The following annotated CV emphasizes activities specifically related to teaching. For a full accounting of all other research and service activities, please visit https://www.raysciences.com/cv/

EDUCATION

PhD, Chemistry**, Lehigh University, Bethlehem PA, **2007
- Dissertation: "Bottom-Up Surface Self-Assembly of Polymer Colloids to Form Patterned Arrays"
- Advisers: Li Jia, Greg Ferguson

MS, Chemistry**, Lehigh University, Bethlehem PA, **2005
- Thesis: "Dynamic Self-Assembly of Polymer Colloids to Form Linear Patterns"
- Adviser: Li Jia

BS, Chemistry**, (magna cum laude), Bob Jones University, Greenville SC, **2001
- Minor: Physics, Major-Minor GPA: 4.00, Cumulative GPA: 3.88
- Thesis: "Synthesis of a Novel Cross-Linking Monomer for Fuel Cell Membrane Applications"
- Adviser: George Matzko (Clemson REU-SURP Adviser: Darryl DesMarteau)

TEACHING EXPERIENCE

***University of Wisconsin – Stout, Department of Chemistry and Physics,** Menomonie WI*
Department Chair, 2023 – Present
Professor of Chemistry, 2019 – Present
Associate Professor, 2014 – 2019 (tenured 2016)
Assistant Professor, 2010 – 2014

***Lehigh University, Department of Chemistry and Emulsion Polymers Institute,** Bethlehem PA*
Teaching Assistant, 2001 – 2002
- Led Advanced General Chemistry laboratories and lecture course recitations

The courses that I have taught since joining UW-Stout:

CHEM-241 (341): Chemistry of Materials – I have offered this 4-credit course 32 times to a total of 55 sections of students. This course is required for Manufacturing Engineering, Mechanical Engineering, and some Applied Science concentrations. I have redesigned and tailored the lecture and lab content to the program needs of these populations of students. I met with professors from Manufacturing Engineering to discuss their courses and find ways to specifically connect the chemistry concepts in my course to topics they learn about elsewhere in their major. Students also work on a semester long group project in which they explore a particular material application or contact a local company related to the course and give 15-minute in-class oral presentations during the last 2 weeks of class. Through this experience, each student becomes actively involved in the teaching process and must assimilate and redistribute the concepts learned throughout the semester which undoubtedly deepens their learning. Students have also received internships as a result of contacts made through this project. Students from CHEM-341 have also presented a total of **30 STEM EXPO posters** covering case studies in materials science, different 3M technologies as part of a broader "Spotlight 3M Technologies Symposium" and uses of materials in local manufacturing companies in a "Spotlight Northwest Wisconsin Business Symposium"


CHEM-341 Glass Lab

CHEM-341 Students Presenting at STEM EXPO

— "Dr. Ray is awesome. His enthusiasm makes me want to become a chemistry major." CHEM-341, Spring 2013

CHEM-245 (325): Chemistry of Polymers – I have offered this 4-credit course 12 times to a total of 19 sections of students. I completely redesigned both the lecture and laboratory component of this course as well. In industry, taking an idea from concept through commercialization is the goal. I wanted to convey this mantra to the students in this course using the laboratory experience. I developed a "**Synthesize, Characterize, Utilize**" approach to lab, modeled after industrial research and development. Using glass reactors identical to those I used in industry, students synthesize and formulate three different products and then benchmark them against similar commercially available materials. Specifically, the students synthesize and test acrylic paint binder, pressure sensitive adhesive, injection moldable polystyrene. Student data on new formulations added to a growing body of data with the intent of eventual publication of results. Students have presented a total of **9 STEM EXPO posters** all highlighting different 3M technologies as part of a broader "Spotlight 3M Technologies Symposium"

CHEM-135: College Chemistry – I have offered this 5-credit course 9 times to a total of 17 sections of students. I consistently took the "***Chemistry in the Classroom***" approach, matching in-class demonstrations with course content on at least a weekly basis to amplify lecture concepts and maintain a high level of interest. Three of my course offerings were a part of an Engineering Learning Community (F12, F13, F14), where a cohort of freshman students register for my course along with a particular engineering course to facilitate the establishment of peer support early in their academic career and encourage retention. I found working with this group to be very rewarding. I see many of these students again in CHEM-341 and can therefore offer a high degree of cohesion between the courses.

