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Academic Positions

2019 – **Assistant Professor**, University of Delaware, Department of Chemistry & Biochemistry

My lab at the University of Delaware studies the chemical, structural, and molecular mechanisms that control RNA-modifying enzymes and their links to human disease. We work at the interface of enzyme chemistry and RNA modifications biology in order to understand how the cell leverages chemical complexity on RNA to help regulate gene expression.

Education & Training

2011 – 2019 **Postdoctoral Fellow / Associate Specialist**, University of California San Francisco
Advisor: John D. Gross
I investigated the structural and molecular mechanisms that regulate the dynamic, multiprotein mRNA decapping complex, which removes the 5' cap modification found on all eukaryotic mRNA transcripts during a critical step in RNA decay. My work at UCSF defined the structural basis for substrate recognition and catalysis by the mRNA decapping enzyme Dcp2, and complementary mechanisms that different protein cofactors use to engage the decapping complex and tune decapping activity (Mugridge et al, NSMB 2016; Mugridge et al, Nat. Commun. 2018).

2006 – 2010 **Ph.D. in Chemistry**, University of California, Berkeley
Advisor: Kenneth N. Raymond (co-advisor: Robert G. Bergman)
I studied molecular recognition and the physical organic chemistry of small molecules encapsulated within a synthetic, enzyme-like supramolecular host-guest complex. My PhD work showed how host dynamics and structure can manipulate guest binding and reactivity in a model host-guest system, and laid the groundwork for my current and future interests in enzyme-substrate interactions.

2002 – 2006 **B.S. in Chemistry**, University of Chicago
Advisor: Michael D. Hopkins
I explored the synthesis and physical and electronic properties of air-sensitive, dialkylidyne complexes with different ligand systems as precursors to molecular wires.

Selected awards & funding

2026 UD Research Foundation Strategic Initiative Award, University of Delaware
2024 CAREER award, NSF
2024 Most Valuable Professor (MVP), UD student-nominated teaching award
2021 Maximizing Investigators' Research Award for Early-Stage Investigators (ESI-MIRA), NIH NIGMS
2021 UD Research Foundation Award, University of Delaware
2019 Research Independence Award Investigator, NIH Delaware-INBRE
2013 Ruth L. Kirschstein NRSA Postdoctoral Fellowship (F32) award, NIH NIGMS
2007 Graduate Research Fellowship (GRFP) award, NSF

Publications – research articles

[†co-equal authors; *corresponding author]

26. Geissler EP†, Moawad Y†, Roehling PN, Driscoll C, Martin K, Asare-Okai PN, **Mugridge JS***. Elp3 uses a conserved molecular tunnel to transport acetate between distant active sites and catalyze tRNA wobble base modification. *Nature Communications* (2026), doi:10.1038/s41467-026-73699-5.

25. Zhou W†, D'Oliviera A†, Dai X, **Mugridge JS***, Zhang Y*. Discovery of a novel covalent inhibitor of SARS-CoV-2 main protease with target-specific deep learning and crystal structure determination. *ACS Chemical Biology* (2026), 21, 5, 1112–1124, doi:10.1021/acschembio.6c00120.

24. Eluwawalage KDA, Shimanski B, Warminski M, Katta S, Payne R, Yu Y, Kowalska J, Jemielity J, **Mugridge JS***. FTO separation-of-function mutations alter m6A versus m6Am demethylation selectivity on RNA. *bioRxiv* [preprint] (2026), doi:10.64898/2026.05.19.726201.

23. D'Oliviera A†, Olson S†, Bernhard H, Yu Y*, **Mugridge JS***. Mapping the interactome of human tRNA methyltransferase TRMT1 using dual proximity labeling and label-free quantitative proteomics. *bioRxiv* [preprint] (2026), doi:10.64898/2026.05.18.725941.

22. Calzini LO, Warminski M, Kowalska J, Jemielity J, **Mugridge JS***. How ascorbate tunes the activity and substrate selectivity of Fe(II)-dependent dioxygenase superfamily enzymes. *bioRxiv* [preprint] (2026), doi:10.1101/2025.05.06.652568.

