

Graeme R. A. Wyllie Ph.D

Department of Chemistry
Concordia College
Moorhead, MN 56562

wyllie@cord.edu
(218) 299-4956

<https://www.linkedin.com/in/graeme-wyllie-4b005a19a>

EDUCATION

Ph.D., Bioinorganic Chemistry, University of Notre Dame, Notre Dame, IN, August 2003 (Advisor W. Robert Scheidt)

Postgraduate Instrumental and Analytical Chemistry, The Robert Gordon University,
Diploma Aberdeen, Scotland, August 1994

B.Sc., Inorganic Chemistry, University of St. Andrews, St Andrews, Scotland, June 1993

PROFESSIONAL EXPERIENCE

September 2011 – Present Assistant Professor of Chemistry, Concordia College, Moorhead, MN

Aug 2006 – September 2011 Laboratory Coordinator / Stockroom Manager for the Department of Concordia College, Moorhead, MN

Sept 2003 – Aug 2006 Postdoctoral Research Fellow with Professor Kenton R. Rodgers
North Dakota State University, Fargo, ND
“*Transient Absorbance Studies of the Heme Oxygen Sensor FixL*” and
“*Synthesis and Spectroscopy of peripherally substituted (nitrosyl)iron porphyrinates.*”

Jan 1999 - Sept 2003/
Aug 1994 - June 1996 Graduate Research Assistant with Professor W. Robert Scheidt,
University of Notre Dame, Notre Dame, IN
Dissertation Title: “*Structural and Spectroscopic Studies of Nitrogen Oxide-coordinated Iron Porphyrinates.*”

Sept 1993 - Aug 1994 Postgraduate Research Assistant at McAuley Land Use Research
Institute, Aberdeen Scotland.
“*Detection of Polyaromatic Hydrocarbons and Polychloro-biphenyls in Sewage Treated Soils by GC-MS.*”

Oct 1992 - May 1993 Undergraduate Research with Professor R. W. Hay, University of St.
Andrews, St Andrews, Scotland.
“*Synthesis and Metallation of a 30-membered Hexa-aza Macrocylic Ligand.*”

March 1992 - Sept 1992 Work Placement Program with Analytical Chemistry Division of
McFarlan Smith Pharmaceuticals, Edinburgh, Scotland.

PUBLICATIONS: (All Peer Reviewed)

1. Alexandra M. Ward and Graeme R. A. Wyllie “Bioplastics in the General Chemistry Laboratory: Building a Semester-Long Research Experience” *Journal of Chemical Education*, **2019**, 96, 668-676.
2. Graeme R. A. Wyllie, “Embracing Limits in Creating a Responsible Scientist/Citizen” Reformation and Resilience: Lutheran Higher Education for Planetary Citizenship, Ernest Simmons and Erin Hemme Froslic (editors), Lutheran University Press, **2017**. pp. 299-303.
3. Graeme R. A. Wyllie Spectroscopic Determination of Triclosan Concentration in a Series of Antibacterial Soaps: A First-Year Undergraduate Laboratory Experiment. *Journal of Chemical Education*, **2015**, 92, 153-156.
4. Graeme R. A. Wyllie, Nathan J. Silvernail; Allen G. Oliver, Charles E. Schulz, and W. Robert Scheidt. Iron Nitrosyl "Natural" Porphyrinates: Does the Porphyrin Matter? *Inorganic Chemistry* **2014** 53(7), 3763-3768.
5. Ming Li, Teresa J. Neal, Graeme R. A. Wyllie, Allen G. Oliver, Charles E. Schulz, and W. Robert Scheidt. Metalloporphyrin Mixed-Valence π -Cation Radicals: $[\text{Fe}(\text{oxoOEC}\cdot/2)(\text{Cl})]_2\text{SbCl}_6$, Structure, Magnetic Properties, and Near-IR Spectra *Inorganic Chemistry* **2011** 50 (18), 9114-9121.
6. Ming Li, Teresa J. Neal, Graeme R. A. Wyllie, Charles E. Schulz, and W. Robert Scheidt Structural and Magnetic Effects of meso-Substitution in Alkyl-Substituted Metalloporphyrinate π -Cation Radicals: Characterization of $[\text{Fe}(\text{alkylP}\cdot)(\text{Cl})]\text{SbCl}_6$ (alkyl = ethyl and n-propyl) *Inorganic Chemistry* **2010** 49 (17), 8078-8085
7. Valeriia Starovoitova, Graeme R. A. Wyllie, W. Robert Scheidt, Wolfgang Sturhahn, E. Ercan Alp, and Stephen M. Durbin. Intermolecular Dynamics in Crystalline Iron Octaethylporphyrin (FeOEP) *The Journal of Physical Chemistry B* **2008** 112 (40), 12656-12666.
8. Bogdan M. Leu, Nathan J. Silvernail, Marek Z. Zgierski, Graeme R. A. Wyllie, Mary K. Ellison, W. Robert Scheidt, Jiyong Zhao, Wolfgang Sturhahn, E. Ercan Alp, and J. Timothy Sage, Quantitative Vibrational Dynamics of Iron in Carbonyl Porphyrins, *Biophysical Journal*, **2007**, 92, 3764-3783.
9. Kenton R. Rodgers, Graeme R. A. Wyllie, and Gudrun S. Lukat-Rodgers. “Insights into Heme-based O_2 sensing from Structure Function Relationships in the FixL Protein.” From The Smallest Biomolecules: Diatomics and their Interactions with Heme Proteins, Abhik Ghosh (editor), Elsevier, **2008**, pp. 564-596.
10. Graeme R. A. Wyllie, Orde Q. Munro, Charles E. Schulz and W. Robert Scheidt. “Structural and Electronic Characterization of (Nitrate)iron(III) Porphyrinates $[\text{Fe}(\text{Por})(\text{NO}_3)]$: Variable Coordination of Nitrate” *Polyhedron* **2007**, 26, 4664-4672.