CHEM-365: Industrial Chemistry – I have offered this 3-credit course three times (3 sections). I developed the curriculum for this course which covers the materials and processes used to synthesize all the major materials in the chemical industry spanning fertilizers, agricultural chemicals, pharmaceuticals, food additives, petroleum products, fuels, plastics, as well as patents and business aspects of the chemical industry. The course is primarily geared toward Applied Science students with a concentration in Industrial Chemistry or Plastics Engineering students with a minor in Materials Science.

CHEM-301/303: Physical Chemistry – I have offered this 4-credit course three times (3 sections). The lecture component of this course focuses on thermodynamics, spectroscopy, quantum mechanics, and surface chemistry. The lab component of this course is very data intensive, and students process their results using spreadsheets. Lab reports are written in a style and length similar to published journal articles. Students participate in the experimental design process and are required to think critically about the interpretation of their results. Students have presented a total of **11 STEM EXPO posters** reporting experimental data collected throughout the semester on topics ranging from fluorescence to surface tension.

NANO-401: Nanotechnology Applications – I have only taught this 3-credit course one time (one section), but it was a very rewarding experience. The class was populated by 8 upper-level materials and nanoscience concentration students. I moved the class location to a conference room because I wanted to structure the class to be the same as an industrial R&D meeting or a research group meeting in graduate school. We discussed both industrial and academic applications as well as how to best represent their experiences on job and grad school applications. The students also decided to take on an out-of-class synthesis project. We assembled a synthesis and characterization **lab manual** that is frequently used as reference material in other NANO courses. Students presented **7 STEM EXPO posters** reporting the results of their independent research projects.

Lecture Recordings: Recording lecture videos is not a new concept for me. I have recorded and posted **all** of my lectures as a YouTube playlist for nearly every course each semester since **2014**. I have recorded and posted ***1255*** *lecture videos* representing over ***900*** *hours of content!* I progressively add each lecture to a course playlist all semester so the students can review all of the material we have covered at any time. I also add various other YouTube videos to go along with course content to augment and illustrate topics covered during lecture.

Student Course Evaluations – Student evaluations from all of the courses that I have taught have consistently been overwhelmingly positive and encouraging. Students consistently indicate that they appreciate the content, humor, and delivery of the lecture course work. They also comment on how much they enjoy the lab experiences.

— "being able to rewatch his lectures that he records is amazing. So glad he goes through the extra effort for his students."
CHEM-241, Fall 2021

It is apparent that students enjoy, appreciate, and value the content taught. Several example student evaluations are shown below.

- "Dr. Ray is an excellent teacher. He makes himself available to students and clearly identifies and explains subject matter. His class in depth yet he keeps it interesting and fun! I am a junior and he is hands down one of the best teachers I have experienced at Stout! I am not even good at chemistry and I enjoyed his class and he has changed my attitude toward chemistry. He ROCKS!" ***CHEM-135, Fall 2012***
- "Dr. Ray was the best professor I've had at this school. His lectures are very easy to look forward to, and Chemistry is my one of least favorite subjects. He knows how to keep it fresh and interesting, does fun experiments in class occasionally (not too much or too little) and he has a good sense of humor. On top of everything, he's very knowledgeable and understands what he's talking about and does a very good job of explaining in easy ways if it's a complicated topic." ***CHEM-135, FALL 2013***
- "He encouraged all curiosity, especially the child-like curiosity that I exhibited, talking in length about anything I asked about" ***CHEM-245, SPRING 2021***
- "I saw a lot of overlap in my classes while taking this class (first time I can remember this much information being useful in other classes). He draws on a lot of examples to really describe what is happening and to further explain the material." ***CHEM-241, Fall 2022***