21. Boswinkle K†, Roehling PN†, Dos Santos P, Carrell T, **Mugridge JS**, de Crecy-Lagard V*. The *E. coli* radical SAM enzyme YhcC substitutes for the FAD-dependent oxidase activity of MnmC in 5-methylaminomethyl-2-thiouridine tRNA modification under anaerobic conditions. *bioRxiv* [preprint] (2026), doi:10.64898/2026.05.18.725915.

20. Shimanski B, Marin JF, Warminski M, McKeon RM, Kowalska J, Jemielity J, Hadden-Perilla JA*, **Mugridge JS***. The RNA demethylase FTO uses conserved aromatic residues to recognize the mRNA 5' cap structure and promote efficient demethylation of m6Am modifications. *bioRxiv* [preprint] (2025), doi:10.1101/2025.05.09.653100.

19. D'Oliviera A, Dai X, Mottaghinia S, Olson S, Geissler EP, Etienne L, Zhang Y, **Mugridge JS***. Recognition and Cleavage of Human tRNA Methyltransferase TRMT1 by the SARS-CoV-2 Main Protease. *eLife* (2025), doi:10.7554/eLife.91168.3.

18. Warminski M, Trepkowska E, Smietanski M, Sikorski PJ, Baranowski MR, Bednarczyk M, Kedzierska H, Majewski B, Mamot A, Papiernik D, Popielec A, Serwa RA, Shimanski BA, Sklepkiewicz P, Sklucka M, Sokolowska O, Spiewla T, Toczydlowska-Socha D, Warminska Z, Wolosewicz K, Zuberek J, **Mugridge JS**, Nowis D, Golab J, Jemielity J, Kowalska J. Trinucleotide mRNA Cap Analogue *N*6-Benzylated at the Site of Posttranscriptional m6Am Mark Facilitates mRNA Purification and Confers Superior Translational Properties In Vitro and In Vivo. *Journal of the American Chemical Society* (2024), *146*, 8149-8163.

17. Bednarczyk M, Peters JK, Kasprzyk R, Starek J, Warminski M, Spiewla T, **Mugridge JS**, Gross JD, Jemielity J, Kowalska J. Fluorescence-based activity screening assay reveals small molecule inhibitors of vaccinia virus mRNA decapping enzyme D9. *ACS Chemical Biology* (2022), *17*, 1460.

16. **Mugridge JS**, Ziemniak M, Jemielity J, Gross JD. Structure of the activated Edc1-Dcp1-Dcp2-Edc3 mRNA decapping complex with substrate analog poised for catalysis. *Nature Communications* (2018), *9*, 1152.

15. Paquette DR, **Mugridge JS**, Weinberg D, Gross JD. Application of a Schizosaccharomyces pombe Edc1-fused Dcp1-Dcp2 decapping enzyme for transcription start site mapping. *RNA* (2017), *24*, 251-257.

14. **Mugridge JS**, Ziemniak M, Jemielity J, Gross JD. Structural basis of mRNA-cap recognition by Dcp1–Dcp2. *Nature Structural & Molecular Biology* (2016), *23*, 987 – 994.

13. Ziemniak M, **Mugridge JS**, Kowalska J, Rhoads RE, Gross JD, Jemielity J. Two-headed tetraphosphate cap analogs are inhibitors of the Dcp1/2 RNA decapping complex. *RNA* (2016), *22*, 518 – 529.

12. Sgarlata C, **Mugridge JS**, Pluth MD, Zito V, Arena G, Raymond KN. Different and often opposing forces drive the encapsulation and multiple exterior binding of charged guests to a M4L6 supramolecular vessel in water. *Chemistry - A European Journal* (2017), *23*, 16813-16818.

11. **Mugridge JS**, Zahl A, van Eldik R, Bergman RG, Raymond KN. Solvent and pressure effects on the bond rotational barriers of encapsulated guests: probing the flexibility of a supramolecular host. *Journal of the American Chemical Society* (2013), *135*, 4299 – 4306.

