptides" *Tetrahedron* **2006**, *62*, 9533–9540.
12. M. Sastry, C. Brown, G. Wagner, and **T. D. Clark**,* "Cyclic Peptide Helices: A Hybrid β-Hairpin, β-Helical Supersecondary Structure" *J. Am. Chem. Soc.* **2006**, *128*, 10650–10651.
13. **T. D. Clark**,* E. C. Dugan, "Preparation of Oligo(ethylene glycol)-Terminated Icosanedisulfides" *Synthesis*, **2006**, 1083–1086.
14. R. Ferrigno, A. Strook., **T. D. Clark**, M. Mayer, and G. M. Whitesides* "Membraneless Vanadium Redox Fuel Cell Using Laminar Flow", *J. Am. Chem. Soc.*, **2002,** *124*, 18–19.
15. **T. D. Clark,** R. Ferrigno, J. Tien, K. E. Paul, and G. M. Whitesides* "Template-Directed Self-Assembly of 10-μm-Sized Hexagonal Plates" *J. Am. Chem. Soc.* **2002**, *124*, 5419–5426.
16. **T. D. Clark**, M. Boncheva, J. M. German, M. Weck, and G. M. Whitesides* "Design of Three-Dimensional, Millimeter-Scale Models for Molecular Folding" *J. Am. Chem. Soc.* **2002**, *124*, 18–19.
17. S. R. J. Oliver, **T. D. Clark**, N. Bowden, and G. M. Whitesides* "Three-Dimensional Self-Assembly of Complex, Millimeter-Scale Structures through Capillary Bonding" *J. Am. Chem. Soc.* **2001**, *123*, 8119–8120.
18. **T. D. Clark,** J. Tien, D. C. Duffy, K. E. Paul, and G. M. Whitesides* "Self-Assembly of 10-μm-Sized Objects into Ordered Three-Dimensional Arrays" *J. Am. Chem. Soc.* **2001**, *123*, 7677–7682.
19. D. T. Y. Bong, **T. D. Clark**, J. R. Granja, and M. R. Ghadiri* "Self-Assembling Organic Nanotubes" *Angew. Chem., Int. Ed.* **2001**, *40*, 988–1011.
20. M. S. Vollmer, **T. D. Clark**, C. Steinem, and M. R. Ghadiri* "Photoswitchable Hydrogen-Bonding in Self-Organized Cylindrical Peptide Systems" *Angew. Chem., Int. Ed.* **1999**, *38*, 1598–1601.
21. **T. D. Clark**, K. Kobayashi, and M. R. Ghadiri* "Covalent Capture and Stabilization of Cylindrical β-Sheet Peptide Assemblies" *Chem. Eur. J.* **1999**, *5*, 782–791.
22. **T. D. Clark**, J. M. Buriak, K. Kobayashi, M. Isler, D. R. McRee, and M. R. Ghadiri* "Cylindrical β-Sheet Peptide Assemblies" *J. Am. Chem. Soc.* **1998**, *120*, 8949–8962.
23. J. D. Hartgerink, **T. D. Clark**, and M. R. Ghadiri, "Peptide Nanotubes and Beyond" *Chem. Eur. J.* **1998**, *4*, 1367–1372.
24. **T. D. Clark**, L. K. Buehler, and M. R. Ghadiri* "Self-Assembling Cyclic β^3-Peptide Nanotubes as Artificial Transmembrane Ion Channels" *J. Am. Chem. Soc.* **1998**, *120*, 651–656.
25. **T. D. Clark** and M. R. Ghadiri* "Supramolecular Design by Covalent Capture. Design of a Peptide Cylinder via Hydrogen-Bond-Promoted Intermolecular Olefin Metathesis" *J. Am. Chem. Soc.* **1995**, *117*, 12364–12365.
26. J. S. Panek* and **T. D. Clark** "Ireland-Claisen Rearrangements of Chiral (*Z*)–Vinylsilanes. Highly Diastereoselective Synthesis of anti-α-Alkoxy-β-(dimethylphenylsilyl)-(*E*)-hex-4-enoates" *J. Org. Chem.* **1992**, *57*, 4323–4326.

PATENTS

1. J. L. Kulp, III and T. D. Clark, "Methods for Preparing Stabilized Peptide Structures in Polar Solvents," US Patent No. 8247533 (2012). Foreign filing in progress.
2. J. L. Kulp III, M Kolel-Veetil and T. D. Clark. "Methods for Preparing Linked Peptide Rings. Provisional US Patent application filed August 2009. Full US patent application filed August 12, 2010 (US12/855,379). Pending.

