

**Susan J. Schroeder**, Associate Professor  
Department of Chemistry and Biochemistry  
Department of Microbiology and Plant Biology  
University of Oklahoma  
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### **Research Interests**

My long-term research goal is to understand the fundamental physical interactions in RNA in order to predict RNA three-dimensional structures, functions, and drug targets from sequence. My lab probes structure-function relations in viral RNA and virus-host interactions using nanopore and Illumina sequencing, chemical probing, nuclear magnetic resonance, crystallography, and UV optical melting, as well as a diverse array of biophysical, molecular biology, sequencing, and computational techniques. My lab studies diverse RNA, including Satellite Tobacco Mosaic Virus RNA, Human Endogenous Retroviral RNA, influenza, and noncoding RNA yet to be discovered.

### **Employment**

Associate Professor, Dept. of Chemistry & Biochemistry, Dept. of Microbiology & Plant Biology, 2012-  
Assistant Professor, Dept. of Microbiology & Plant Biology, 2010-2012  
Assistant Professor, Dept. of Chemistry & Biochemistry, 2006-2012

### **Education and Training**

Pennsylvania State University, State College, PA, visiting scholar, 2017, Structure-Seq genome-wide *in vivo* RNA chemical probing in plants

Mentors: Philip C. Bevilacqua, Ph.D., Sarah Assmann, Ph.D.

Yale University, New Haven, CT, NIH postdoctoral fellow, 2002-2005, ribosome crystallography  
Mentor: Peter B. Moore, Ph.D.

University of Rochester, Rochester, NY, Ph.D., 1996-2002, biophysical chemistry  
Mentor: Douglas H. Turner, Ph.D.

Glasgow University, Glasgow, Scotland, service learning program, 1995-1996, public health  
Mentor: Garth Cruikshank, M.D.

University of Rochester, Rochester, NY, B.S., 1991-1995, chemistry  
Mentor: Douglas H. Turner, Ph.D.

### **Honors**

NSF CAREER Award, 2009- 2015

Nancy L. Mergler Faculty Mentor Award for Undergraduate Research, 2013

NIH Ruth L. Kirchstein Postdoctoral Fellow, Yale University, 2003-2005

Weissberger Memorial Fellowship for Research Accomplishments, 1999-2000

W.D. Walters Teaching Award, 1997.

Sherman-Clarke Fellowship, 1996-2000

Bausch & Lomb Scholar, University of Rochester, 1991-1995

### **Funding**

“NSFMRI: Acquisition of the First 800 MHz NMR Spectrometer with a Cryogenically Cooled Probe in Oklahoma for Interdisciplinary Research and Training,” National Science Foundation, September 1, 2017-August 31, 2022 (co-PI).

“Analysis of Single Molecule RNA Sequencing Data to Discover How Viruses Reprogram Host Gene Expression,” Data Institute for Societal Challenges, University of Oklahoma, June 1, 2022- May 31, 2023

“Modulation of the human lung transcriptomic immune response by SARS-CoV-2 M protein,” Presbyterian Health Foundation (co-PI), May 1, 2020- April 30, 2021.

Ed Kline Faculty Development Award, University of Oklahoma Faculty Senate, February 10, 2020-present.

“Viral RNA Structures, Function, and Energetics,” Oklahoma Center for Respiratory and Infectious Diseases Pilot Project Grant, NIH Center of Biomedical Research Excellence, November 1, 2018-June 30, 2019.

“Discovering the Roles of Satellite Virus RNA and RNA Structure in Virus-Host Interactions,” University of Oklahoma Faculty Investment Program, October 1, 2018- December 1, 2019.

“Metal Ion Interactions in RNA Shapeshifters,” Burroughs Wellcome Fund Collaborative Research Travel Grant. June 1, 2017 - August 31, 2018.

“RNA Structure and the Hide-and-Seek Games in Virus-Host Interactions.” University of Oklahoma Faculty Investment Program. February 1, 2017 - January 31, 2018.

“Metal Ion and Protein Binding Sites in Viral RNA,” Senior Faculty Summer Fellowship, College of Arts and Sciences, University of Oklahoma. June 1, 2017 – September 1, 2017.

“Protein and Metal Ion Binding in Viral RNA,” NIH HIV Accessory and Regulatory Complexes Collaborative Center, University of California, San Francisco. September 1, 2016 - September 30, 2017.

“Oklahoma State Regents for Education K20-OKC Physical Science Foundations Teacher Academy.” Oklahoma State Regents. March 7, 2016 - March 1, 2019 (co-PI).

“Noble Public Schools Central Oklahoma Rural Partnership for Science (CORPS).” Noble Public Schools. February 1, 2016 - February 1, 2019 (co-PI).

“Predicting Viral RNA Structure, Function, and Drug Targets from Sequence,” Oklahoma Center for the Advancement of Science and Technology Health Research Program. September 1, 2013-August 31, 2016.

“NSF CAREER: Advancing Viral RNA Structure Prediction,” National Science Foundation. September 1, 2009 - September 30, 2015.

“NSFMRI: Acquisition of Robotics Instrumentation for Crystallization of Macromolecules,” National Science Foundation (co-PI). July 1, 2009 - September 1, 2013.

“RNA Energetics and Structures that Enable Cancer Therapies,” Oklahoma Center for the Advancement of Science and Technology Health Science Research Program. July 1, 2009- July 1, 2012.

“RNA Energetics and Structures that Enable Cancer Therapies,” American Cancer Society Institutional Research Grant Oklahoma Health Sciences Center. May 1, 2008- December 31, 2009.

