

Jennifer Crodelle, PhD

Assistant Professor of Mathematics

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Research Interests

- **Neuronal Networks:** Understanding the dynamics of neuronal networks during development and diseased states such as epilepsy and tauopathies.
- **Pain Processing:** Uncovering mechanisms underlying pain processing in the spinal cord using mathematical modeling.

Academic Appointments

- 2020–Present** Assistant Professor of Mathematics, Middlebury College, Middlebury, VT
- 2017–2020** NSF Mathematical Sciences Postdoctoral Research Fellow (MSPRF), Courant Institute of Mathematical Sciences, New York University

Education

- Aug 2017** **Ph.D. in Mathematics**, Rensselaer Polytechnic Institute
- May 2012** **B.S. in Applied Mathematics**, Marist College

Publications

(* indicates undergraduate student co-authors)

- [1] **J. Crodelle** and W. P. Dai. Uncovering Potential Effects of Spontaneous Waves on Synaptic Development: The Visual System as a Model. *PRX Life*, 4, 013022 (2026).
- [2] A.G. Ginsberg, S.F. Lempka, B. Duan, V. Booth, **J. Crodelle**. Mechanisms for dysregulation of excitatory-inhibitory balance underlying allodynia in dorsal horn neural subcircuits. *PLoS Computational Biology*, 21(1): e1012234 (2025).
- [3] X. Du, **J. Crodelle**, V. J. Barranca, S. Li, Y. Shi, et al. Biophysical modeling and experimental analysis of the dynamics of C. elegans body-wall muscle cells. *PLoS Computational Biology*, 21(1): e1012318 (2025).
- [4] **J. Crodelle**, C. Vanty*, and V. Booth. Modeling homeostatic and circadian modulation of human pain sensitivity. *Frontiers in Neuroscience*, 17: 1166203 (2023).
- [5] J. M. Epstein, E. Hatna, **J. Crodelle**. Triple contagion: a two-fears epidemic model. *Journal of the Royal Society Interface*, 18(181): 20210186 (2021).

- [6] **J. Crodelle** and D. W. McLaughlin. Modeling the role of gap junctions between excitatory neurons in the developing visual cortex. *PLoS Computational Biology*, 17(7): e1007915 (2021).
- [7] **J. Crodelle**, C. Vallejo, M. Schmidtchen, C. Topaz, and M.R. D’Orsogna. Impacts of California Proposition 47 on crime trends in Santa Monica, CA. *PLoS ONE*, 16(5): e0251199 (2021).
- [8] **J. Crodelle** and P. Maia. A Computational model for pain processing in the dorsal horn following axonal damage to receptor fibers. *Brain Sciences*, 11(4): 505 (2021).
- [9] **J. Crodelle**, D. Zhou, G. Kovacic, and D. Cai. A computational investigation of electrotonic coupling between pyramidal cells in the cortex. *Journal of Computational Neuroscience*, 48(4): 387–407 (2020).
- [10] Z.K. Tian, **J. Crodelle**, and D. Zhou. A Combined Offline-Online Algorithm for Hodgkin-Huxley Neuronal Networks. *Journal of Scientific Computing*, 84(1): 10 (2020).
- [11] **J. Crodelle**, K.A. Newhall, P.B. Pyzza, and G. Kovacic. Coarse-grained descriptions of oscillations in neuronal network models. *Communications in Mathematical Sciences*, 17(5): 1437–1458 (2019).
- [12] **J. Crodelle**, M. Hagenauer, S. Piltz, and V. Booth. Modeling the daily rhythm of human pain processing in the dorsal horn. *PLoS Computational Biology*, 15(7): e1007106 (2019).
- [13] **J. Crodelle**, D. Zhou, G. Kovacic, and D. Cai. A role for electrotonic coupling between cortical pyramidal cells. *Frontiers in Computational Neuroscience*, 13: 33 (2019).
- [14] Z.Q. Xu, **J. Crodelle**, D. Zhou, and D. Cai. Maximum entropy principle analysis in network systems with short-time recordings. *Physical Review E*, 99: 022409 (2019).
- [15] M. Hagenauer, **J. Crodelle**, S. Piltz, N. Toporikova, P. Ferguson, and V. Booth. The Modulation of Pain by Circadian and Sleep-Dependent Processes: A Review of the Experimental Evidence. *Proceedings of A Research Collaboration Workshop for Women in Mathematical Biology*, Springer (2016).