11. Valeria Starovoitova, Timo E. Budarz, Graeme R. A. Wyllie, W. Robert Scheidt, Wolfgang Sturhahn, E. Ercan Alp, Earl W. Prohofskey, and Stephen M. Durbin. "Vibrational Spectroscopy and Normal Mode Analysis of Fe(II) Octaethylporphyrin" *Journal of Physical Chemistry B*, **2006**, *110*, 13277-13282.
12. Bogdan Leu, Marek Z. Zgierski, Graeme R. A. Wyllie, Mary K. Ellison, W. Robert Scheidt, Wolfgang Sturhahn, E. Ercan Alp, Stephen M. Durbin, and J. Timothy Sage. "Vibrational Dynamics of Biological Molecules: Multi-Quantum Contributions." *Journal of Physics and Chemistry of Solids* **2005**, *66*, 2250-2256.
13. Douglas P. Linder, Kenton R. Rodgers, Jennifer Banister, Graeme R. A. Wyllie, Mary K. Ellison and W. Robert Scheidt. "Five-Coordinate Fe^{III}NO and Fe^{II}CO Porphyrinates: Where Are the Electrons and Why Does It Matter?" *Journal of the American Chemical Society* **2004**, *126*, 14136-14148.
14. Bogdan Leu, Marek Z. Zgierski, Graeme R. A. Wyllie, W. Robert Scheidt, Wolfgang Sturhahn, E. Ercan Alp, Stephen M. Durbin, and J. Timothy Sage. "Quantitative Vibrational Dynamics of Iron in Nitrosyl Porphyrins." *Journal of the American Chemical Society* **2004**, *126*, 4211-4227.
15. Graeme R. A. Wyllie, Charles E. Schulz, and W. Robert Scheidt. "Five- to Six-Coordination in (Nitrosyl)iron(II) Porphyrinates: Effects of Binding the Sixth Ligand." *Inorganic Chemistry* **2003**, *42*, 5722-5734.
16. Charles E. Schulz, Graeme R. A. Wyllie, and W. Robert Scheidt. "Mössbauer Studies of Fe(II)-nitrosyl Porphyrin Model Compounds." *Hyperfine Interactions* **2002**, 321-324.
17. Graeme R. A. Wyllie and W. Robert Scheidt. "NO Orientation and Tilting in (Nitrosyl)-iron(II) Deuteroporphyrin IX." *Inorganic Chemistry* **2003**, *42*, 4259-4261.
18. Brakesh K. Rai, Stephen M. Durbin, Earl W. Prohofskey, J. Timothy Sage, Graeme R. A. Wyllie, W. Robert Scheidt, Wolfgang Sturhahn, and E. Ercan Alp. "Iron Normal Mode Dynamics in (Nitrosyl)iron(II)tetraphenylporphyrin from X-ray Nuclear Resonance Data." *Biophysical Journal* **2002**, *82*, 2951-2963.
19. Graeme R. A. Wyllie and W. Robert Scheidt. "Solid-State Structures of Metalloporphyrin NO_x Compounds." *Chemical Reviews* **2002**, *102*, 1067-1089. (Invited review)
20. Xaio Hua, Krister Larsson, Teresa J. Neal, Graeme R. A. Wyllie, Mayou Shang, and A. Graham Lappin. "Structure and Magnetic Properties of [Cr(en)₂(ox)][Cr(en)(ox)₂].2H₂O, Δ-[Cr(en)₃]Δ-[Cr(ox)₃], and Δ-[Co(en)₃]Δ-[Cr(ox)₃]." *Inorganic Chemistry Communications* **2001**, *4*, 635-639.
21. J. Timothy Sage, Charles Paxson, Graeme R. A. Wyllie, Wolfgang Sturhahn, Stephen M. Durbin, E. Ercan Alp, and W. Robert Scheidt. "Nuclear Resonance Vibrational Spectroscopy of a Protein Active-site Mimic." *Journal of Physics: Condensed Matter* **2001**, *13*, 7707-7722.
22. Robert W. Hay, David T. Richens, Graeme Wyllie, Andrew Danby, and Thomas Clifford. "Binuclear Metal(II) Complexes of a 30-Membered Hexa-aza Macrocyclic Ligand." *Transition Metal Chemistry (London)* **1995**, *20*, 220-3.