“Discovering Satellite Tobacco Mosaic Viral RNA Structure,” Oklahoma Center for the Advancement of Science and Technology Plant Science Basic Research Program. May 1, 2008-September 1, 2009.

“Computational Advances Towards Predicting Encapsidated Viral RNA Structure,” Pharmaceutical Research and Manufacturers of America Foundation. January 1, 2008- September 1, 2009.

### **Patent**

“Novel pRNA three-way junctions,” Alyssa C. Hill, Susan J. Schroeder, University of Oklahoma, US Patent Office file date August 23, 2018, application # 16079476, approval date January 26, 2021 patent # 10900035. international application number PCT/US2017/019556.

## Editorial Board Member

*Science Advances*, American Association for the Advancement of Science, October 2018-present.

*Biophysical Journal*, Biophysical Society, January 2019-present.

*Journal of Biological Chemistry* editorial board member, January 2021-present.

## Publications

(Undergraduate researchers are indicated by underlining, corresponding author at OU denoted with \*)

39. “Plant Single-Cell/Nucleus RNA-seq Workflow.” Thibivilliers, S., Farmer, A., Schroeder, S., Libault, M. *Plant Methods Molecular Biology*, volume 2584, R. Cologero, V. Benes (Eds) *Single Cell Transcriptomics*, Chapter 6, in press (2022).

38. “Nearest neighbor rules for RNA helix folding thermodynamics: improved end effects.” Zuber, J., **Schroeder, S.J.** (co first author), Sun, H., Turner, D.H., Mathews, D.H. *Nucleic Acids Research* in press <https://doi.org/10.1093/gkac261> (2022).

37. “Biophysicists Continued Outstanding Response to COVID-19.” T. Schlick, E. Sundberg, **S.J. Schroeder**, M. Babu. *Biophysical Journal* 120(14), E1 (2021).

36. “Biophysicists Outstanding Response to COVID-19.” T. Schlick, E. Sundberg, **S.J. Schroeder**, M. Babu. *Biophysical Journal* 120(6), E1-E2 (2021).

35. “Perspectives on Viral RNA Genomes and the RNA Folding Problem.” **S.J. Schroeder\***. *Viruses* 12, 1126 (2020).

34. “Challenges and Approaches to Predicting RNA with Multiple Functional Structures.” **S.J. Schroeder\***. *RNA* 24, 1615-1624 (2018).

33. “Surprising Sequence Effects on GU Closure of Symmetric 2 x 2 Nucleotide RNA Internal Loops.” K.D. Berger, S.D. Kennedy, **S.J. Schroeder**, B.M. Znosko, H. Sun, D. H. Mathews, D. H. Turner. *Biochemistry*, 57: 2121-2131 (2018).

32. “Swellix: A Computational Tool to Explore RNA Conformational Space.” N. Sloat, J.-W. Liu, **S.J. Schroeder\*** *BMC Bioinformatics* 18: 504 (2017).

31. “Stack Locally and Act Globally: A Few Nucleotides Make All the Difference in Enterovirus 71 IRES Binding in hnRNAP A1 and Infectious Phenotypes.” **S.J. Schroeder\*** *J. Mol. Biol.* 429, 2859-2862 (2017).

30. “Advancing Viral RNA Structure Prediction: Measuring the Thermodynamics of Pyrimidine-Rich Internal Loops.” A. Phan, K. Mailey, J. Saeki, X. Gu, **Schroeder, S.J.\*** *RNA*. 23, 770-781 (2017).

29. “Thermodynamic Stabilities of Three-way Junction Nanomotifs in Prohead RNA.” A.C. Hill, **S.J. Schroeder\***, *RNA* 23, 521-529 (2017).

28. “NMR Structures and Dynamics in a Prohead RNA Loop that Binds Metal Ions.” X. Gu, S.-Y. Park, M. Tonnelli, G. Cornilescu, T. Xia, D. Zhong, **S.J. Schroeder\***, *J. Phys. Chem. Lett.* 7, 3841-3846(2016).

27. “Prohead RNA: A non-coding viral RNA of novel structure and function.” A.C. Hill, L.E. Bartley, **S.J. Schroeder\***. *RNA Wires*, doi: 10.1002/wrna.1330 (2016).

26. “Structures and Energetics of Four Adjacent GU Pairs that Stabilize an RNA Helix.” X. Gu, B.H.M. Mooers\*, L. Thomas, J. Malone, S. Harris, **S.J. Schroeder\*** *J. Phys. Chem. B.* 119, 13252-13261(2015).

25. “A Parallel, Low Memory Implementation of the Wuchty Algorithm with Additional Experimental Filters to More Thoroughly Explore RNA Conformational Space.” J. Stone, S. Bleckley, S. Lavelle, **S.J. Schroeder\***, *PLoS ONE* 10(2):e0117217 (2015).