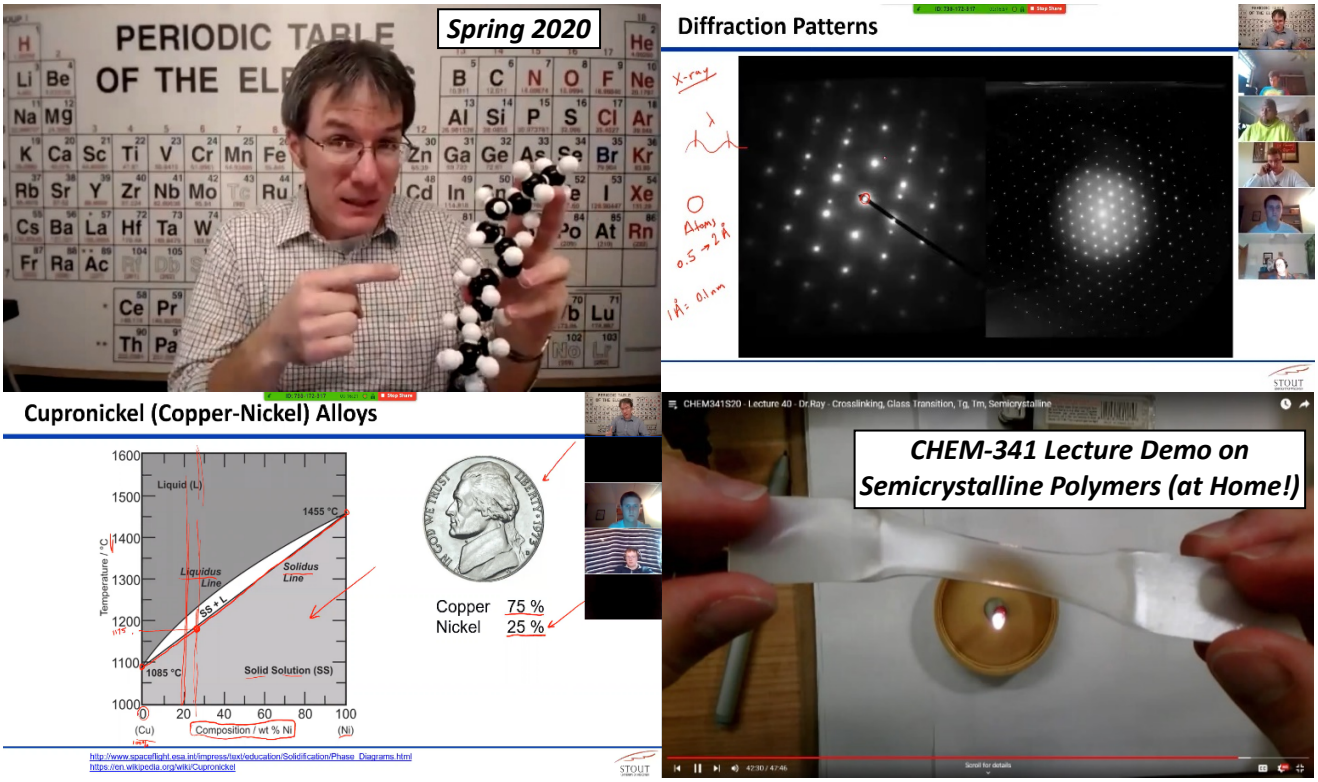
COVID Challenges: Because I had been recording and posting all of my lectures since 2014, I was already practiced in some respects to transition to online learning full-time at the beginning of the pandemic. However, I did not just want to record and post videos and lose the classroom interaction, so I decided to setup a YouTube Studio in my basement over the transitional spring break (lights, backdrops, multiple camera views, document camera, etc.), purchased a ZOOM license, learned OBS Studio (Open Broadcaster Software), sent out instructions to my students toward end of spring break, and began with live *synchronous* lecture Monday after spring break at our regularly scheduled class times. The students attended online lecture, asked questions, and interacted. All lectures were still recorded and posted for those who were unable to attend synchronously. My goal was to keep the course experience as close as possible to on-campus delivery. Laboratory experiments were replaced with field observations, case studies, simulations, and in-home experiments.

