

Stefan Mark Irby, Ph.D. Candidate

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EDUCATION

Ph.D. Chemistry - Chemical Education (3.88 GPA)

August 2014 - Present

Purdue University

West Lafayette, Indiana

B.S. Biochemistry (3.72 GPA)

September 2010 - June 2014

Western Washington University

Bellingham, Washington

A.A. Business

January 2009 - June 2010

Green River Community

Auburn, Washington

High School Diploma

September 2007 - June 2010

Tahoma Senior High School

Covington, Washington

RESEARCH

Doctoral Researcher - Biochemistry Education

August 2014 - Present

Purdue University

West Lafayette, Indiana

Conducting research under the advisement of Dr. Trevor R. Anderson as part of the Visualization in Biochemistry Education (VIBE) research group within the Department of Chemistry at Purdue University. My thesis research focuses on a biochemistry Course-based Undergraduate Research Experience (CURE), where students use a combination of computational and biochemistry lab techniques to elucidate the function of proteins that have been structurally characterized.

Undergraduate Researcher - Chemistry Education

March 2011 - June 2014

Western Washington University

Bellingham, Washington

Conducted research under the advisement of Dr. Emily J. Borda of the Department of Chemistry at Western Washington University in the area of chemistry education and epistemology.

- Researched the effects of learning chemistry using virtual modules in place of traditional wet labs
- Designed and implemented a card sorting task to investigate the use of the multiple representations in chemistry to model and understand different chemical concepts.
- Analyzed Views on Science-Technology-Society (VOSTS) data
- Analyzed and modified the Chemical Concept Questionnaire (CCQ)
- Helped to modify the chemistry 101 curriculum
- Evaluated students' ability to generate models to explain chemical phenomena

Research Intern

June 2013 - August 2013

Fred Hutchinson Cancer Research Center

Seattle, Washington

Conducted research under Dr. Barry Stoddard at the Fred Hutchinson Cancer Research Center in the Basic Science division. The lab's focus is structural biology and crystallography. My specific experiences included:

- *Studying de novo* enzymes that model the enzyme Purine Nucleoside Phosphorylase.
 - Expressed and purified engineered proteins
 - Created a purification protocol
 - Generated point mutants and GST fused versions of the *de novo* enzyme
 - Began crystal trials to obtain structural data on the proteins
- Homing endonucleases
 - Expressed and purified the homing endonuclease, I-Cth
 - Began crystal trials to obtain structural data on the protein

TEACHING

General Chemistry Course Coordinator

June 2016 - Present

Purdue University

West Lafayette, Indiana

I coordinate all of the logistical matters of the course. This includes, but is not limited to, maintaining the blackboard site, managing student accommodations, preparing lecture handouts, proof reading exams, and serving as the liaison between the instructors, students and general chemistry office staff. In addition to these tasks I also lead staff meetings, modify and update course materials, perform student grade checks, facilitate weekly Preparation And Readiness for Taking Exams (PARTÉ) problem solving sessions for students, host an office hour, distribute lab keys, , aid in the training and development of TAs, and act as a resource to help with any questions that arise from both TAs and students.

- General Chemistry II - College of Science and Engineering Majors (CHM 116): Summer 2016

General Chemistry Lab Supervisor

August 2015 - Present

Purdue University

West Lafayette, Indiana

I maintained the enforcement of course policies and lab safety for up to 13 different general chemistry lab sections at a time. In addition, I lead staff meetings, modify and update course materials, perform student grade checks, facilitate weekly PARTÉ problem solving sessions for students (CHM 116), host an office hour, distribute lab keys, organize/conduct concept quiz regrades, aid in the training and development of TAs, as well as act as a resource to help with any questions that arise from both TAs and students.