24. "Probing Viral Genomic Structure: Alternative Viewpoints and Alternative Structures for Satellite Tobacco Mosaic Virus RNA." **S.J. Schroeder\***. *Biochemistry* 53, 6728-6737 (2014).
23. "The Effects of Salt, Polyethylene Glycol, and Locked Nucleic Acids on the Thermodynamic Stabilities of Consecutive Terminal Adenosine Mismatches in RNA Duplexes." X. Gu, M.-T. Nguyen, A. Overacre, S. Seaton, **S.J. Schroeder\***. *J. Phys. Chem. B.* 117, 3531-3540 (2013).
22. "Incorporating Global Features of RNA Motifs in Predictions for an Ensemble of Secondary Structures for Encapsidated MS2 Bacteriophage RNA." S. Bleckley, **S.J. Schroeder\***. *RNA.* 18,1309-1318 (2012).
21. "Crumple: A Method for Complete Enumeration of All Possible Pseudoknot-Free RNA Secondary Structures." S. Bleckley, J.W. Stone, **S.J. Schroeder\***. *PLoS ONE.* 7, e52414 (2012).
20. "Nucleotide Dynamics at the A-site Cleft in the Peptidyltransferase Center of *H. marismortui* 50 S Ribosomal Subunits." Y. Wang, J.K. Shen\*, **S.J. Schroeder\***. *J. Phys. Chem. Lett.* 3, 1007-1010 (2012).
19. "Ensemble of Secondary Structures for Encapsidated Satellite Tobacco Mosaic Virus RNA Consistent with Constraints from Chemical Probing and Crystallography." **S.J. Schroeder\***, J.W. Stone, S. Bleckley, T.R. Gibbons, D. Mathews, *Biophys. J.*,101, 167-175 (2011).
18. "Different Sequences Show Similar Quaternary Interaction Stabilities in Prohead Viral RNA Self Assembly." X. Gu, **S.J. Schroeder\*** *J. Biol. Chem.*, 286, 14419-14426 (2011).
17. "NMR Structure of a Prohead RNA E-loop Hairpin." S. Harris, **S.J. Schroeder\***. *Biochemistry*, 49, 5989-5997 (2010).
16. "Consecutive Terminal GU Pairs Stabilize RNA Helices." M.-T. Nguyen, **S.J. Schroeder\*** *Biochemistry.* 49, 10574-10581 (2010).
15. "Advances in RNA Structure Prediction from Sequence: New Tools for Generating Hypotheses about Viral RNA Structure-Function Relationships." **S.J. Schroeder\***, *J. Virol.*, 83, 6326-6334 (2009).
14. "Optical Melting Measurements of Nucleic Acid Thermodynamics." in *Biophysical, Chemical, and Functional Probes of RNA Structure, Interactions, and Folding, Part A* (D. Hershlag, ed.) **S.J. Schroeder\*** and D.H. Turner, *Methods in Enzymology*, 468, 371-387 (2009).
13. "'3' Terminal Nucleotides Determine Thermodynamic Stabilities at the Ends of RNA Helices." K. Clanton-Arrowood, J. McGurk(co-first author), **S.J. Schroeder\***, *Biochemistry*, 47, 13418-13427 (2008).
12. "rRNA Mutations Outside the Anisomycin Binding Site can Make Ribosomes Drug-resistant." G. Blaha, G. Gurel, **S.J. Schroeder** (co-first author), P.B. Moore, T.A. Steitz, *J. Mol. Biol.*, 379, 505-519 (2008).
11. "The Structures of Antibiotics Bound to the E Site Region of the 50 S Ribosomal Subunit of *Haloarcula marismortui*: 13-deoxytedanolide and Girodazole." **S.J. Schroeder**, G. Blaha, J. Tirado-Rivas, T.A. Steitz, P.B. Moore, *J. Mol. Biol.*, 367, 1471-1479 (2007).
10. "Negamycin Binds to the Wall of the Nascent Chain Exit Tunnel of the 50S Ribosomal Subunit." **S.J. Schroeder**, G. Blaha, P.B. Moore. *Antimicrobial Agents and Chemotherapeutics* 51, 46662-4665 (2007).
9. "The NMR Structures of (rGCUGAGGCU)<sub>2</sub> and (rGCGGAUGCU)<sub>2</sub>: Probing the Structural Features that Shape the Thermodynamic Stability of Tandem GA Pairs." B. Tolbert, S.D. Kennedy, **S.J. Schroeder**, T.R. Krugh, D.H. Turner, *Biochemistry*, 46, 1511-1522 (2007).
8. "Incorporating Chemical Modification Restraints into a Dynamic Programming Algorithm for Prediction of RNA Secondary Structure." D.H. Mathews, M.D. Disney, J.L. Childs, **S.J. Schroeder**, M. Zuker, and D.H. Turner, *Proc. Natl. Acad. Sci. USA*, 101, 7287-7292 (2004).

7. "Thermodynamic Stabilities and Structural Features of the J4/5 Loop in a *Pneumocystis carinii* Group I Intron." **S.J. Schroeder**, M.A. Fountain, S.D. Kennedy, P.J. Lukavsky, J.D. Puglisi, T.R. Krugh, and D.H. Turner, *Biochemistry*, 42, 14184-14196 (2003).
6. "Sheared A<sub>anti</sub> · A<sub>anti</sub> Base Pairs in a Destabilizing 2 X 2 Internal Loop: The NMR Structure of 5'(rGGCAAGCCU)<sub>2</sub>." B.M. Znosko, M.E. Burkard, **S.J. Schroeder**, T.R. Krugh, and D.H. Turner, *Biochemistry*, 41, 14969-14977 (2002).
5. "The Energetics of Small Internal Loops." **S.J. Schroeder**, M.E. Burkard, and D.H. Turner, *Biopolymers*, 52, 157-167 (2001).
4. "Thermodynamic Stabilities of Internal Loops with GU Closing Pairs in RNA." **S.J. Schroeder** and D.H. Turner, *Biochemistry*, 40, 11509-11517 (2001).
3. "Factors Affecting the Thermodynamic Stability of Small Asymmetric Internal Loops in RNA." **S.J. Schroeder** and D.H. Turner, *Biochemistry*, 39, 9257-9274 (2000).
2. "Thermodynamic Parameters for an Expanded Nearest-Neighbor Model for Formation of RNA Duplexes with Watson-Crick Base Pairs." T. Xia, J. Santa Lucia, Jr., M.E. Burkard, R. Kierzek, **S.J. Schroeder**, X. Jiao, C. Cox, and D.H. Turner, *Biochemistry*, 37, 14719-14735 (1998).
1. "GA and UU Mismatches Can Stabilize RNA Internal Loops of Three Nucleotides." **S.J. Schroeder**, J. Kim, and D.H. Turner, *Biochemistry*, 35, 16105-16109 (1996).