SELECTED PROFESSIONAL PRESENTATIONS

1. *"Concordia Science Academy: Bringing Science to the Elementary Schools"* Graeme R. A. Wyllie. Oral Presentation at 19th Biennial Conference for Chemical Education (BCCE), Bloomington, IN, July 2008
2. *"Developing the research experience in the freshman chemistry laboratories"* Graeme R. A. Wyllie, Mark B. Jensen. Oral Presentation at 242nd ACS National Meeting & Exposition, Denver, CO, United States, August 28-September 1, 2011.
3. *"Bringing the general chemistry lab into the 21st century: Introducing modern instrumentation to general chemistry students"* Graeme R. A. Wyllie. Oral Presentation at 21st Biennial Conference for Chemical Education (BCCE), Penn State, July 2012.
4. *"Modeling the research experience in the general chemistry laboratory through an ongoing class wiki"* Graeme R. A. Wyllie. Poster Presentation at 21st Biennial Conference for Chemical Education (BCCE), Penn State, July 2012.
5. *"ChemBio – An integration of chemistry and biology labs for college freshmen"* Graeme R. A. Wyllie. Oral Presentation at 22nd Biennial Conference for Chemical Education (BCCE), Grand Rapids, July 2014.
6. *"Triclosan – how much, how bad, how to make it go away?"* Graeme R. A. Wyllie. Oral Presentation at 22nd Biennial Conference for Chemical Education (BCCE), Grand Rapids, July 2014.
7. *"Why does it keep changing? Sulfa drugs vs Ph"* Graeme R. A. Wyllie. Oral Presentation at 22nd Biennial Conference for Chemical Education (BCCE), Grand Rapids, July 2014.
8. *"The Use of Chlorine Dioxide in the Degradation of a Series of Sulfa Drugs"* Graeme R. A. Wyllie. Oral Presentation at Joint Great Lakes/Central Regional American Chemical Society Meeting; Grand Rapids, MI, June 2015.
9. *"Concordia Science Academy—Bringing Science to the Fargo Moorhead Area and Beyond"* Graeme R. A. Wyllie. Oral Presentation at 22nd Biennial Conference for Chemical Education (BCCE), Greeley, Colorado, August 2016.
10. *"Enhancing the First Year for STEM Majors: Focusing on Laboratory Experiences"* Graeme R. A. Wyllie. Oral Presentation at 22nd Biennial Conference for Chemical Education (BCCE), Greeley, Colorado, August 2016.
11. *"Sustainable General Chemistry: Incorporating Sustainability into Both Theme and Experiment Design in the Freshman Chemistry Lab"* Graeme R. A. Wyllie. Oral Presentation at 2016 Association for Advancement of Sustainability in Higher Education (AASHE); Baltimore, Maryland, October 2016.