BIOGRAPHICAL SKETCH

Shizuka Hsieh, hsiehs@trinitydc.edu, 202 884 9299
Trinity Washington University, 125 Michigan Ave NE, Washington, DC 20017

(a) Professional preparation

Carleton College	Chemistry	B.A. 1993
Oxford University, U.K.	Physical Chemistry	D. Phil. 1997
University of Wisconsin, Madison	Physical Chemistry	1997-2000

(b) Appointments

Associate professor, Chemistry and Assistant Provost for the Sciences	Trinity Washington University	2013-present
Visiting scientist, School of Public Health	University of Maryland	2012-2013
Associate professor, Chemistry	Smith College	2008-2013
Visiting scientist, Chemistry	University of Maryland	2006-07
Assistant professor, Chemistry	Smith College	2001-08
Visiting assistant professor, Chemistry	Oberlin College	2000-01

(c) Publications

(i) Project related publications

1. T. Yvanka de Soysa, A. Ulrich, T. Friedrich, D. Pite, S.L. Compton, D. Ok, R.L. Bernardos, G.B. Downes, S. Hsieh, R. Stein, M.C. Lagdameo, K. Halvorsen, M.J.F. Barresi, "Macondo crude oil from the Deepwater Horizon oil spill disrupts specific developmental processes during zebrafish embryogenesis," *BMC Biology*, *10*, 40, **2012**.
2. S. Kapoor, S. Hsieh. R. Wood. C. Bearer, A. Sapkota, "Alcohol Exposure from Hand Hygiene Products in Preterm Infants in Neonatal Giraffe Isolette," Pediatric Academic Societies Annual Meeting, **2013**.

(ii) Other

1. S. Hsieh, R. Vushe, Y.T. Tun, J.L. Vallejo, "Trends in organic hydroperoxide photodissociation and absorption cross sections between 266 and 377 nm," *Chemical Physics Letters, 591*, 99, **2014**.
2. S. Hsieh, T. Thida, M.K. Nyamumbo, K.A. Smith, N. Naamad, R.G. Linck, "O-H stretch overtone excitation of ethyl hydroperoxide conformers." *Journal of Physical Chemistry A,* 115, 14040, **2011**.
3. J. Du, L. Yuan, S. Hsieh, F. Lin and A.S. Mullin, "Dynamics of Weak and Strong Collisions: Highly Vibrationally Excited Pyrazine (E = 37900 cm^{-1}) with DCl," *Journal of Physical Chemistry A*, 112, 9396 – 9404, **2008**.
4. L.M. Haynes, K.M. Vogelhuber, J.L. Pippen and S. Hsieh, "Effects of torsion on O-H stretch overtone spectra and direct overtone photolysis of methyl hydroperoxide." *Journal of Chemical Physics*, 123, 234306, **2005**.
5. J.M. Hutchison, R.J. Holiday, A. Bach, S. Hsieh and F.F. Crim, "Action spectroscopy and photodissociation of vibrationally excited methanol," *Journal of Physical Chemistry A*, 108, 8115-8188, **2004**.

(d) Synergistic activities

1. AAAS Science and Policy Technology Fellow at U.S. Environmental Protection Agency (2009-10). My interest in Environmental Justice (EJ) grows from a fellowship year where I worked closely with the Office of Solid Waste and Emergency Response (OSWER) Outreach Team on an EJ regulatory impact statement, attended an EJ Symposium on Air Quality, and served on workgroups for OSWER's Community Engagement Initiative (CEI). For the CEI workgroup to Evaluate and Improve EPA Technical Assistance Processes, I presented case studies of university service-based learning courses that empowered communities with their own data, and suggested actions for EPA to promote community engagement through such service-learning courses. For the CEI workgroup on the OSWER-Wide/Regional Community Engagement Training Program, I reviewed agency internal and external

documents for guiding principles for effective community engagement, and worked with a core group to develop workgroup strategy and plan

2. Visiting Faculty Fellow for the Associated Kyoto Program (2011, 2014). I developed and taught an interdisciplinary course titled *Industrial Pollution and Waste in Japan: Chemistry and Society* that illustrates how chemistry, in conjunction with multi-disciplinary considerations of politics, medicine, history, and culture, contributed to a series of public health crises accompanying Japan's rapid industrialization in the 1960s. I led students on field trips (to the Liberty Museum of Human Rights, the Maishima Incineration Plant, the Kyoto Nambu Recycling Facility, and the Toba Wastewater Treatment Plant) that further served as a springboard for exploring Japanese attitudes and actions towards climate change, waste, and nuclear power. I visited the International Center for Environmental Technology Transfer to learn how environmental monitoring informed policy and changes in air quality, for Japan.

3. Steering committee member for the Environmental Science and Policy (ES&P) Program, Smith College (2001-2012). I taught CHM108: Environmental Chemistry, a course for non-science majors that counts towards the ES&P major. Making chemistry accessible through courses such as CHM108 contributed towards my selection as a recipient of the Sherrerd Teaching Award in its inaugural year at Smith (2004). In 2012 I served as the Smith College representative at the annual Council of Environmental Deans and Directors meeting.

4. Faculty mentor and research advisor for first-year students from underrepresented groups, Smith College (2010-11, 2007-08, 2005-06). As academic and research advisor for students selected to participate in Smith's AEMES (Achieving Excellence in Mathematics Engineering and Science) program to increase retention of students from underrepresented groups, I met with first-year advisees (Aaline Ahmad '14, Risha Sinha '14, Geraldine Rogriguez '12) weekly and introduced them to research in laser spectroscopy and quantum chemistry. As part of the Early Mentoring Program, I shared two mentees with three members of the Chemistry Department. I worked closely with Kimberly Kufel ('10) and Kristin Wilson ('10) several times a semester in my laser laboratory. I also was faculty advisor to American Chemical Society (ACS) Scholar Amanda Lapahie ('12).