### Book Chapters

- "Crumple: An efficient tool to explore thoroughly the RNA folding landscape." in *RNA Structure Determination: Methods and Protocols*. **I. Guerra, S.J.Schroeder\***, (ed. D. H. Turner, D.H. Mathews). Humana Press, *Methods in Mol. Biol.* 1490, 1-14 (2016).
- "Predicting RNA Secondary Structure." in *The RNA World* (ed. R.F. Gesteland, T.R. Cech, J.F. Atkins) D.H. Mathews, **S.J. Schroeder**, D.H. Turner, and M. Zuker, pp 631-657. Cold Spring Harbor Press (2005).

### Synergistic Activities

1. University of Oklahoma Research Council: Chair 2014-2015 academic year, member 2013-2015. Provide advice on distinguished faculty awards and internal funding supported through the Office of the Vice President of Research for all areas of research and creative activity on the Norman campus. Service as chair of the research council includes service on the Faculty Senate Executive Committee and the Faculty Advisory Council for the Vice President of Research.
2. Undergraduate Curriculum Development: Develop new courses promoting convergent science in biological physical chemistry (spring 2014-2016), virology (fall 2011-2015), and RNA (spring 2011-2013). These courses are taught in new technology-enhanced classrooms that facilitate active learning. Written, oral, and visual communication skill development is a focus of the courses. The biological physical chemistry course is part of a new undergraduate major in chemical biosciences. I have helped develop new curriculum as a team for the chemical biosciences major and biotechnology concentration.
3. Undergraduate Research and Infrastructure Development at the University of Oklahoma:
  - i. Oklahoma Undergraduate Research Faculty Advisory Committee, spring 2015- fall 2018. Review proposals to develop undergraduate research opportunities in internships and classrooms.
  - ii. Four Year Research Experience for Undergraduates (FYRE) mentor, 2012- present. The program began as a collaborative initiative in undergraduate research between the Department of Chemistry & Biochemistry and the Honors College and now involves the entire Norman campus. I currently mentor five FYRE students in my lab. As a founding member, I have mentored seven FYRE students starting in spring of their first year through the completion of their honors senior thesis.

- iii. McNair Scholar mentor, spring 2012- summer 2015, spring 2019- spring 2021.  
OU has an active program that is part of the national McNair Scholars program to encourage students from underrepresented minorities and first-generation students to pursue careers in science. I have mentored three McNair Scholars as undergraduates in my lab, all of whom have continued their science careers in graduate school.
  - iv. Provost Advisory Committee on STEM, spring 2015-2016. Chair, subcommittee on Broadening Participation, member of executive committee, member subcommittee on Undergraduate Research. This committee develops recommendations for improving STEM education at all levels on the Norman campus to the provost.
  - v. Freshman Seminar: Research Sooner! Invited lectures, spring 2012, 2013. Research Sooner! is part of the OU STEM Initiative and aims to broaden participation of undergraduates in research. The long term goal is to provide all students with authentic research experience during their OU undergraduate education.
  - vi. STEM Charette, spring 2013; Undergraduate Research Advisory group, spring 2012; Undergraduate Research Action Team, spring 2011. As part of a selected group of faculty leaders in undergraduate STEM, we work with administration to create the vision for undergraduate research
  - vii. Session Chair, Undergraduate Research Day, spring 2010. Undergraduate Research Day is the OU forum for undergraduate researchers to present their work.
  - viii. Women in Science Freshman Seminar Series, Invited lecturer, Undergraduate College, University of Oklahoma, fall 2007.
4. Science Café, Norman, OK: Organize interactive poster presentations with directors of Science Café Norman, a grassroots community organization that promotes science dialogue. University of Oklahoma students and Norman community citizens discuss student posters on RNA, RNA therapeutics, and viral RNA diseases at the Science Café at the Norman Public Library. May 12, 2010; December 5, 2011; May 10, 2012; December 9, 2012; May 7, 2013; December 4, 2014; December 5, 2015; December 2, 2016; May 3, 2018; December 6, 2018; December 5, 2019. Worked with directors to provide online information about COVID19 when in-person activities for were suspended in April 3, 2020.
5. Oklahoma State Science Education:
- i. Central Oklahoma Rural Partnership for Science (CORPS) Project. Collaborate with the K20 Center at OU as a co-principal investigator on a Mathematics and Science Partnership Grant, Oklahoma State Department of Education. Advise Oklahoma state teachers on curriculum and implementation of new state-wide science standards, March 2016- August 2018.
  - ii. K20-OKC Physical Science Foundations Teacher Academy. Collaborate with the K20 Center at OU on summer workshops in the physical sciences for Oklahoma City teachers. March 20016-August 2018.
6. NSF Grant Reviewer:
- i. NSF reviewer, January 2015, 2017, 2018, 2020, 2021.
  - ii. Member of NSF Review Panel on Gene Expression, April 2009.
  - iii. Ad hoc grant reviewer, 2008-present.
7. Regional NMR Conferences:
- i. Assist with online workshops for training on new Bruker 800 MHz NMR instrument at state-wide NMR facility in Stillwater, OK on October 1, October 14, November 5, and November 12, 2020.
  - ii. Co-chair, NMR Workshop, Oklahoma State University, July 17, 2015.
  - iii. NMR Session Chair, American Chemical Society 55<sup>th</sup> Annual Pentasectional Meeting, April, 2010.
  - iv. Co-chair, Great Plains Regional Annual Symposium on Protein and Macromolecular NMR Spectroscopy, October 29-30, 2010.
8. NMR Resources and Infrastructure at the University of Oklahoma:

- i. Renovate department's 500 MHz NMR spectrometer in Chemistry & Biochemistry Department.
- ii. Train organic graduate students and staff in NMR spectroscopy, 2006-2009.
- iii. Guest lectures on biomolecular NMR spectroscopy in undergraduate and graduate biochemistry courses and graduate spectroscopy courses, 2006-present.

9. Second Wind College Ministry Association:

- i. Student faculty advisor for coffeehouse outreach and hospitality ministry, 2015-present. Chair of board of Second Wind Ministries, May 2020-present. Second Wind is a student-run nonprofit coffeeshop that promotes inclusion and offers outrageously generous hospitality,

10. Science Education Community Outreach:

- i. Participate in Science Education Outreach Program (SEOP) to introduce genetics concepts and hands-on science experiments in seventh grade classrooms in New Haven, CT schools serving minority and low-income students, Yale University, 2003-2004.
- ii. Develop program of hands-on science experiments for community after-school program serving minority, low-income neighborhood at New Life Presbyterian Church, Rochester, NY, 1999-2002.
- iii. Adult Christian Education teacher, "Loving Your Neighbor in the Modern Era of Genomic Medicine", using resources from Personal Genomics Education Project, Harvard University, at First Presbyterian Church, Norman, OK, Fall 2018.
- iv. Personal Genomics Education Project, Harvard Medical School, community education resources to engage communities in dialogue about genetic engineering, collaborator and workshop facilitator.

11. International Online Conference for COVID-19 Research:

- i. "Biophysicists Address COVID-19 Challenges" Biophysical Society Special Symposium, October 29, 2020, co-organizer and session chair for nucleic acids. This international online conference highlights the research in two special issues of *Biophysical Journal* that focus on SARS-CoV-2.

**Committee Service:**

*University service*

- Alumni and Foundation Fellowship Committee, Spring 2019-present.
- Provost Advisory Committee for STEM, Spring 2015-2016.
- University of Oklahoma Research Council, Chair, 2014-2015, Member 2013-2015.
- Faculty Advisory Council to Vice President of Research, 2014-2016.
- Faculty Senate Executive Committee, 2014-2015.
- Oklahoma Undergraduate Research Faculty Advisory Committee, Spring 2015-Fall 2018.
- NSF ADVANCE team, Fall 2014-Fall 2015.

*College of Arts and Sciences Service*

- College of Arts and Science Tenure and Promotion Committee, Fall 2018, 2022
- College of Arts and Science Scholarship Committee, Fall 2012-Spring 2016.
- Ed Kline Faculty Development Award Committee, Spring 2015-Spring 2016.

*Department service*

- Department of Microbiology and Plant Biology Faculty Awards Committee, Fall 2022- present.
- Department of Microbiology and Plant Biology Honors Coordinator, Fall 2021- present.
- Department of Microbiology and Plant Biology Undergraduate Committee, Fall 2019- spring 2021.
- Department of Microbiology and Plant Biology Biotechnology Committee, Fall 2014- Fall 2018.
- Department of Microbiology and Plant Biology Graduate Committee, Fall 2015-Fall 2016.
- Department of Microbiology and Plant Biology Scholarship Committee, Fall 2011-Spring 2013, Spring 2019-Spring 2021.
- Department of Chemistry & Biochemistry Faculty Awards Committee, Fall 2022- present.

Department of Chemistry and Biochemistry Undergraduate Committee, Fall 2009-present.  
Department of Chemistry and Biochemistry Teaching Emphasis Faculty Search Committee, Fall 2015.  
Department of Chemistry and Biochemistry Textbook Selection Committee, Fall 2007.  
Department of Chemistry and Biochemistry Crystallography Staff Position Search Committee, Fall 2007.  
Department of Chemistry and Biochemistry Canvassing Committee, Fall 2006.  
Department of Chemistry and Biochemistry Seminar Committee, Fall 2005-Fall 2009.  
Department of Chemistry and Biochemistry NMR Users Committee, Fall 2005-Fall 2009.

**Professional Memberships:**

1995-present Member, American Chemical Society  
1997-present Member, American Association for the Advancement of Science  
2000-present Member, RNA Society  
2005-present Member, Biophysical Society  
2016- present Member, Stephenson Cancer Center, Preclinical Translational Cancer Research Program  
2020-present Member, American Society for Biochemistry and Molecular Biology  
2021- present Member, Data Institute for Societal Challenges at University of Oklahoma

**Postdoctoral Sponsor:**

Dr. Xiaobo Gu, PhD. 2005 Nankai University, Department of Microbiology  
Dr. Negin Mirhoseinni, PhD. 2010, Texas A&M University, Department of Veterinary Pathobiology

**Thesis Sponsor:**

University of Oklahoma Department of Microbiology and Plant Biology former graduate students:  
Alyssa Hill, PhD. NSF Graduate Fellowship, Postdoctoral Fellow, Pharmaceutical Chemistry, ETH.