12. *“Concordia Science Academy: Ten years of science outreach in the Fargo-Moorhead area and beyond”* Graeme R. A. Wyllie, Robin Fetting, Hannah Wollenzein and Bailey Houle Poster Presentation at Great Lakes Regional American Chemical Society Meeting; Fargo, ND, June 2017
13. *“Greening the general chemistry laboratory. Incorporating sustainability into the lab through multiple avenues”* Graeme R. A. Wyllie Oral Presentation at Great Lakes Regional American Chemical Society Meeting; Fargo, ND, June 2017
14. *“Bioplastics: Combining seaweed and lobsters to create a new general chemistry research experience”* Graeme R. A. Wyllie and Alexandra M. Ward, Oral Presentation at 23rd Biennial Conference for Chemical Education (BCCE), Notre Dame, IN, August 2018.
15. *“Crafting a semester long science program for local high school students with intellectual disabilities”* Graeme R. A. Wyllie and Robin Fetting, Oral Presentation at 23rd Biennial Conference for Chemical Education (BCCE), Notre Dame, IN, August 2018.
16. *“Bioplastics: Using a summer research experience to craft a large-scale semester long classroom research project”* Graeme R. A. Wyllie and Alexandra M. Ward. 2019 Symposium on Excellence in Nurturing Undergraduate Research, North Dakota State University, April 27 2019 (invited talk)
17. *“Bioplastics: Two years of implementing a new semester long project”* Graeme R. A. Wyllie and Alexandra M. Ward, Oral Presentation at Great Lakes Regional Meeting of the American Chemical Society, Lisle, IL, May 1 – 4 2019.
18. *“Improving Student Understanding of Polarity in the General Chemistry Laboratory: New Chromatographic studies using commercial food dyes and candies”* Graeme R. A. Wyllie, Sofia Palme and Andrew H. Johnson. Concordia College Centennial Scholars Lecture, February 13th 2020.

TEACHING EXPERIENCE

Concordia College (August 2006 – Present)

Primary Courses Designed / Taught

- *General Chemistry I Laboratory [CHEM 127L] (August 2006 – present)*
 - *General Chemistry II Laboratory [CHEM 128L] (January 2007 – present)*
 - *Organic Chemistry I Laboratory [CHEM 341L] (primarily taught in summer)*
 - *Organic Chemistry II Laboratory [CHEM 342L] (primarily taught in summer)*
 - *Inorganic Chemistry Laboratory [CHEM 462L]*
 - *Physical Science (for Elementary Education Majors) [PHYS 215 / SCI 215]*
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- Responsible for General Chemistry and Summer Organic laboratory course development, lab manual and online resource preparation, teaching of multiple laboratory sections including delivering pre-lab lectures, developing new experiments particularly those with a green focus, maintaining online resources, and developing new pedagogy for the undergraduate chemistry teaching laboratory.
 - Responsible for coordinating multiple lab sections of General Chemistry laboratory collaborating with and assisting other faculty to ensure all content is taught to a uniform standard and integrating the lab where relevant with the lecture material. Responsible for coordination of and training of student teaching assistants for the general chemistry.
 - Developed and implemented a multi-week undergraduate research project into the second semester general chemistry laboratory program which provides an impactful Course-based Undergraduate Research Experience (CURE) for all students in the class. Past themes for this student research project have included degradation of environmentally harmful pharmaceuticals and creation and testing of chitosan-alginate bioplastics.
 - Significantly revamped all aspects of first semester general chemistry laboratory program to improve experience for all students focusing on increasing real world themes and better connection between experiments throughout semester. This created a more integrated program that shares skills and themes between lab periods instead of focusing on just the experiment of the week.
 - Developed a range of experiments that introduce High Performance Liquid Chromatography (HPLC) to the general chemistry lab.
 - For all laboratory classes taught, have worked on compilation and sharing of class data to allow students to critically evaluate their work within the context of their peers.
 - For all laboratories taught, have continuously worked on implementing the philosophy of green chemistry in reducing the number of expensive chemicals and the waste generated.