- General Chemistry I - College of Science and Engineering Majors (CHM 115): Fall 2015 and Fall 2016
- General Chemistry II - College of Science and Engineering Majors (CHM 116): Spring 2016, Summer 2016, and Spring 2017

Graduate Chemistry Teaching Assistant

August 2014 - May 2015

Purdue University

West Lafayette, Indiana

As a general chemistry teaching assistant, I instructed up 24 students per section twice a week (a 1 hr recitation and a 3 hr lab). In addition to teaching, I also held office hours, graded assignments, and provided feedback during staff meetings, on potential improvements to the labs or to the course in general.

- General Chemistry I - College of Science and Engineering Majors (CHM 115): Fall 2014 (two sections)
- Intro to Chemistry II - Chem Majors (CHM 126): Spring 2015 (two sections)

Chemistry Lab Teaching Assistant

January 2011 - June 2014

Western Washington University

Bellingham, Washington

I performed a diverse range of laboratory duties requiring the use of various procedures with limited supervision. I also performed technical duties with prescribed materials and methods as well as some requiring decision making in the selection of materials and methods. I performed routine set-up of laboratory equipment, maintained written records, and contributed to the refinement of procedures and methods for laboratory exercises.

- Introductory Chemistry (chem 101): Spring 2012 (two sections)
- General Chemistry III (chem 123): Winter 2012, Winter 2013, Spring 2013, Fall 2013
- Elementary Organic Chemistry (chem 251): Fall 2012
- Biochemistry (chem 474): Fall 2013

AWARDS, DISTINCTIONS, AND SCHOLARSHIPS

ASBMB Graduate Student Travel Award 2017

American Society for Biochemistry
and Molecular Biology

Honorable Mention 2016

Graduate Research Fellowship Program

National Science Foundation

Initiated into Phi Lambda Upsilon 2015

Chemistry Honor society, Nu Chapter

Purdue University

Barbara French Duzan Scholarship 2013

Western Washington University

Hach Land Grant Undergraduate Scholarship 2013

American Chemical Society

President's Honor Roll (4.0 GPA) Spring 2012

Western Washington University

Julia Ann Rutherford Memorial Scholarship 2012

ACS - Puget Sound Chapter

Hach Land Grant Undergraduate Scholarship 2012

American Chemical Society

Chemistry Department Tuition Waiver Scholarship 2012

Western Washington University

Brilliant Scientist of Tomorrow Book Scholarship 2012

Brilliant Scientist of Tomorrow

President's Honor Roll (4.0 GPA) Fall 2011

Western Washington University

Future Wooding Scholar 2010

Woodring College of Education

Future Educator of Tomorrow Scholarship 2010

Tahoma Education Association

PAPERS, PRESENTATIONS, AND POSTERS

Publications

Irby, S. M., Pelaez, N. J., & Anderson, T. R. (2017). A Process for Identifying and Validating the Specific Competencies for a Course-based Undergraduate Research Experience (CURE) Laboratory Course. *Manuscript in preparation*.

Irby, S. M., Phu, A. L., Borda, E. J., Haskell, T. R., Steed, N., & Meyer, Z. (2016). Use of a card sort task to assess students' ability to coordinate three levels of representation in chemistry. *Chemistry Education Research and Practice*, 17(2), 337-352.

Oral Presentations *underlined author denotes presenter(s)*

Irby, S., Phu, A., Borda, E., Haskell, T. (2014, August). Scratching the surface of chemistry: A progression for categorizing chemistry problems. Presented at Biennial Conference on Chemical Education, Allendale, MI.

Haupt, J., Borda, E., **Irby, S.**, and Phu, A. (2014, August). Cognitive affordances of multiple external representations in a virtual chemistry lab. Presented at Biennial Conference on Chemical Education, Allendale, MI.

Poster Presentations *underlined author denotes presenter(s)*

Irby, S. M., Pelaez, N. J., & Anderson, T. R. (2017, April). A Process for Defining and Validating Learning Competencies for Course-Based Undergraduate Research Experiences in a Biochemistry Laboratory Curriculum. Poster session presented at Experimental Biology, Chicago, IL.