Cari Quick, MS. Assistant Coordinator at Langston University NASA Advanced Research in Biology Center.

Mengyi Yang, MS. Lecturer, Henan University of Animal Husbandry and Economy.

University of Oklahoma Department of Chemistry and Biochemistry former graduate students:  
Steven Harris, PhD. NSF Bridge to Doctorate Fellow, Asst. Professor at Christopher Newport University.

Koree Clanton-Arrowood, MS. Chief, Analytical Chemistry Section, Tinker US Air Force Base

Andy Phan, MS. Bruker technical engineer, Norman, OK.

Shelly Sedberry, MS. Podiatry resident at Yale New Haven Hospital, New Haven, CT.

In addition, I have served on over 40 current and past masters and doctoral graduate student committees.

**Undergraduate Thesis Sponsor:**

Current: Kristen Duong, Andrea Jones, Nicole Karnig, Matthew Lettow, Daniel Pfaff, Anna Swierkosz

Previous: Esmeralda Alcalá, graduate student, University of Missouri

Sydney Bader, graduate student, University of Wisconsin, Madison

Koree Clanton-Arrowood, Chemistry Lecturer at Oklahoma City Community College,  
currently Chief, Analytical Chemistry Section, Tinker US Air Force Base

Wade Craig, graduate student, George Mason University

Brian Doherty, lab technician at IMMY, a biotechnology company in Norman, OK

Amr Elghondakly, graduate student at University of Maryland

Theodore Gibbons, graduate student at University of Maryland

Jane Hsi, art studio student in Florence, Italy

Amy King, validation technician, neutraceutical company, Dallas, TX

Jose Macias, graduate student at University of Oklahoma Health Science Center

Jessica (Mackiewicz) Sakai, English language tutor in Japan



Katherine Mailey, medical student at University of Oklahoma Health Science Center  
Joshua Malone, lab technician at Caisson, a biotechnology company in Oklahoma City, real estate sales  
Jonathan McGurk, medical student at University of Texas Southwestern Medical Center  
Jake Morgan, medical student at University of Oklahoma Health Science Center  
Becky Myers, high school science teacher at Veritas Academy, medical student at University of Oklahoma Health Science Center  
Mai-Thao Nguyen, medical student at University of Oklahoma Health Science Center  
Sizathu Nxmalo, quality control technician for Coca Cola Company, Oklahoma City, OK  
Abigail Overacre, graduate student at University of Pittsburgh  
Ella Parsons, graduate student at University of California, Berkeley  
Andy Phan, graduate student Chemistry and Biochemistry Department University of Oklahoma, currently, Bruker technical engineer, Norman, OK.  
Christiane Phillips, medical student at University of Washington  
Richard Pody, medical student University of Oklahoma Health Science Center  
Amanda Riggs, medical student at University of Texas, Austin  
William Runion, medical student, University of Tulsa  
Samantha Seaton, patent law student at Washington University, St. Louis  
Gretchen Scheel, medical student at University of Oklahoma Health Science Center  
Thanh Truong, dental student, University of Oklahoma Dental School

I have mentored over 50 undergraduate researchers in my laboratory.

### **New Courses Developed**

**i. Basic Physical Chemistry: Biological Applications of Physical Chemistry** (Spring 2014, 2015, 2016, 2018, 2019, 2020) This course is a one-semester physical chemistry course for biochemistry and biology students. The course is part of a new chemical biosciences major that is based on the AMA and HHMI guidelines for medical training. Course topics include thermodynamics, kinetics, calorimetry, entropy, an introduction to quantum mechanics, and spectroscopy. The goals of the course include the following:

- understand fundamental physical chemistry concepts in thermodynamics and spectroscopy and their applications to solving biological problems;
- develop problem-solving skills for answering questions in biological chemistry;
- integrate chemistry, biochemistry, microbiology, physics, and calculus knowledge in order to explore interdisciplinary medical research.

Active Learning Methods:

- group problem solving sessions in technology-enhanced active learning classroom.
- online videos for calculus review (Spring 2014-2015).

**ii. What a Wonderful RNA World!** (Spring 2011, 2012, 2013) This course is a context-based capstone course for biochemistry and chemistry undergraduates in their final semester. The course integrates concepts from previous biochemistry, physical chemistry, and organic chemistry courses and focuses on writing and communication skills. Topics include the RNA World hypothesis, ribozymes, and siRNA therapeutics. The goals of the course include the following:

- understand the many roles of RNA in gene expression;
- gain awareness of RNA therapeutics and RNA drug targets;
- synthesize chemistry and biochemistry knowledge in order to explore interdisciplinary RNA research;
- analyze primary scientific literature; and
- develop skills for communicating scientific information at both advanced and general public levels.

Writing and communication assignments include:

- a resume and cover letter for an application for a job at Dharmacon, Inc., which sells synthetic RNA;
- a press release about a current literature article;
- written critiques of current journal articles;

- oral presentations to the class; and
- participation in Science Café Norman.

#### Active Learning Projects:

- building an all-atom 1Å: 1 cm scale tRNA model;
- visualization of RNA molecules with Pymol;
- field trips to research facilities, such as NMR, sequencing facility, OU supercomputer;
- magic bag questions for literature discussion.