5. Panelist at national SACNAS (Society for Advancement of Chicanos and Native Americans in Science) meeting (October 2007). With one other faculty member (Prof. Renae Brodie, Mt. Holyoke Biology Department), I represented the Five Colleges at a session designed to raise awareness about academic careers in liberal arts colleges amongst Chicano and Native American graduate students and post-doctoral fellows. I presented my own experiences, from preparing applications to involving undergraduates in research, and shared advice for starting an equipment-intensive laboratory at a selective liberal arts college.

(e) Collaborators and other affiliations

Collaborator: Amanda Northcross	George Washington University
Collaborator: Dickerson, Russell R.	University of Maryland, College Park
Collaborator: Sapkota, Amir	University of Maryland, College Park
Collaborator: Wilson, Sacoby	University of Maryland, College Park
Collaborator: Morris, Vernon	Howard University
Collaborator: Kapoor, Shiv	Mercy Hospital, Baltimore
Collaborator: Mullin, Amy S.	University of Maryland, College Park
Postdoctoral sponsor: Crim, F. Fleming	University of Wisconsin, Madison
Graduate advisor: Eland, John H.D.	Oxford University, U.K.

BIOGRAPHICAL SKETCH

Patrice E. Moss
Trinity Washington University
125 Michigan Avenue NE, Washington, DC 20017
202-884-9276 / mossp@trinitydc.edu

A. Professional Preparation

Institution	Area of Study	Year ____
University of Maryland Eastern Shore	Biology	B.S., 2003
Meharry Medical College	Biomedical Sciences (Cancer Biology)	Ph.D., 2010
Georgetown University Medical Center	Cancer Biology	Visiting Faculty, 2013
Howard University	Biochemistry	Visiting Faculty, 2014-present

B. Appointments

2012-present	Clare Boothe Luce Assistant Professor of Biochemistry, Trinity Washington University
2014-present	Visiting Faculty Research Volunteer, Howard University
2013	Visiting Faculty Research Volunteer, Georgetown University Medical Center
2010-2012	Adjunct Faculty, Biology and Biochemistry, Trinity Washington University
2008-2011	Instructor, Meharry Medical College

C. Products

Peer reviewed publications

Lyles, B., Akinyeke, T., **Moss, P.E.** and Stewart, L.V. Thiazolidinediones regulate expression of cell cycle proteins in human prostate cancer cells via PPARγ- dependent and PPARγ- independent pathways. Cell Cycle, 2009.

Moss, P.E., Lyles, B.E. and Stewart, L.V. The PPARγ ligand ciglitazone regulates androgen receptor activity differently in androgen-dependent versus androgen-independent human prostate cancer cells. Experimental Cell Research, 2010.

D. Synergistic Activities

1. Teaching both Fundamentals and Interdisciplinary Applications at Trinity: **General Biology** provides a comprehensive foundation in biology for both majors and non-majors. The goal of the course is to give science majors an understanding of basic biological processes. The course begins with a discussion of the basic chemistry of life and then moves to the cell, the basic functional unit of all living things, with an emphasis on the relationship between structure and function. The course also includes cellular metabolism, cellular reproduction, molecular genetics, the mechanisms of evolution and biological diversity, and plant and animal form and function. In **Forensic Science**, students explore scientific principles of Forensic Science and methods of investigation. The course was designed to introduce students to the many specialties within forensic science and methods for collecting and recording evidence at crime scenes. Scientific principles based in chemistry and biology are incorporated into discussions of techniques used for analyzing crime scene evidence. Students are introduced to technologies for analyzing crime scene evidence such as separating and identifying compounds, microscopy, fingerprinting, document analysis, pathology, anthropology, odontology, entomology, serology, DNA analysis, toxicology, and soil and fiber analysis. Students also explore ethical and legal considerations in forensic science. **Molecular Biochemistry** explores the molecular basis of biological processes, with special emphasis on the structure and function of proteins and nucleic acids and the interplay between these important classes of macromolecules. The course concludes with the study of biochemistry, including reaction mechanisms, metabolic pathways and energetics. In all of these courses, students enhance their skills of quantitative analysis and reasoning, critical thinking, hypothesis posing and problem solving. In addition, communication skills, both written and oral, will be enhanced through written laboratory reports and oral presentations. Students are assessed via exams, quizzes, written reports, and oral presentations.

2. Developing courses and programming at Trinity: Active in the rebuilding of the Biochemistry program, and restructuring of curriculum and course offerings for Natural Sciences programs. Developed and taught inaugural Forensic Science course (Spring 2013); developed and sought approval of new Forensic Science major/program (start date: Fall 2014). Organized and hosted interdisciplinary event "Henrietta Lacks at Trinity."

3. Mentoring Trinity undergraduates and enhancing their professional opportunities in STEM: Academic advisor, Pre-professional advisor, and faculty advisor for Math and Science student organization. Identified and advised cohort of high-achieving Trinity science students in applying for summer internship programs. Developed a semester long internship program for credit for TWU students in the sciences; implemented professional development workshops for TWU students. Over the course of my two-year tenure at Trinity Washington University, I have developed a mechanism for Trinity students to benefit from close mentoring at Trinity while gaining experiences in summer undergraduate research programs at other institutions. During the summer of 2014, eight students in the science program applied for and successfully obtained competitive undergraduate research positions across the country. Some of the programs include, but are not limited to Johns Hopkins University (Baltimore, MD), Georgetown University (Washington, DC), and Baylor College of Medicine (Houston, TX). Upon completion of their summer undergraduate research experiences, students were granted the opportunity to present their data at a number of national scientific platforms. Of the most significant, every Trinity student presented her work at the Annual Biomedical Research Conference for Minority Students (ABRCMS, November 2014, San Antonio, TX). I plan to use my research, professional training, and modern facilities to develop and provide Trinity students with the research fundamentals that will make them competitive and successful in any research laboratory for a summer or semester internship.