- Developed and taught four years of an integrated general chemistry/molecular biology course for freshman providing an interdisciplinary lab experience breaking down boundaries between two disciplines and providing a strong introductory lab experience developing practical skills and critical thinking skills necessary to succeed in science.
- Developed an Advanced Inorganic Laboratory experience for upper level chemistry majors focusing on the major themes in modern inorganic chemistry – biomimetic models, materials chemistry and catalysis, an experience which also tied together skills and experiences from other classes taken by the students resulting in a culminating experience for all students in the class.
- Developed a revamped science course for elementary education majors designed to satisfy the majority of Board of Teaching requirements for physics and chemistry. The course integrates theory with hands-on demonstrations and uses primarily commonly found materials with the goal of teaching material and experiments that students can use in their own classroom at a later date.

GRANTS, AWARDS AND AFFILIATIONS

Co-Principle Investigator on NSF-CCLI Grant (NSF-0837192) “Enhancing Student Engagement in the Analytical Process and Scientific Inquiry in the Chemistry Curriculum at Concordia College” 01/01/2009 - 12/31/2011 Amount awarded: \$149,700

Co-Principle Investigator on Funding Applications for the Concordia Science Academy program 2008-2009 – Jeffers Foundation - \$3,000

2008-2009 – Greater Fargo Moorhead Economic Development Corporation - \$2,500

2008-2009 – Red River Valley Section of American Chemical Society - \$500

Red River Valley Local Section of American Chemical Society.

- Local Section Chair (2014 – 2015 and 2017-2019)
- Counsilar (2021 – present)

Conference Chair for 2017 Great Lakes Regional ACS Meeting, Fargo, June 2017

Sigma Zeta National Honors Society

- President Elect (March 2018 – 2019)
- President (March 2019 – March 2021)

American Chemical Society Local Section Outreach Volunteer of Year, 2014

American Chemical Society – Chemistry Ambassador (Awarded January 2015)

Concordia College Centennial Classroom Scholar (Summer 2019)

Concordia College Centennial Research Scholar (summer 2021)

RESEARCH INTERESTS

My primary research interest focuses on developing new and engaging laboratory activities and modules which not only teach laboratory skills to a high standard but also engage students through strong real-world connections. The work of the Wyllie lab focuses not only on identifying topics suitable for investigation but developing experiments based on these that work with the resources and time constraints of the general chemistry laboratory. In addition, the Wyllie lab provides opportunities for undergraduate students to further develop their own extra-curricular research projects based on the themed modules they encounter in the teaching labs.

Initial experiments based on degradation of specific environmentally harmful pharmaceuticals been found in rivers and lakes such as sulfa drugs and triclosan were developed and multiple undergraduate students had the opportunity over the summer to investigate aspects of these topics over the summer, work which was almost always presented by the students at a range of conferences. Summer research studies also better served to better understand the chemistry under investigation which proved invaluable as these same topics formed the basis of the Course-based Undergraduate Research Experience (CURE) being implemented in the general chemistry labs.

In 2017, the Wyllie lab began to investigate chitosan-alginate bioplastics as a topic suitable for a CURE and a multi-week module was developed and implemented in 2018. Again, multiple students have engaged in extra-curricular studies to provide better understanding of the relevant chemistry of these systems, work which has again been presented at a range of conferences.

In addition, work on single-week activities and multi-week modules with undergraduate students on soil analysis, polarity of food dyes, and the kinetics of bleach and food dyes has been carried out, experiments for the teaching lab developed and implemented and several manuscripts on these topics are in preparation.

I also continue collaboration with a colleague in physics (Thelma Berquo) looking at preparation of transition-metal doped iron oxides, specifically goethite and the effects of metal such as aluminum substitution on the magnetic properties of these materials. Our current efforts focus on developing better synthetic methods for these materials which will allow us to create materials of desired metal/iron ratio and correlate this composition with material properties.