10. **Mugridge JS**, Bergman RG, Raymond KN. Equilibrium isotope effects on noncovalent host-guest interactions. *Journal of the American Chemical Society* (2012), *134*, 2057 – 2066.

09. **Mugridge JS**, Bergman RG, Raymond KN. ^{1}H NMR chemical shift calculations as a probe of supramolecular host-guest geometry. *Journal of the American Chemical Society* (2011), *133*, 11205 – 11212.

08. **Mugridge JS**, Szigethy G, Bergman RG, Raymond KN. Encapsulated guest-host dynamics: guest rotational barriers and tumbling as a probe of host interior cavity space. *Journal of the American Chemical Society* (2010),*132*, 16256 – 16264.

07. **Mugridge JS,** Fiedler D, Raymond KN. A ferrocene-based catecholamide ligand: the consequences of ligand swivel for directed supramolecular self-assembly. *Journal of Coordination Chemistry* (2010), *63*, 2779 – 2789.

06. **Mugridge JS**, Bergman RG, Raymond KN. Does size really matter? The steric isotope effect in a supramolecular host-guest exchange reaction. *Angewandte Chemie International Edition* (2010), *49*, 3635 – 3637.

05. Sun J, Shaner SE, Jones MK, O'Hanlon DC, **Mugridge JS**, Hopkins MD. Synthesis, structures, bonding, and redox chemistry of ditungsten butadiyne complexes with WCCW backbones. *Inorganic Chemistry* (2010), *49*, 1687 – 98.

04. **Mugridge JS**, Bergman RG, Raymond KN. High-precision measurement of isotope effects on noncovalent host-guest interactions. *Journal of the American Chemical Society* (2010), *132*, 1182 – 1183.

03. Sgarlata C, **Mugridge JS**, Pluth MD, Tiedemann BE, Zito V, Arena G, Raymond KN. External and internal guest binding of a highly charged supramolecular host in water: deconvoluting the very different thermodynamics. *Journal of the American Chemical Society* (2010), *132*, 1005 – 1009.

02. Pluth MD, Fiedler D, **Mugridge JS**, Bergman RG, Raymond KN. Encapsulation and characterization of proton-bound amine homodimers in a water-soluble, self-assembled supramolecular host. *Proceedings of the National Academy of Sciences USA* (2009), *106*, 10438 – 10443.

01. Davenport TC, Gleason AE, Liska PL, **Mugridge JS**, Pluth MD. N,N'-(pyrene-1,8-diyl)bis(2,3-dimethoxybenzaldehyde). *Acta Crystallographica Section E* (2007), *E63*, O3621.

Publications – reviews & commentary

03. **Mugridge JS**, Coller J, Gross JD. Structural and molecular mechanisms of eukaryotic 5'-3' mRNA decay. *Nature Structural & Molecular Biology* (2018), 25, 1077 – 1085. *Review Article.*

02. **Mugridge JS**, Gross JD. Decapping enzymes STOP 'cancer' ribosomes in their tracks. *EMBO Journal* (2018), 37(23). *News & Views Article.*

01. **Mugridge JS**, Gross JD. Judge, jury, and executioner: DXO functions as a decapping enzyme and exoribonuclease in pre-mRNA quality control**.** *Molecular Cell* (2013), 50, 2 – 4. *Preview Article.*

Deposited PDB structures

08. *Crystal structure of human FTO in complex with Ga(III) and ascorbate* (PDB 9OHS). Calzini LO, **Mugridge JS**. Deposited May 2025.
07. *Crystal structure of human AlkBH3 in complex with manganese and 2-oxoglutarate* (PDB 9NCZ). Suma K, **Mugridge JS**. Deposited February 2025.

06. *Crystal structure of human HRSP12* (PDB 9N80). Suma K, **Mugridge JS**. Deposited February 2025.

05. *Crystal structure of SARS-CoV-2 main protease (Mpro) in complex with covalent inhibitor A02* (9E9P). D'Oliviera A, **Mugridge JS**. Deposited November 2024.

04. *Crystal structure of SARS-CoV-2 main protease (Mpro) C145A mutant in complex with peptide from human tRNA methyltransferase TRMT1* (PDB 9DW6). D'Oliviera A, **Mugridge JS**. Deposited October 2024.