With all of the psychological stressors during that period, I wanted to "preserve normalcy" and still hold a regular class schedule to give my students structured scheduled class events to participate in. Because all lectures were recorded, the students could self-select into synchronous or asynchronous course delivery. Most opted for synchronous and consistently attended the live lecture.

I received some unexpected and unsolicited feedback at the end of the Spring 2020 semester. The following email, titled: "**Fan mail!**" from a colleague on campus who is a Professor of English and Philosophy was sent to me: "*In my composition class, I asked students to do a short writing exercise about someone they met at Stout who impressed them. Here is one of the responses.* ☺"

> *"One person who impressed me was my Chemistry of Polymers professor this semester. Dr. Ray was able to teach the students what they needed to succeed while making it one of the most fun and interesting classes I have ever taken. He has also been able to do a complete transition online that is super effective and I was very impressed at how fast he was able to do it."*

When the campus reopened, I decided to get back to on-campus delivery as soon as possible and deliver all lectures and labs face-to-face (or at least mask-to-mask). For the Fall 2020 and Spring 2021 semesters, we had spaced seating charts, desk wash down after every class, and reduced capacity labs. The labs in particular presented a significant challenge. In a given week, my time was split, along with a teaching assistant, between two adjacent *half-filled* labs. Every few weeks, we would rotate, so each student spent the same amount of time in the "main lab" and "satellite lab". It was **a lot** of extra work and *doubled* my lab prep and cleanup each week, but it was worth it to deliver the full lab experience and essentially give the students all the same course elements that their peers received in previous years. It certainly was not ideal, but from student comments, it was apparent that they truly appreciated the extra effort to give them the fullest course experience possible.



COVID Era Student Course Evaluations

- "Dr. Ray is one of the best professors I have had at Stout. He is extremely knowledgeable and passionate about the subjects he teaches. This semester with having things being moved to online learning this class was as close as possible to being taught how it would have been if it was in person. Lectures were at the same time as usual and there were labs based on the course material that were interactive and clearly showed concepts." ***CHEM-341, SPRING 2020***
- "Dr. Ray's class was a bright spot in my day. He made it very interesting and he was always very prepared and willing to help any and all students. He showed us all respect, which made it very easy to pay attention and be respectful in return. I've had some teachers who do not seem to grasp this concept. Furthermore, when we switched to online classes, he did his best to find related labs that we could do at home and always had online office hours" ***CHEM-325, SPRING 2020***
- "You did a wonderful job transitioning to online learning, by far the best teacher I had this semester. A very rememberable class" ***CHEM-325, SPRING 2020***
- "I swear he is the only professor this fall semester to actual care about his job. If it wasn't for Dr. Ray I'd probably be demanding my tuition back just so I could burn it. College is a joke in 2020. While other professors delivered garbage content this semester, Dr. Ray was the only one to care about his job and run a productive class. He is easily one of my top 3 professors I've ever had." ***CHEM-241, FALL 2020***
- "Having access to additional resources via Canvas and recordings of current and past lectures was SO NICE! If I was ever confused about a topic, it was extremely easy to go back in time to a past lecture and re-learn it." ***CHEM-241, Fall 2020***
- "Dr. Ray is one of the professors that I believe really worked hard and succeeded in changing this class for COVID. It was not online, but he did have all of the online stuff organized well. He tried his best to keep it as close to a regular offering as possible and I appreciate it. I would recommend this class and this professor to others. Stout is lucky to have him!" ***CHEM-241, SPRING 2021***

— "Dr. Ray provided one of the safest and inclusive learning environments that I have had in my 3 years at Stout."
CHEM-241, Fall 2021

STUDENT COURSE EVALUATION SUMMARY

- ***What do Dr. Ray's students think about his courses?***

COURSES TAUGHT

- **College Chemistry I – CHEM-135**
- **Chemistry of Materials – CHEM-241**
- **Chemistry of Polymers – CHEM-245**
- **Physical Chemistry – CHEM-301**
- **Industrial Chemistry – CHEM-365**
- **Nanotechnology Applications – NANO-401**
- **Advanced Chemistry Experience – CHEM-489**

These un-edited word clouds represent aggregated data from ***all student comments*** from all course evaluations between 2010 – 2021 . . .