**iii. Topics in Virology: RNA Viruses from Molecular Structure to Infectious Disease and Therapeutic Strategies.** (Spring 2010, Fall 2011-2016, Spring and Fall 2018, Fall 2020, Fall 2021) I developed this course with Dr. Karen Meysick, an expert in pathogenesis who developed vaccines at government labs prior to teaching at OU. Our complementary backgrounds in molecular science and pathogenesis created a dynamic synergy in the class. This literature discussion course for junior and senior undergraduate students and first-year graduate students has one class focused on active learning instruction and one class discussion of a journal article each week. The course teaches fundamental concepts in virology through the examples of poliovirus, HIV-1, influenza, and SARS-CoV-2 virus and focuses on development of critical thinking skills. Students develop written, oral, and visual communication skills through class presentations, written assignments, and participation in Science Café Norman as part of the final exam.

Course topics at the interface of molecular-level science and cellular-level pathology:

- Vaccine development
- RNAi-based viral therapeutics and CRISPR-Cas9 screening and therapeutic strategies

#### Active Learning Methods:

- visualization of RNA molecules with Pymol;
- magic bag questions for literature discussion;
- active learning classrooms at the University of Oklahoma, which are based on model classrooms at the University of Minnesota. The classroom includes 6 projection screens with connections to round student tables, internet access, and writeable white boards on all the walls.

**iv. Methods to Explore Macromolecular Structure and Function.** (Fall 2006, Spring 2008, Fall 2009) This graduate-level course discusses crystallography, NMR spectroscopy, and fluorescence spectroscopy through examples of ribosome structure and function. This context-based course focuses on skill development in 3 areas: critical reading and discussion of current literature, theory and derivation of fundamental equations, and experiment design.

**v. Biochemistry Special Topics: Innovations in Sequencing Technology.** (Spring 2021). This special topics graduate course discusses new sequencing technologies and their applications to biochemistry and structural biology, including next-generation sequencing, single molecule and single cell sequencing, and nanopore sequencing. This course focuses on skill development in critical reading and discussion of current literature.

### **Traditional Courses Taught**

**i. Introduction to Molecular Biology** (Fall 2019) This combined undergraduate and graduate course focuses on the Central Dogma and learning objective themes of evolution, catalysis, and the scientific method.

**ii. Introduction to Biochemical Methods** (Fall 2010) This graduate level course discusses basic techniques and current topics in biochemistry. The writing assignments include a critical review of a journal article, a protocol, and experiment design as a step towards proposal development.

**iii. Introduction to General Chemistry** (Fall 2008, Fall 2007, Spring 2007) I taught one section (210-286 students) of a large, coordinated introductory course (total enrollment @ 1200-1800 students). The course is nationally recognized by the American Chemical Society for pedagogical excellence in curriculum

development and the guided inquiry student laboratories. The course uses clicker questions to engage students in active learning in a large lecture setting.

**iv. Introduction to Biochemistry** (Spring 2022) This undergraduate course for nonmajors preparing for careers in the medical sciences includes an introduction to the structure and function of biological molecules, enzyme kinetics, and metabolic cycles.

### **Professional Invited Oral Presentations**

46. "Advancing Viral RNA Structure Prediction." University of Texas Medical Branch at Galveston, April 22, 2021.
45. "Structures, Dynamics, and Metal Ion Binding in Prohead RNA." University of Oregon, October 20, 2019.
44. "The Challenges of Predicting Viral RNA with Multiple Functional Structures," Southwest Theoretical and Computational Chemistry Conference, Norman, OK, October 25-27, 2019.
43. "STMV RNA Structure and Function in Virus-Host Interactions". Phage and Virus Assembly, Brainerd, MN, July 16, 2019.
42. "The Challenges of Predicting Human Endogenous Retroviral RNA Structure and Function," IDeA Central Regional Conference, June 13, 2019.
41. "The Challenges of Predicting Human Endogenous Retroviral RNA Structure and Function," Oklahoma Center for Respiratory and Infectious Disease 6<sup>th</sup> Annual Research Symposium, Stillwater, OK, April 9, 2019.
40. "Structures, Dynamics, and Metal Ion Binding in Prohead RNA." Gordon Research Conference RNA Nanotechnology. Ventura, CA, January 13-18, 2019.
39. "Ultrafast Insights into RNA-Metal Ion Interactions and Prohead RNA." University of Kansas Medical School, Kansas City, KS, October 11, 2018.
38. "The Challenges of Predicting Viral RNA with Multiple Functional Structures" FASEB Virus Structure and Assembly, Steam Boat Springs, CO, July 26, 2018.
37. "Structures, Energetics, and Metal Ion Binding in Viral RNA." Kenyon College, September 14, 2017.
36. "NMR Structures and Dynamics in a Prohead RNA Loop That Bonds Metal Ions." Phage and Virus Assembly, Ellicott City, MD, August 23, 2017.
35. "Ultrafast Insights into RNA-Metal Ion Interactions and Prohead RNA." West Virginia University, April 27, 2017.
34. "Exploring RNA at the University of Oklahoma." Langston University, November 16, 2016.
33. "Structures, Dynamics, and Metal Ion Binding in Prohead RNA." Great Plains Regional Annual Symposium on Protein NMR, Univ. of Kansas, Lawrence, KS, November 14, 2015.
32. "Advancing Viral RNA Structure Prediction." Phage and Virus Assembly, Les Diablerets, Switzerland, June 10, 2015.
31. "Advancing Viral RNA Structure Prediction." Indiana University, April 16, 2015.
30. "Advancing Viral RNA Structure Prediction." National Center for Genome Resources, Santa Fe, New Mexico, March 27, 2015.
29. "Advancing Viral RNA Structure Prediction." FASEB Virus Structure and Assembly, Saxtons River, VT. July 3, 2014.