Craig, P., Mills J., Roberts, R., Pikaart, M., Daubner, C., **Irby, S.**, & Anderson, T. (2017, April). Transition to a Course-based Undergraduate Research Experience (CURE). Poster session presented at Experimental Biology, Chicago, IL.

Mills, J., DiCola, A., Roberts, R., Pikaart, M., Daubner, C., **Irby, S.**, Anderson, T., Bernstein, H., & Craig, P. (2017, April). Assessing Learning Gains Through ePortfolios in an Undergraduate Biochemistry Lab. Poster session presented at Experimental Biology, Chicago, IL.

Roberts, R., Koeppe, J., Price, S., Allwein, B., Anderson T., Daubner, S. C., **Irby, S.**, Mills, J., Pikaart, M., & Craig, P. (2017, April). Modeling Interdisciplinary Collaborations Through a Course-Based Undergraduate Research Experience (CURE). Poster session presented at Experimental Biology, Chicago, IL.

Irby, S. M., Pelaez, N. J., & Anderson, T. R. (2016, August). Towards an understanding of reasoning about proteins of unknown function in biochemistry course-based undergraduate research experiences. Poster session presented at Biennial Conference of Chemical Education, Greeley, CO.

Irby, S., Phu, A., Borda, E., and Haskell, T. (2014, May). Scratching the surface of chemistry: A progression for categorizing chemistry problems. Poster session presented at Western Washington University Scholars Week, Bellingham, WA.

Irby, S. and Stoddard, B. (2013, August). Characterization of the Homing Endonuclease I-Cth. Fred Hutchinson Cancer Research Center's Summer Undergraduate Research Program competitive poster session. Seattle, WA.

Irby, S. and Borda, E. (2012, June). Analysis of module learning and student outcomes: Using technology to increase gains in chemical education. Poster session presented at ACS North West Regional Meeting, Boise, ID.

Irby, S. and Borda, E. (2012, May). Analysis of module learning and student outcomes: Using technology to increase gains in chemical education. Poster session presented at Western Washington University Scholars Week, Bellingham, WA.

DEPARTMENTAL VOLUNTEERING AND OUTREACH

National Chemistry Week

October 2016

Purdue University

West Lafayette, Indiana

National Chemistry Week is a week-long event designed to encourage chemistry enthusiasts to spread their love of chemistry at a local level. This involves traveling to local schools and encouraging students to develop an interest in science, as well as showed kids the fun side of chemistry. My participation in this program consisted of traveling to a local elementary school, and working through various chemistry activities with the students. This provided me with the opportunity to work with students and to help them develop their chemistry understanding. This also afforded me the opportunity to further develop my ability to communicate complex chemistry concepts in ways that are more readily comprehensible, in this case at an appropriate level for elementary schoolers. There was also time for them to ask questions about chemistry, myself, college, post-secondary opportunities and what it was like to be a scientist/graduate student.

Chemistry Department Recruitment

March 2016 and 2017 (annually)

Purdue University

West Lafayette, Indiana

I act as a host and a contact person for several potential chemistry graduate students. I make myself available for questions and a resource for information about the department, university or the greater Lafayette area. Specifically, I partake in several of the various recruitment activities, such as department facility tour, escorting recruits to different events, campus and city tours, host recruits, and partake in informal social time. I also, made a point to reach out to potential students prior to their recruitment visit, and would stay in contact with them after formal recruitment if they had persisting questions.

Chemistry Graduate Student Mentoring Program

August 2015 - Present

Purdue University

West Lafayette, Indiana

I have been appointed as a mentor to 1-2 mentees each year in the Chemistry Department's graduate student mentoring program. As a mentor, I reach out to my mentees and offer any support they may need as part of their transition to Purdue. This includes, but is not limited to, advising on course work, research group selection, and aiding in qualifying exam preparation. I also make an effort to develop genuine personal connections with my mentees to help them get situated with all aspects of life here at Purdue and the greater Lafayette community.