— "He's the best professor I have ever had" CHEM-241, Spring 2023

From Synthesis to Injection Molding, a 360° Polymer Lab Experience

Clayton Barrix, Dayton Ramirez, Mitchell Woellner, Matthew Ray*
Department of Chemistry, University of Wisconsin-Stout

Abstract

Undergraduate laboratory experiences are frequently comprised of experiments and procedures with fully known and previously characterized outcomes. Studies have shown that learning is significantly enhanced by empowering students with the ability to be a part of the experimental design and discovery process. In the laboratory component of Chemistry of Polymers, students synthesize new polymer compositions and the experimental parameters are varied. Sections of 24 students are divided into 5 synthesis groups, each with a different combination of monomer identity, concentration, temperature, stirring rate, etc. Each group fully characterizes their polymer products, the data is trended and findings are discussed during lecture. New polymerizations expanding upon literature procedures are pursued each semester with the goal of accumulating publishable data. On the final day of lab, students make an injection molded product from the polymer they synthesized. The manufactured part is a molecule shaped keychain that is a model of the monomer they started with at the beginning of the semester. By completing this conceptual loop, students are reminded of where their polymer came from and the chemical concepts learned at the beginning of the semester are significantly reinforced.

Figure 1: Injection molded styrene molecule shaped keychain

Reactor Design

Polymerization reactors consisted of a three-neck round-bottom flask fitted with an overhead stirrer, glass stir shaft with half moon impeller, thermocouple, heating mantle, temperature controller, cold water condenser, nitrogen inlet, and bubbler.

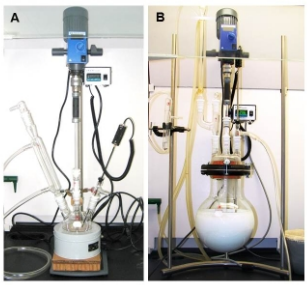


Figure 2: **Panel A** shows a typical 250-mL reactor setup used by student groups while **Panel B** shows a 5 L reactor used to make large batches of polymer.

Suspension Polymerization

Suspension polymerization produces a sand like polymer product directly from the reactor that can be used in injection molding equipment without the need for pelletization. The polymer composition used in the injection molding process for the key chains is shown in **Table 1** below.

Table 1: Suspension Polymer Recipe

Ingredients	Amount
Water	234 g
5% Polyvinyl Alcohol	26 g
Styrene	88 g
Hexadecane	2 g
Benzoyl Peroxide	0.4 g

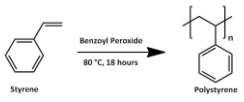
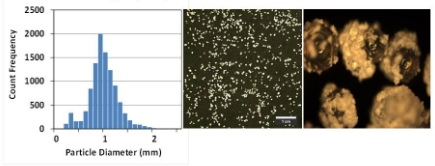


Figure 3 below shows the particle size distribution and morphology of the resulting polymer product.



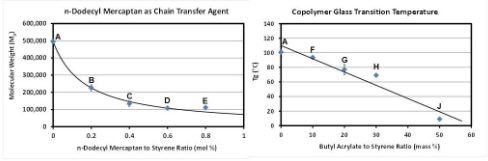
Emulsion Polymerization

Emulsion polymerization was used to study the effect of chain transfer agents and co-monomers on the molecular weight and glass transition temperature. The continuous phase composition was 98 g water, 20 g 5% sodium dihexyl sulfosuccinate surfactant, 0.23 g sodium bicarbonate, and 0.2 g potassium persulfate. Monomer compositions were varied and added as shown in **Table 2** below.