4. Innovation in teaching: Attended 14th Annual Conference in Case Study Teaching in Science (September 2013, Buffalo, NY); have implemented Case Study based teaching strategies in each of the courses taught at Trinity.

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EDUCATION

Ph.D., Organic Chemistry, Georgia Institute of Technology, 1974
Fannie and John Hertz Foundation Fellow
B.S., Chemistry, North Carolina State University, 1969

PUBLIC SERVICE

Solid Waste Advisory Committee, Montgomery County, Maryland, 1990-1992
Citizens' Landfill Design Oversight Group, Montgomery County, Maryland, 1990-1992

CERTIFICATIONS

ARM (Associate in Risk Management), Insurance Institute of America, 1989
Health and Safety Training for Hazardous Waste Activities OSHA Training Requirements (CFR 1910-120) including Red Cross and CPR, 1989
Maryland Certified Underground Storage Tank Installer, MDIC 89-0251

EMPLOYMENT HISTORY

Tufts University School of Medicine June 2009-: Adjunct research professor of medicine.
Flexible Employment 2003-2009, 2011-
American Wood Preservers Institute (1996- 2002): Director of Environmental & Regulatory Affairs
Louis Berger & Associates, Inc. (1991-1996): Chief Scientist/Program Manager
Kamber Engineering, Inc. (1989-1991): Director, Environmental Programs
Dynamac Corporation (1988): Executive Assistant to the President
Dynamac Corporation (1980-1988): Senior Scientist, Department Manager
Food and Drug Administration, Division of Chemical Technology (1977-1980): Chemist
U.S. Environmental Protection Agency, Office of Toxic Substances (1976-1977): Chemi
National Bureau of Standards, National Research Council (1974-1976): Research Chemist

SELECTED PUBLICATIONS

Parris GE, Lamont C and Hlatky L. Effects of Ionizing Radiation on Mesenchymal Stem Cells. submitted to Radiation Research December 2012.

Parris GE. 2013. Historical Perspective of Cell-Cell Fusion in Cancer Initiation and Progression. Critical Reviews in Oncogenesis. 18(1-2):1-18.

Parris GE. Asymmetric Division and the Immortal Strand Hypothesis. Hypotheses in the Life Sciences. 2011. 1(2):52-55.

Parris GE. The Hopeful Monster Finds and Mate and Founds a New Species. Hypotheses in the Life Sciences. 2011. 1(2):1-6.

Javaherian K with Parris GE et al. 2010.Two Endogenous Antiangiogenic Inhibitors, Endostatin and Angiostatin, Demonstrate Biphasic Curves in their Antitumor Profiles. Dose Response. 2011;9(3):369-76.

Parris GE. 2010. Comment on "Methylmagnesium Alkoxide Clusters with Mg_4O_4 Cubane- and Mg_7O_8 Biscubane-Like Cores: Organometallic Precursors for Low-Temperature Formation of MgO Nanoparticles with Variable Surface Defects" Chemistry of Materials. 22 (15):4512.

Parris GE. 2008. Cell-cell fusion is the rate-limiting step in causation and progression of clinically significant cancers. Cancer Genet Cytogenet. 2008; 185(2):113.

Parris, G.E., G.W. Diachenko, R.C. Entz, J.A. Poppiti, P. Lombardo, T.K. Rohrer, and J.L. Hesse. 1980. Waterborne 2-chloroaniline and 4,4'-methylenebis(2-chloroaniline) contamination around Adrian, Michigan. Bull. Environ. Contam. Toxicol. 24: 497.

Sherman, P.L., A.M. Kemmer, L. Metcalfe, H.D. Toy, and G.E. Parris. 1979. Sampling and analysis of beta-chloroethers

in the environment. Pp. 205-212, in: H.S. Hertz and S.N. Chesler (eds.), Trace Organic Analysis in the Environment: A New Frontier in Analytical Chemistry. U.S. Department of Commerce, National Bureau of Standards, Washington, D.C.

Parris, G.E., and F.E. Brinckman. 1975. Reactions which relate to the environmental mobility of arsenic and antimony. I. Quaternization of trimethylarsine and trimethylstibine. J. Org. Chem. 40:3801.

Parris, G.E., *et al*. 1976. An unexpected decomposition of triphenyl(methyl)stibonium bromide under mild conditions. J. Org. Chem. 41:1276.

Parris, G.E., and F.E. Brinckman. 1976. Reactions which relate to the environmental mobility of arsenic and antimony. II. Oxidation of trimethylarsine and trimethylstibine. Environ. Sci. Technol. 10:1128.

Parris, G.E. 1980. Covalent binding of aromatic amines to humates. I. Reactions with carbonyls and quinones. Environ. Sci. Technol. 14:1099.