SELECTED STUDENT RESEARCH PRESENTATIONS:

“Sulfa drug degradation by ferrate (VI) oxidation: application of a green oxidizing agent in the removal of pharmaceuticals from the environment” Kyle Czech and Graeme R. A. Wyllie National Conference on Undergraduate Research (April 2011)

“Sulfa drug degradation by ferrate(VI) oxidation: Application of a green oxidizing agent in the removal of pharmaceuticals from the environment”, Kyle Czech, Molly Haugen, Alex Jorgenson, and Graeme Wyllie, August 2011- ACS National Meeting, Denver, CO

“Advances in the Study of Sulfa Drug Degradation by Ferrate (IV)”, Molly Haugen, Alex Jorgenson, and Graeme R. A. Wyllie, Fall 2011—Poster Presentation, Poster Presentation at Undergraduate Research in Molecular Sciences (URMS), Moorhead State University Moorhead

“Does Chlorine Dioxide Degrade Sulfa Drugs?” Janelle Jennissen and Dr. Graeme R.A. Wyllie. Oral presentation at National Conference for Undergraduate Research (NCUR) (April 2014)

“Combining Seaweed and Lobsters to Create a New General Chemistry Laboratory Pedagogy” Alexandra M Ward, and Graeme R.A. Wyllie. Poster Presentation at Winchell Undergraduate Research Symposium poster presentation, University of St. Thomas, St. Paul, MN, April 2018.

“Concordia Science Academy: The Evolution of Our Science Outreach Program.” Robin Fettig and Dr. Graeme R. A. Wyllie. Oral presentation at the Sigma Zeta National Science & Mathematics Convention (March 2017).

Additional student presentations to date include 2 additional NCUR poster presentation, 5 additional URMS presentations and 14 presentations at Concordia Celebration of Student Scholarship event along with multiple departmental and homecoming presentations.

SCIENCE OUTREACH ACTIVITIES

Concordia Science Academy and other programs (2006 – present)

Coordinator for Concordia Science Academy, a science outreach program, targeting children of all ages through engaging hands-on activities designed that enhance their interest and understanding of science. This program involves Concordia students from all the sciences, interacts with several thousand children every year and has received frequent and extremely favorable press-coverage.

My responsibilities as coordinator include working with local organizations, developing and preparing suitable science activities for each event, doing science at events, training volunteers as needed and dealing with all other logistics.

Early Concordia Science Academy events were after-school visits with activity stations where 100 - 200 elementary students could interact with the Concordia students and do science. I was responsible for coordinating Concordia student sign-up, preparing existing station materials and developing new stations for each event. Other pre-event duties include liaising with local schools in signing up students on-line, publicizing the event and answering parent queries prior to the event. We still run one or two similar events though volunteers are often drawn from high schools or PTAC committees and I prepare all materials and train all volunteers prior to the event.

Selected examples of other community programs created and implemented include:

- Great Chemistry for Teens program at local public libraries (one hour workshop every three or four months running since 2010)
- Regular elementary / middle school one hour science sessions with all local and several regional libraries often linked to summer reading programs
- Inspire + Create – All day hands-on chemistry event with Fargo Parks (Fall 2019)

Science Academy has also carried out numerous science outreach events in the Fargo-Moorhead area community working with multiple organizations (Streets Alive, Schools Alive, Salvation Army, Churches United, Fargo YMCA, Great Plains Foodbank, Fargo Police, Fargo and Moorhead Parks, Fargo Boys and Girls Club, Clay and Cass county 4H and Riverkeepers.

I regularly carry out visits to elementary and high schools schools in the region, to carry out in-class workshops and often host class visits to campus for science activities.

I regularly work behind the scenes developing activities and training undergraduate students to lead middle school students in science workshops as part of programs such as Expanding Your Horizons, and BrainSTEM events.

Finally, in 2018 and 2019, we were one of the science outreach organizations accepted to be part of STEM day at the Minnesota State Fair. As part of this, I ran an activity booth all day and in 2018, was the only stage performer to be allocated two slots throughout the day. Estimated attendance in the STEM region of the fair in 2019 was ~1700.