Table 2: Emulsion Polymer Recipe Variations

Variation	Styrene (g)	Butyl Acrylate (g)	n-Dodecyl Mercaptan (g)
A	51	0	0
B	51	0	0.2
C	51	0	0.4
D	51	0	0.6
E	51	0	0.8
F	45.9	5.1	0
G	40.8	10.2	0
H	35.7	15.3	0
I	30.6	20.4	0
J	25.5	25.5	0

The recipe variations resulted in polymer with properties that followed well behaved trends as shown in the plots below.



Mold Design

A set of styrene molecule shaped cavity and core mold inserts for a master unit die (MUD) unit was designed using Dassault Systèmes Solidworks 3D CAD software. The flow behavior of polystyrene was modeled using Autodesk Simulation Moldflow Synergy 2013 software to determine the optimal sprue, runner, and gating locations for the part. The mold was machined from blocks of 6061 Aluminum on a Milltronics 3-axis milling machine.

Figure 4: Core (left) and cavity (right) halves of key chain mold

Injection Molding

The mold inserts were installed into the MUD unit on a Toyo Ti-35G2 injection molding machine. The process settings (barrel temperature, injection speed, pack pressure, cooling time, etc.) were optimized so that full parts could be made consistently with the machine running on automatic cycle. Different colored pellets were added to each student batch so the progress of their polymer through the injection molding process could be followed.

Figure 5: (Left) full part including the sprue and runners. (Right) Toyo Ti-35G2 injection molding machine used to process the suspension polymer.

Acknowledgements

The authors would like to thank Adam Kramschuster and Wendy Stary for assistance and suggestions with injection mold design, Greg Slupe and his Spring 2013 Computer Aided Manufacturing students for machining the mold, and the Spring 2012 and Spring 2013 Chemistry of Polymers students for their synthetic work.

— "Dr. Ray has been my favorite semester. I wish more of my professors were like him." CHEM-325, Spring 2019

SELECTED CONFERENCES AND WORKSHOPS ATTENDED

- ***2023 UW System Chemistry Faculties Meeting***, University of Wisconsin-Madison, Madison WI, November 3-4, **2023**
- ***AFIT Summer Institute, Finding the Future First: Building Breakthrough Innovations in Higher Education***, Lead Learning Partner: Larry Keeley, Innovation Scientist, Westin Denver Downtown, Denver CO, July 12-15, **2023**
- ***Polytechnic Summit 2019***, University of Wisconsin-Stout, Menomonie WI, June 3-5, **2019**
- ***Effective Teaching: A Workshop***, presented by Dr. Rebecca Brent, President of Education Designs Inc. and Dr. Richard M. Felder, Professor Emeritus, North Carolina State University, hosted by the UW-Stout Nakatani Teaching and Learning Center, Menomonie WI, January 16-17, **2019**
- ***42nd UW System Chemistry Faculties Meeting***, Madison WI, Oct. 23–24, **2015**
- ***41st UW System Chemistry Faculties Meeting***, La Crosse WI, October 10–11, **2014**
- ***Learning Community Summer Workshop***, Menomonie WI, August 21, **2014**
- ***7th Annual Wisconsin Science and Technology Symposium***, Eau Claire WI, July 21-22, **2014**
- ***Transforming Student Learning with Undergraduate Research Workshop***, Research Skill Development Framework, presented by Dr. John Willison from the University of Adelaide, hosted by the UW-Stout Nakatani Teaching and Learning Center, Menomonie WI, July 2, **2014**
- ***UW System Office of Professional and Instructional Development (OPID) 2014 Spring Conference***, Green Lake WI, April 17-18, **2014**
- ***40th UW System Chemistry Faculties Meeting****, River Falls WI*, Oct. 25, **2013**
- ***Learning Community Summer Workshop***, Menomonie WI, August 22, **2013**
- ***Learning Community Summer Workshop***, Menomonie WI, August 23, **2012**
- ***38th UW System Chemistry Faculties Meeting****, Menomonie WI*, Oct. 21-22, **2011**
- ***Opening Workshop for New STEM Educators: Inclusive Teaching Methods***, Clearwaters Hotel & Convention Center, Marshfield WI, Sept. 30-Oct. 1, **2010**
- ***New Instructor Workshop***, University of Wisconsin-Stout, Menomonie WI, August 17-19, **2010**