Parris, G.E. 1980. Environmental and metabolic transformations of aromatic amines and related compounds. Residue Rev. 76.1.

Parris, G.E., et al. 1977. Chemical and physical considerations in the use of atomic absorption detectors coupled with a gas chromatograph for determination of trace organometallic gases. Anal. Chem. 49:378.

Brinckman, F.E., G.E. Parris, W.R. Blair, K.L. Jewett, W.P. Iverson, and J.M. Bellama. 1977. Questions concerning environmental mobility of arsenic: needs for a chemical data base and means for speciation of trace organoarsenicals. Environ. Health Persp. 19:11

Parris, G.E. Biotransformations of sulfur as evolutionary prototypes for metabolism of metals and metalloids. 1978. Pp. 23-38, in: F.E. Brinckman and J.M. Bellama (eds.), Organometals and Organometalloids: Occurrence and Fate in the Environment, ACS Symposium Series 82. American Chemical Society, Washington, D.C.

Ashby, E.C., J. Laemmle, and G.E. Parris. 1969 Stable mixed alkoxyalkyl bridged organoaluminum compounds. J. Organomet. Chem. 19:24.

Ashby, E.C, G.E. Parris, and F.Walker. 1969. Direct nuclear magnetic resonance observation of Me_2Mg and MeMgBr in a diethyl ether solution of methylmagnesium bromide. Chem. Commun. 1464.

Parris, G.E., and G.G. Long. 1970. Complexes of tribenzylarsine oxide. I. Complexes with first row transition metals. J. Inorg. Nucl. Chem. 32:1585.

Parris, G.E., and G.G. Long. 1970. Complexes of tribenzylarsine oxide. II. Complexes with lanthanon (III) nitrates. J. Inorg. Nucl. Chem. 32:1593.

Parris, G.E., and E.C. Ashby. 1971. The composition of Grignard compounds. VII. The composition of methyl- and tert-butyl-magnesium halides and their dialkylmagnesium analogs in diethyl ether and tetrahydrofuran as inferred from nuclear magnetic resonance spectroscopy. J. Am. Chem. Soc. 93:1206.

Parris, G.E. 1973. Reaction of chromium with mercury halides. Preparation of chromium halide solvates. Synth. Inorg. Met. Org. Chem. 3:245.

Brill, T.B., G.E. Parris, G.G. Long, and L.H. Bowen. 1973. Mossbauer and nuclear quadrapole resonance spectra of some organoantimony compounds and of the arsenic analogs. Inorg. Chem. 12:1888.

Parris, G.E., and E.C. Ashby. 1974. The composition of Grignard compounds. IX. The structure and solution composition of cyclopentadienylmethylmagnesium in benzene and ether solvents. J. Organomet. Chem. 72:1.

Ashby, E.C., J.A. Nackashi, and G.E. Parris. 1975. The composition of Grignard compounds. X. NMR, IR, and molecular association studies of some methylmagnesium alkoxides in diethyl ether, tetrahydrofuran and benzene. J. Am. Chem. Soc. 97:3162.

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EDUCATION

Howard University, Washington, District of Columbia, 2013- 2016

Ph.D. in Biochemistry, In Progress

Howard University, Washington, District of Columbia, 2011-2013

M.S. in Biochemistry, 2013

Cedar Crest College, Allentown, Pennsylvania, 2006-2010

B.S. in Chemistry, 2010

PRESENTATIONS

Poster Presentation, ACS 247th National Meeting, Dallas, Texas, 2014
Poster Presentation, Advanced Computational Biology Symposium, Washington, District of Columbia, 2014
Verbal Presentation, Biological Research Talk for Undergraduates, Washington, District of Columbia, 2014
Poster Presentation, 7th Frontiers at the Chemical-Biology Interface Symposium, Baltimore, Maryland, 2014
Verbal Presentation, Mt. St. Mary's School, Frederick, Maryland, 2013
Poster Presentation, 20th Undergraduate and Graduate Research Symposium, Baltimore, Maryland, 2013
Poster Presentation, American Cancer Society Convention, Washington, District of Columbia, 2010

RESEARCH EXPERIENCE

Master's Research: Computational Biology, Howard University, 2011-2013 (research adviser: Dr. Lystranne Maynard).

- Synthesized Novel Stilbene derivatives as potential chemopreventives.

- Computational studies of HOMO-LUMO diagrams to determine how the substituents affect reactivity of the olefin.

Undergraduate Research: Synthetic Organic Chemistry, North Carolina A&T State University, 2007-2008 (research adviser: Dr. Marion Franks).

- Synthesized Calixarenes for electrode studies.
- Molecular modifications to increase water solubility of calixarenes.

RESEARCH INTEREST

- Synthetic organic chemistry of natural products and novel compounds.
- Development of novel methodologies for synthetic organic and organometallic chemistry.

TEACHING EXPERIENCE

Teaching Assistant: General Chemistry Laboratory, North Carolina A&T State University, Fall 2008.

- General Chemistry laboratory and discussion sections.

Teaching Assistant: Organic Chemistry Laboratory, North Carolina A&T State University, Spring 2008 – Summer 2010.

- Organic Chemistry laboratory and discussion sections.

Instructor: College Algebra, Bennett College for Women, 2008 – 2010.