03. *Crystal structure of K. lactis Edc1-Dcp1-Dcp2-Edc3 decapping complex with synthetic cap substrate analog* (PDB 6AM0). **Mugridge JS**, Gross JD. Deposited August 2017.

02. *Crystal structure of S. pombe Dcp1/Dcp2 in complex with H. sapiens PNRC2 and synthetic cap analog* (PDB 5KQ4). **Mugridge JS**, Ziemniak M, Jemielity J, Gross JD. Deposited July 2016.

01. *Crystal structure of S. pombe Dcp1/Dcp2 in complex with H. sapiens PNRC2* (PDB 5KQ1). **Mugridge JS**, Ziemniak M, Jemielity J, Gross JD. Deposited July 2016.

Selected invited talks

2026 *How ascorbate tunes the activity and selectivity of Fe(II)-dependent dioxygenases*.
Metals in Biology Gordon Research Conference (GRC), January 2026.

2026 *How vitamin C tunes the activity and selectivity of DNA/RNA demethylases to help regulate the epigenome and epitranscriptome*.
University of Minnesota, Epigenetics Consortium Seminar Series, May 2026.

2026 *Vitamin C regulation of Fe(II)-dependent dioxygenases in RNA modification and biological oxidation*.
Johns Hopkins University, Department of Chemistry, April 2026.

2026 *How metalloenzymes do chemistry on RNA to control gene expression*.
University of Maryland, Department of Pharmaceutical Sciences, April 2026.

2026 *How metalloenzymes do chemistry on RNA to control gene expression*.
New York University, Department of Chemistry, March 2026.

2026 *How metalloenzymes do chemistry on RNA to control gene expression*.
Virginia Tech, Department of Biochemistry, March 2026.

2026 *How vitamin C tunes the activity of Fe(II)-dependent enzymes to regulate biological oxidation reactions*.
University of Delaware, UD Faculty Lecture in Biomedical Research Excellence, March 2026.

2025 *Metals, mechanisms, and messages: how metalloenzymes do chemistry on RNA to control gene expression*.
University of Maryland, Baltimore County, Department of Chemistry & Biochemistry, November 2025.

2025 *Mechanisms controlling human RNA demethylase activity and specificity*.
New England Biolabs, Ipswich MA, October 2025.

2025 *Metals, mechanisms, and messages: how metalloenzymes do chemistry on RNA to control gene expression*.
Wake Forest University, Department of Chemistry, September 2025.

2025 *Control of RNA demethylases by vitamin C (why RNA needs its fruits and veggies too!)*.
Bioorganic Chemistry Gordon Research Conference (GRC), Andover NH, June 2025.

2024 *Bridging the gap: how the radical SAM enzyme Elp3 uses a unique mechanism to bring together distant cofactors and catalyze tRNA modification*.
Enzymes, Coenzymes and Metabolic Pathways Gordon Research Conference (GRC), Waterville Valley NH, July 2024.

2024 *Deciphering the structural and chemical mechanism for tRNA wobble base modification by the radical SAM enzyme Elp3*.
Frontiers in Chemistry and Biology Interface Symposium, UMBC, Baltimore MD, May 2024.

2023 *How the SARS-CoV-2 main protease targets human TRMT1 to disrupt tRNA modification and translation during infection*.
EMBO Workshop: Eukaryotic RNA turnover and viral biology, Brno, Czech Republic, June 2023.

2023 *How the SARS-CoV-2 main protease targets human TRMT1 to disrupt tRNA modification and translation during infection*.
University of Warsaw, Centre of New Technologies, Warsaw Poland, June 2023.

2020 2020 Nobel Prize in Chemistry: Rewriting the Code of Life.
University of Delaware, 2020 Nobel Symposium (virtual), November 2020.

2019 *The structural basis of mRNA decapping: how conformational changes and protein interactions control mRNA stability.*
Noncoding RNA and Therapeutics Interest Discovery Group RNA Salon, Baltimore MD, November 2019.