SELECTED SEMINARS AND WEBINARS ATTENDED

- ***Polymeric Coatings: From Fundamentals to Future Technologies***, presented by Marek W. Urban of Clemson University, ACS Webinar, June 2, **2022**
- ***Materials to the Rescue: Innovation in Materials and Manufacturing, Responding to the COVID Crisis***, virtual webinar event hosted by WiSys and the Regional Materials and Manufacturing Network (RM2N), Feb 23-25, **2021**
- ***Face Masks: Materials, Disinfection, and Reuse During COVID-19***, presented by Supratik Guha of University of Chicago and Argonne National Laboratory and Yi Cui of Stanford University, ACS Webinar, May 14, **2020**
- ***Understanding the Scientific and Medical Aspects of the Pandemic***, presented by Jonathan Lai of Albert Einstein College of Medicine and Raymond Forslund, Syner-G, ACS Webinar, May 13, **2020**
- ***Safer Chemistry Education at Home***, presented by Debbie Decker of UC Davis, Jennifer Bishoff of Frostburg University, and Ralph Stuart of Keene State College, ACS Webinar, May 7, **2020**
- ***Creating an Environment for Innovation at 3M***, presented by Dr. Larry Wendling, Vice President 3M Corporate Research Laboratory, 3M Innovation Center in collaboration with the Minnesota section of ACS, Maplewood MN, January 14, **2014**

AWARDS

- ***Outstanding Teaching Award***, UW-Stout 2022-2023

OUTREACH

- **Science Olympiad**
  - *National, Division C - Chemistry Lab Event Co-Supervisor* (2016)
    (supervised competitive event)
  - *Wisconsin State, Division C - Chemistry Lab Event Supervisor* (2016; 2019; 2021; 2022)
    (authored state exam and supervised competitive event)
  - *Wisconsin State, Division C – Technical Problem-Solving Event Supervisor* (2014)
    (authored state exam and supervised competitive event)

- *Wisconsin Regional, Menomonie H.S., Division C – Materials Science Event Supervisor* (2014) (authored exam and supervised competitive event)

- **STEPS** (Science, Technology, & Engineering Preview Summer Camp)
  - *Chemistry Technical Activity Instructor* (2013 – 2019) (Taught over ***1100 campers*** – *in groups of 10* – 1.5 hour lessons with hands on activities in electrochemistry and chemical thermodynamics)
- **STEM Summer Camp**, UW-Stout
  - *Chemistry Instructor – Drones* (2017)
  - *Chemistry Instructor – Rockets* (2016)
- **Stout Proud PreCollege Summer Camp**, UW-Stout
  - *Materials Science and Chemistry Instructor* (2015; 2016)
- **FIRST LEGO League Challenge** (2020)
  - "Materials Science Expert" for Team #23260, N.O.A.M – Nerds On A Mission, LaCrosse, WI
- **Wisconsin Science Festival** (2013; 2014)
- **Chemistry Demonstration Outreach Programs**
  - 2012 Wisconsin State Science Olympiad, March 31, 2012
  - Menomonie High School, December 9, 2011
  - 2011 Wisconsin State Science Olympiad, April 2, 2011
  - Colfax Middle School – with Professor Emeritus Marty Ondrus, demonstration program for 60 students visiting campus, May 20, 2011
- **Tutoring** – Numerous two-hour tutoring sessions, Menomonie High School Science Olympiad:
  - Chemistry Team (Fall 2014 – Spring 2015)
  - Chemistry and Materials Science Teams (Fall 2013 – Spring 2014)
  - Chemistry Team (Spring 2013)
  - Materials Science Team (Spring 2013)
  - Chemistry Team (Fall 2012)
  - Chemistry Team, competed in the National SO Competition (Spring 2011)

— "He knows how to get the information in students' head" CHEM-325, Spring 2015