- Algebra Instructor: Provided instructions in basic mathematical operations, elementary algebra, elementary analytical geometry, and measurement.

Instructor: General Chemistry, North Carolina A&T State University, Spring 2012.

- A course, which emphasizes basic principles and important theoretical concepts of chemistry. Topics will include atomic structure, electronic configuration, the wave mechanical model of the atom, chemical bonding, states of matter, chemical equilibria, systems of acids and bases, and electrochemistry.

Instructor: Organic Chemistry Laboratory, North Carolina A&T State University, Spring/Summer 2012.

- This laboratory course emphasizes the study of physical and chemical properties of aliphatic and aromatic compounds. Modern instrumentation such as gas and column chromatography, and HPLC are used. Emphasis is also placed on qualitative identification of organic compounds.

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Education

Chromatin Structure and Epigenetic Mechanisms, Laboratory of Receptor Biology and Gene Expression, National Cancer Institute, National Institutes of Health, Bethesda, Maryland, August 2013- present
Post-doctoral Fellow

Brown University, Providence, Rhode Island, September 2008- July 2013
Doctor of Philosophy in Molecular and Cellular Biology and Biochemistry

Mount Holyoke College, South Hadley, Massachusetts, September 2002- May 2006
A.B. in Biology May 2006, *cum laude* and with High Honors in Biochemistry

Certifications

ChIP-seq Data Analysis (2013) Bioinformatics Training and Education Program, NCI

Scientists Teaching Science (2014) Office of Intermural Training and Education, NIH

Workplace Dynamics (2014) Office of Intermural Training and Education, NIH

Professional Experience

Mount Holyoke College, South Hadley, Massachusetts
Research Technician, June 2006-July 2008, Department of Chemistry, laboratory of Professor Megan Nunez

Salado Veterinary Hospital, Salado, Texas
Veterinary Technician, May 2004-August 2004, clinic of Dr. Jonathan Kendall

Research Experience

Post-doctoral Fellow, National Cancer Institute, Laboratory of Yamini Dalal (2013-Present). Investigate the biophysical properties of nucleosome arrays containing histone variants and characterize the cellular consequences of histone variant overexpression.

Graduate Student, Brown University, Laboratory of Sarah Delaney (2009-2013). Investigated the influence of oxidative damage on the structure of a three-way junction containing CAG trinucleotide repeats. Constructed nucleosome core particles (NCPs) from isolated chromatin and DNA containing trinucleotide repeats and determine how the nucleosome structure is altered by changes to the length, sequence, or secondary structure of the repeat tract.

Rotation Student, Brown University, Laboratory of Sarah Delaney (2009). Synthesized, purified, and probed the structure of CAG trinucleotide repeats containing the oxidative damaged DNA base 8-oxo-7,8-dihydroguanine.

Rotation Student, Brown University, Laboratory of Tricia Serio (2009). Expressed and purified the Sup35 yeast prion protein and determined its ability to form linear aggregates.

Rotation Student, Brown University, Laboratory of Richard Bennett (2009). Created a cloning library of *Candida albicans* genes using the Gateway cloning system.

Rotation Student, Brown University, Laboratory of Wolfgang Peti (2008-2009). Examined the interaction between the bacterial quorum-sensing protein SdiA and the chaperone DnaK by expressing each protein in bacteria and monitoring their interaction by their elution from an affinity column.

Research Technician in Chemistry, Mount Holyoke College, Laboratory of Megan Nunez (2006-2008). Examined a bacterial predator/prey relationship on the nanoscale by analyzing the composition of lipopolysaccharides (LPS) from *E. coli* prey and *Bdellovibrio bacteriovorus* predator cells as well as imaging bacterial cells in fluid using AFM to assess changes that occur in the prey cells as they are attacked. I also managed day-to-day laboratory upkeep and activities of undergraduates involved in laboratory work

Senior Thesis Student in Biochemistry, Mount Holyoke College, Laboratory of Megan Nunez (2005-2006). Explored the biophysical differences in the LPS of the predatory bacteria *Bdellovibrio bacteriovorus* and LPS from several prey strains of *Escherichia coli* using a modified Langmuir technique to create supported LPS membranes, which were then imaged with AFM.

Professional Memberships

Biophysical Society

American Chemical Society

Association of Women in Science

Awards, Honors, and Grants Funded

Sallie Rosen Kaplan Fellowship for Women Scientists in Cancer Research (2013-present)

National Defense Science and Engineering Graduate Fellow (2010-2013)

NIH National Graduate Student Research Conference, participant (2012)

Young Researcher (Participant), 61st Lindau Meeting of Nobel Laureates (2011)

Mary Lyon Scholar (2006)

Papers

Catherine B. Volle and Yamini Dalal. (2014) "Histone Variants: Tricksters of the Chromatin World" Current Opinions in Genetics and Development 25 8-14.

Catherine B. Volle and Sarah Delaney. (2013) "AGG/CCT Interruptions Affect Nucleosome Formation and Positioning of Healthy-Length CGG/CCG Triplet Repeats" BMC Biochemistry 14 1-12.

Catherine B. Volle and Sarah Delaney. (2012) "CAG/CTG Repeats Alter Affinity for the Histone Core and Positioning of DNA in the Nucleosome" Biochemistry 51 9814-9825.