Chemistry Graduate Student Orientation

August 2015 and 2017 (annually)

Purdue University

West Lafayette, Indiana

I help to organize and lead micro-teaching sessions during orientation week for incoming chemistry graduate students. These sessions allowed the incoming students to practice their teaching, before they serve as a TA. I lead micro-teaching sessions, demonstrate good classroom practices and problem-solving strategies, and provide feedback for their mock lecture presentation.

PROFESSIONAL DEVELOPMENT

Safe Zone Certified

January 2017

Purdue University

West Lafayette, Indiana

Safe Zone is a training and support program that empowers participants to support LGBTQ students, staff, and faculty. Purdue University Safe Zone members include students, staff, faculty, and community members who have attended a three-hour training workshop exploring the unique needs and concerns LGBTQ people face in higher education while also building their knowledge, skills, and abilities for creating a more inclusive and affirming campus for all students. Additionally, Safe Zone members display a placard in a visible location such as a door to an office or residence hall that identifies them as a friend, supporter, and campus resource for anyone seeking information or a listening ear. This placard identifies dedicated safe spaces on campus for LGBTQ people to connect with allies to the community. I am registered with the Office of Diversity and Inclusion as a member and an ally.

VIBE Research Group Office Manager

August 2015 - Present

Purdue University

West Lafayette, Indiana

I am the acting office manager for my research group. This entails overseeing all office related issues including, but not limited to, maintenance, supply ordering, coordinating with tech support, and aid in taking care of other office and group dynamic matters, such as conference and travel booking. I am also in charge of helping to set up and run VIBE conference meetings and teleconference meetings. This position has provided me with invaluable insight on the inner workings of the logistics and resources it takes to run a research group and how to manage them.

MEETINGS ATTENDED

Experimental Biology (EB)

Biennial Conference on Chemical Education (BCCE)

National Association for Research in Science Teaching (NARST)

Biennial Conference on Chemical Education (BCCE)

ACS North West Regional Meeting (NORM)

Chicago, IL. 2017

Greely, CO. 2016

Chicago, IL. 2015

Allendale, MI. 2014

Boise, ID. 2012

PROFESSIONAL GROUPS AND ORGANIZATIONS

Member of the American Society for Biochemistry and Molecular Biology

2016 - Present

Member of Phi Lambda Upsilon

2015 - Present

Nu Chapter of the National Honorary Chemical Society

Member of the National Association for Research in Science Teaching

2015 - 2016

Member of the Purdue International Biology Research Group

2014 - Present

Member of the Puget Sound Section of the American Chemical Society

2012 - Present

Member of the American Chemical Society

2012 - Present

Research Abstracts of Work Published or Presented while at Purdue

A Process for Defining and Validating Learning Competencies for Course-Based Undergraduate Research Experiences in a Biochemistry Laboratory CurriculumPoster
(2017)*Irby, S. M., Pelaez, N. J., & Anderson, T. R.*