28. "Advancing Viral RNA Structure Prediction." Center for RNA Biology, State University of New York, Albany, NY. November 8, 2013.
27. "Advancing Viral RNA Structure Prediction." Phage and Virus Assembly. Lake Arrowhead, CA. September 9, 2013.
26. "Advancing Viral RNA Structure Prediction." Gordon Conference on Physical Virology. Ventura, CA. January 22, 2013.
25. "Advancing Viral RNA Structure Prediction." Dept. of Microbiology, Ohio State University, Columbus, OH, November 7, 2012.
24. "Sequence Variation in Prohead RNA." Dept. of Biochemistry, Kansas State University, Manhattan, KS, September 26, 2012.
23. "Encapsidated Viral RNA Structure Prediction" 17<sup>th</sup> Annual Meeting of the RNA Society, May 30, 2012, University of Michigan, Ann Arbor, MI.
22. "Ensemble of Structures for Encapsidated Satellite Tobacco Mosaic Virus RNA Consistent with Chemical Probing and Crystallography Constraints" Discrete and Topological Models in Molecular Biology, American Mathematical Society, March 11, 2012, University of Southern Florida, Tampa, FL.
21. "Ensemble of Structures for Encapsidated Satellite Tobacco Mosaic Virus RNA Consistent with Chemical Probing and Crystallography Constraints." Phage and Virus Assembly Meeting, October 12, 2011, Port Aransas, TX.
20. "Prohead RNA Sequence Variation." Dept. of Chemistry and Biochemistry, Arkansas State University, April 25, 2011.
19. "Prohead RNA Sequence Variation." Dept. of Chemistry, Michigan State University, February 8, 2011.
18. "Prohead RNA Sequence Variation." 2010 International Conference of RNA Nanotechnology and Therapeutics, Cleveland, OH, October 23, 2010.
17. "Computing RNA Folding Funnels" RNA in Motion, 19<sup>th</sup> Annual Growth Factor and Signal Transduction Symposium, Ames, Iowa, September 11, 2010.
16. "Satellite Tobacco Mosaic Virus RNA Secondary Structure Models Predicted With Constraints From Crystallography and Chemical Probing Data" 3<sup>rd</sup> Mathematical Virology Workshop, Ambleside, England, August 19, 2010.
15. "NMR Studies of Prohead RNA Loops to Improve RNA Structure Prediction," Southwest American Chemical Society Regional Conference, El Paso, TX, November 5, 2009.
14. "Exploring RNA Structure, Function, and Energetics to Enable Predictions from Sequence," Dept. of Chemistry, Lehigh University, Bethlehem, PA, May 27, 2009.
13. "Progress toward Predicting Viral RNA Structure from Sequence." Dept. of Biology, Univ. of Texas at Dallas, Dallas, TX, May 7, 2009.
12. "RNA Structures and Energetics Enabling Cancer Therapies." University of Oklahoma Health Sciences Center, Oklahoma City, OK. February 24, 2009.
11. "Progress toward Predicting RNA Structure from Sequence: How Parallel Computing can Help Solve the RNA Folding Problem." OU Supercomputing Symposium, Univ. of Oklahoma, Norman, OK, October 7, 2008.
10. "Exploring RNA Structure, Energetics, and Function to Enable Prediction from Sequence: Structures and Energetics of an RNA in a Biomolecular Motor." Great Plains Regional Annual Symposium on Protein NMR, Univ. of Kansas, Lawrence, KS, October 4, 2008.

9. "Progress toward Predicting RNA Structure from Sequence." Dept. of Physical Sciences, Univ. of Central Oklahoma, Edmond, OK. September 25, 2008.
8. "Progress toward Predicting RNA Structure from Sequence," Dept. of Chemistry, Pittsburgh State Univ. Pittsburgh, KS, March 28, 2008.
7. "Resistance at a Distance and Exotic Antibiotics Bound to the *H. marismortui* 50S Ribosomal Subunit," American Chemical Society local meeting, Pittsburgh, KS, March 27, 2008.
6. "Progress Towards Predicting Viral RNA Structure from Sequence," Dept. of Biology, Oklahoma State Univ., Stillwater, OK, October 22, 2007.
5. "Resistance at a Distance and Exotic Antibiotics: Mechanisms of Anisomycin Resistance in *Haloarcula Marismortui* and the Structures of 13-deoxytetracycline, Girroline, and Negamycin Bound to the 50S Ribosomal Subunit," Oklahoma Medical Research Foundation, Oklahoma City, OK, March 16, 2007.
4. "Resistance at a Distance: Mechanisms of Anisomycin Resistance in *H. Marismortui* 50S Ribosomal Subunits," Dept. of Chemistry, Univ. of Rochester, Rochester, NY, August 27, 2006.
3. "Studies of Antibiotics and Antibiotic Resistance in the 50S subunit: Mechanisms of Anisomycin Resistance." Yale University RNA Club, New Haven, CT, December 6, 2005.
2. "Exploring RNA Structure, Function, and Energetics to Enable Predictions from Sequence" Dept. of Chemistry and Biochemistry, Univ. of Oklahoma, February 26, 2005.
1. "Exploring RNA Structure, Function, and Energetics to Enable Predictions from Sequence" Dept. of Chemistry, Univ. of Washington-St. Louis, St. Louis, MS, January 5, 2005.

In addition, my students have given over 40 oral and poster presentations at local, regional, and international conferences.