Sarah Delaney, Daniel A. Jarem, **Catherine B. Volle**, and Craig J. Yennie. (2012) "Chemical and Biological Consequences of Oxidatively Damaged Guanine in DNA" Free Radical Research 46 420-441.

Catherine B. Volle, Daniel A. Jarem, and Sarah Delaney. (2012) "Trinucleotide Repeat DNA Alters Structure to Minimize the Thermodynamic Impact of 8-oxo-7,8-dihydroguanine" Biochemistry 51 52-62.

Catherine B. Volle, Megan A. Ferguson, Katherine E. Aidala, Eileen M. Spain, and Megan E. Núñez. (2008) "Spring Constants and Adhesive Properties of Native Bacterial Biofilm Cells Measured by Atomic Force Microscopy" Colloids and Surfaces B: Biointerfaces 67 32-40.

Catherine B. Volle, Megan A. Ferguson, Katherine E. Aidala, Eileen M. Spain, and Megan E. Núñez. (2008) "Quantitative Changes in the Elasticity and Adhesive Properties of Prey Cells During Predation by Bdellovibrio bacteriovorus 109J" Langmuir 24 8102-8110.

Megan A. Ferguson, Jacqueline Schmitt, Anil R. Sindhurakar, **Catherine B. Volle**, Megan E. Núñez, and Eileen M. Spain. (2008) "Rapid Isolation of Host-Independent *Bdellovibrio bacteriovorus*" Journal of Microbiological Methods 73 279-281.

Teaching and Mentoring Experience

Mentor, National Institutes of Health, (2014) Mentored undergraduate student participating in a summer internship program. Taught basic laboratory skills including DNA/RNA extraction, PCR, and Western blotting.

Instructor, Community College Summer Enrichment Program, National Institutes of Health, (2014). Lead a group discussion on research ethics and mentored community college students while they performed research at the NIH.

Instructor, Science Skills Boot Camp, National Institutes of Health, (2014). Engage summer interns in a discussion on the basics of reading a journal article and guided a workshop on basic laboratory techniques. Received an average evaluation of 4.8/5 and course was rated second most helpful.

Scientists Teaching Science course, National Institutes of Health, (2014). This course provided information about teaching methods that ensure students are participating in active learning, effective curriculum design, and evaluation techniques.

Mentor, Brown University, (2010-2013). Mentored three graduate students and two undergraduate students while a member of the Delaney Laboratory. Instructed students in good lab practice and supervised research progress leading to development of an independent research project.

Teaching Assistant, Brown University (2010). Prepared lectures for review sessions, proctored and graded exams, and assisted students with course material for an introductory cell biology class.

Mentor, Mount Holyoke College (2006-2008). Supervised six undergraduate students, four of whom I mentored in independent research projects. Helped students familiarize themselves with appropriate techniques and laboratory practices.

Guest Lecturer, Mount Holyoke College (2006). Prepared classroom discussion on AFM as applicable to the Mount Holyoke College Chemistry Department's weekly seminar speaker's research. Assigned primary source readings and graded homework.

Teaching Assistant, Mount Holyoke College (2004-2006). Prepared experiments, assisted with laboratories, graded laboratory reports, and tutored students for several classes in the major (Organic Chemistry I and II). Helped students become familiar with chemical techniques such as NMR spectrometry, IR spectrometry, GC-MS, UV-Vis spectroscopy, melting point determination, and TLC.

Grader, Mount Holyoke College, (2005-2006). Graded laboratory reports for Biochemistry I and II, graded homework and created answer keys for General Chemistry II, and assessed how well the students understand the material from the lecture and the textbook.

Teaching Assistant, Adventures Underwater, Holyoke Underwater Supply, and Project Deep (2005-2009). Assisted SCUBA instructors during pool and open water dives for NAUI open water and advanced SCUBA classes.

Leadership, Service, and Outreach

Volunteer, Girl Scout Council of the Nation's Capital, (2013-present). Speak with Girl Scout troops about science and demonstrate scientific principles using interactive experiments.

Volunteer, NIH Take Your Child to Work Day, (2014). Demonstrated principles of chromatography with participating children aged 5-9.

Judge, Montgomery County Science Fair, (2014). Judged chemistry projects presented by Middle School students.

Judge, Graduate Student Research Symposium, National Institutes of Health, (2014). Judged posters presented by graduate students in the topics of Biochemistry, Developmental, Cell, and Molecular Biology.

Member, BioMed Advisory Committee, Brown University (2008-2012). Worked with the Dean of the Division of Biology and Medicine to plan career development and community building events for graduate students in the division.

President, Graduate Women in Science and Engineering (2010-2012). Worked to build a community of female science and engineering graduate students and provide mentors for undergraduate women in the sciences. Merged with the Sarah Doyle Women's Center Graduate Women's Group in March 2012.

Chemistry Department Liaison, Mount Holyoke Chemistry Club, Mount Holyoke College (2005-2006). Helped plan chemistry club activities and worked with chemistry department faculty and staff to run club activities.

Volunteer, Greenfield Animal Shelter (2004-2005). Worked with full time shelter staff members to train and care for abused and neglected dogs and cats. Also worked with veterinary staff and helped find placement for animals after training was complete.