Abstract: There is a move in science education to provide students with more Course-based Undergraduate Research Experiences (CUREs). As CUREs begin to be implemented, their impact on student learning needs to be thoroughly evaluated. Thus far, educational research on CUREs has mainly utilized generalized surveys, rubrics, and perception instruments to assess students' technical performance and laboratory experiences; with a dearth of research focusing on the assessment of the scientific research attributes and behaviors that these courses are expected to develop in students. The goal of this study was to design a process for the development and validation of a taxonomy of scientific research abilities that students could acquire during a novel biochemistry CURE laboratory, where students predict and evaluate hypotheses for the function of proteins that have a known structure, but no confirmed function. Towards this goal, the following research questions were addressed: 1) which scientific research abilities are key to the competent performance of the biochemistry CURE laboratory? and 2) what educational research process could be developed to identify these scientific research abilities to enable the construction of the taxonomy? To address these questions, data was collected at six institutions from instructors who had participated in the development of the lab teaching materials. The study was framed by the Concept-Reasoning-Mode of Representation (CRM) model and focused on the scientific reasoning taking place with the various concepts and representations, either presented or generated as part of each lab. The process included the collection of three types of data: content analysis of the lab protocols to identify concepts and representations, a faculty survey to determine how experts reason with the different concepts and representations of relevance to the lab, and faculty interviews to probe deeper into the nature of students' research experiences and abilities that may be encountered during the performance of the laboratory. Analysis of the data allowed for triangulation and identification of items in common across the data sources which, in turn, permitted identification of student competencies acquired from the CUREs. Proposed ability statements were validated by surveying the faculty members about their importance and whether they expected students to acquire such abilities during the lab. The process proved effective for the identification of research abilities that in the future could be used to develop a taxonomy of student learning for biochemistry CURE laboratories. This taxonomy will be used to inform further curriculum development, including student assessment and more carefully targeted teaching and learning activities. Finally, the process shows potential for application to other lab courses across institutions where the goal is to develop students' abilities to think and perform like a research scientist.

Towards an understanding of reasoning about proteins of unknown function in biochemistry course-based undergraduate research experiencesPoster
(2016)*Irby, S. M., Pelaez, N. J., & Anderson, T. R.*

Abstract: There is a current move in science education to provide students with more Course-based Undergraduate Research Experiences (CUREs). This study is part of an NSF-funded IUSE project, investigating the implementation of a novel biochemistry research-like lab across six different institutions. This semester-long lab sequence requires students to elucidate the unknown function of specific proteins from known structural data from the Protein Data Bank. Students use computational techniques to generate a hypothesis about their protein's function and then, through biochemical assays, evaluate their proposed protein function. Research on these types of learning environments rely heavily on quantitative surveys, with a lack of in-depth qualitative analysis. Here we present the first phase of a qualitative evaluation of the lab, which addresses the following research questions: 1) What sources of data, representations and types of reasoning do scientists use when elucidating protein function? and, 2) What perceptions do instructors have about the learning outcomes of the course? These questions were addressed through a combination of content analysis of course materials, an open-ended instructor survey, and instructor interviews. Preliminary findings are revealing the process instructors use to determine protein function, their perceptions of learning outcomes and how such insights translate into their implementation of the course. Future research will involve using these findings to inform the development of student probes aimed at establishing whether what instructors expect students to learn is actually being learned and how to optimize the curriculum to develop students' reasoning about protein function.

Use of a card sort task to assess students' ability to coordinate three levels of representation in chemistryPaper
(2016)*Irby, S. M., Phu, A. L., Borda, E. J., Haskell, T. R., Steed, N., & Meyer, Z.*

Abstract: There is much agreement among chemical education researchers that expertise in chemistry depends in part on the ability to coordinate understanding of phenomena on three levels: macroscopic (observable), sub-microscopic (atoms, molecules, and ions) and symbolic (chemical equations, graphs, *etc.*). We hypothesize this “level-coordination ability” is related to the formation and use of principle-based, vs. context-bound, internal representations or schemas. Here we describe the development, initial validation, and use of a card sort task to measure the level-coordinating ability of individuals with varying degrees of preparation in chemistry. We have also developed a novel method for generating two-dimensional sorting coordinates which were used to arrange participants along a hypothetical progression of level-coordination ability. Our findings suggest the card sort task shows promise as a tool to assess level-coordination ability. With the exception of graduate students, participant groups on average progressed from sorting by level of representation toward sorting by underlying principle. Graduate students unexpectedly sorted primarily by level of representation. We use these data to form initial hypotheses about a typical process for the development of level-coordination ability and schema formation. In doing so, we demonstrate the usefulness of our task paired with sorting coordinate analysis as a tool to explore the space between novice and expert behavior. Finally, we suggest potential uses for the task as a formative assessment tool at the classroom and program levels.