Talks and Posters

Catherine B. Volle. "The Trouble with Triples: Elucidating the Behavior of Trinucleotide Repeat Sequences in Chromatin" (Talk) DNA Repair and Mutagenesis, MIT, February 12, 2013.

Catherine B. Volle and Sarah Delaney. "The Trouble with Triples: Elucidating the Behavior of Trinucleotide Repeat Sequences in Chromatin" (Poster) Biophysical Society Meeting, February 6, 2013.

Catherine B. Volle and Sarah Delaney. "The Trouble with Triples: Elucidating the Behavior of Trinucleotide Repeats in Chromatin" (Poster) National Graduate Student Research Conference, NIH, October 9, 2012.

Catherine B. Volle and Sarah Delaney. "The Trouble with Triples: Elucidating the Behavior of Trinucleotide Repeats in Chromatin" (Poster) Gordon Research Conference, Mutagenesis, August 23, 2012.

Catherine B. Volle and Sarah Delaney. "The Trouble with Triples: Elucidating the Behavior of Trinucleotide Repeats in Chromatin" (Poster) Gordon Research Conference, Chromatin Structure and Function, May 7-8, 2012.

Catherine B. Volle. "The Trouble with Triples: ROS-induced DNA Damage and Its Effect on Trinucleotide Repeat Sequences" (Talk) Providence Area Aging Research Forum, February 28, 2012.

Catherine B. Volle and Sarah Delaney. "Investigation of Trinucleotide Repeats in Nucleosome Core Particles" (Poster) Albany 2011: The 17th Conversation, June 17, 2011.

Catherine B. Volle and Sarah Delaney. "Investigation of Trinucleotide Repeats in Nucleosome Core Particles" (Poster) Biophysical Society Meeting, March 7, 2011.

Catherine B. Volle and Sarah Delaney. "Investigation of Trinucleotide Repeats in Nucleosome Core Particles" (Poster) American Chemical Society Meeting, August 22, 2010.

Catherine B. Volle, Megan A. Ferguson, Katherine E. Aidala, Eileen M. Spain, and Megan E. Núñez. "Physical Properties of Native Biofilm Cells Explored by Atomic Force Microscopy" (Poster) Gordon Research Conference, Applied and Environmental Microbiology, July 16, 2009.

Catherine B. Volle, Megan A. Ferguson, Katherine E. Aidala, Eileen M. Spain, and Megan E. Núñez. "Physical Properties of Native Biofilm Cells Explored by Atomic Force Microscopy" (Poster) Biophysical Society Meeting, February 10, 2009.

Catherine B. Volle and Megan E. Núñez. "Characterization of Lipopolysaccharide Monolayers from *Bdellovibrio* Predator and *E. coli* Prey" (Poster) American Society for Microbiology General Meeting, June 2, 2008.

Catherine B. Volle. "AFM investigations into the physical changes of biofilm cells during attack by *Bdellovibrio bacteriovorus*" (Talk) Invited lecturer, Harvard AFM Workshop, Asylum Research, February 12, 2008.

Catherine B. Volle and Megan E. Núñez. "Characterization of Lipopolysaccharide Monolayers from *Bdellovibrio* Predator and *E. coli* Prey" (Poster) Biophysical Society Meeting, February 3, 2008.

Catherine B. Volle and Megan E. Núñez. "Characterization of Lipopolysaccharide Monolayers from *Bdellovibrio* Predator and *E. coli* Prey" (Poster) American Chemical Society Annual Meeting, August 20, 2007.

Megan A. Ferguson, **Catherine B. Volle**, Megan E. Núñez, and Eileen M. Spain. "Structure of a Pigment Produced by Host-Independent *Bdellovibrio bacteriovorus*" (Poster) American Chemical Society Annual Meeting, August 19, 2007.

Catherine B. Volle and Megan E. Núñez. "Characterization of Lipopolysaccharide Monolayers from *Bdellovibrio* Predator and *E. coli* Prey by Langmuir-Blodgettry and Atomic Force Microscopy" (Poster) American Society for Microbiology General Meeting, May 24, 2007.

Megan A. Ferguson, **Catherine B. Volle**, Megan E. Núñez, and Eileen M. Spain. "Probing Living *Escherichia coli* Biofilms in Fluid Using Quantitative Atomic Force Microscopy Force Measurements" (Poster) American Society for Microbiology General Meeting, May 24, 2007.

Megan A. Ferguson, **Catherine B. Volle**, Megan E. Núñez, and Eileen M. Spain. "Structure and function of a pigment produced by host-independent *Bdellovibrio bacteriovorus*" (Poster) American Society for Microbiology Annual Meeting, May 23, 2007.

Catherine B. Volle and Megan E. Núñez. "Characterization of Lipopolysaccharide Monolayers from *Bdellovibrio* Predator and *E. coli* Prey by Langmuir-Blodgettry and Atomic Force Microscopy" (Poster) Biophysical Society Annual Meeting, March 6, 2007.

Catherine B. Volle, Stephanie Azan, and Megan E. Núñez. "Characterization of Lipopolysaccharides from *Bdellovibrio* Predator and *E. coli* Prey by Chromatographic, Electrophoretic, and Spectroscopic Techniques" (Poster) Biophysical Society Annual Meeting, March 6, 2007.

For letters of reference please contact:

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