Journal Articles in Progress

- A. Byrne and **J. Crodelle**. The importance of model selection when studying gap junctions: A cautionary tale.
- **J. Crodelle**, D. Ellison*, V. Sullivan*, L. Kosowsky*. A modeling approach to investigating inhibitory plasticity in the developing cortex. *Front. in Comput. Neurosci.*

Grant Funding

2026–2027	NSF EPSCoR Research Fellows: NSF, \$375,000
2025–2028	NIH R15 HEAL Initiative, \$540,000
Summer 2025	MAA NREUP, \$35,000

2023–2025	Vermont Biomedical Research Network Project Award, \$150,000
2022–2023	Vermont Biomedical Research Network Pilot Award, \$25,000
2017–2020	National Science Foundation MSPRF, \$150,000

Mentoring Experience

Research Mentor / Advisor to:

- **Alex Laakmann** (Middlebury, Summer 2026 at Duke): Undergraduate RA who developed a mathematical model for changes in neuron activity with pathological tau protein buildup.
- **Fiona Stern** (Middlebury, Summer & Fall 2026): Undergraduate RA who worked to simplify multicompartment models of spinal column neurons into point neurons.
- **Yoyo Zhang** (Middlebury, Spring & Summer 2026): Undergraduate RA focused on using 3d FEM model to predict changes in spinal column axons due to changes across SCS patients.
- **Henry Wang** (Middlebury, Fall 2025 & Spring 2026): Undergraduate RA working to predict interpatient differences in pain processing inside the dorsal horn of the spinal cord.
- **Kai Zhu** (University College Dublin, 2025–present): PhD student at UCD advised by myself and my collaborator Aine Byrne.
- **Vince Sullivan** (Middlebury, Summer 2024 & Winter 2026): Undergraduate RA on understanding the difference between two iSTDP rules.
- **Liza Platonov & Riley Hale** (Middlebury, Summer 2024): Undergraduate RAs working on modeling gap junction (GJ) gating dynamics.
- **Lila Kosowsky & Izzy Pentony** (Middlebury, Winter 2024): Undergraduate RAs focused on inhibitory plasticity in the visual cortex.
- **Alex Ginsberg** (University of Michigan, 2021–2023): PhD student advised by Victoria Booth. Served as mentor and committee member; thesis defended July 2023.
- **Ai Hattori** (Middlebury, Summer 2022): Undergraduate RA modeling the effect of GJs in epileptic seizures.
- **Daniel Ellison** (Middlebury, Summer 2022): Undergraduate RA investigating two plasticity rules.
- **Carrie Vanty** (Middlebury, 2021–2022): Undergraduate RA who developed a mathematical model to explore the interaction of sleep and pain.
- **Bryan Currie** (Middlebury, Summer 2021): Undergraduate RA modeling synchronization properties of neurons coupled by a GJ.
- **Ben Elstner** (Middlebury, Summer 2021): Undergraduate RA characterizing inhibitory STDP.

Teaching Experience

F26, S23, F22, S22, F21	Calculus II (MATH 0122)
F26, F22, S21	Mathematical Modeling (MATH 0315)
S26, S24	Numerical Analysis (MATH 0228)
F25	Linear Algebra (MATH 0200)
S26, S23	Adv. Mathematical Modeling, Senior Seminar (MATH 0715)
S24, F21, S21, F20	Differential Equations (MATH 0226/0225)
F25, S22	Partial Differential Equations (MATH 0326)
W22	Data Science Across Disciplines (NSCI/MATH 1230)
F20	Multivariable Calculus (MATH 0223)

Invited Seminar Talks

Apr 2025	The effect of retinal waves on the formation of visual receptive fields <i>Mathematics Colloquium</i> , Rensselaer Polytechnic Institute, NY
May 2025	Mathematical modeling in neuroscience: neuronal networks and their functional roles, <i>Mathematics Colloquium</i> , Williams College, MA
Dec 2024	Modeling the effect of spontaneous retinal waves on the development of receptive fields of neurons in primary visual cortex, <i>Applied Mathematics Seminar</i> , Courant Institute, NY
Oct 2024	A Modeling approach to studying the effect of retinal waves on the development of receptive fields of neurons in primary visual cortex, <i>Mathematical Biology Seminar</i> , Brandeis University (Virtual)
Oct 2024	Mathematical modeling of neuronal networks and their functional roles, <i>Mathematics Seminar</i> , Swarthmore College, Swarthmore, PA
Oct 2022	Exploring synchrony in the brain through mathematical modeling, <i>Pi Mu Epsilon Induction Ceremony</i> , Saint Michael's College, Colchester, VT
Apr 2022	Development of orientation preference in mice: a mathematical model, <i>RWTH Aachen University EDDY Seminar</i> (Virtual)
Oct 2020	A simple mathematical model of synapse formation in the developing visual cortex of mice, <i>Applied Mathematics Seminar</i> , UNC Chapel Hill, NC (Virtual)

Selected Invited Conference Talks

June 2026	Activity-dependent effects of spontaneous retinal waves during development, <i>International Conference on Mathematical Neuroscience</i> , Montreal, CAN
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Jan 2026	Mathematical modeling of pH-induced effects on gap junction conductance, <i>Joint Math Meetings: AMS Special Session on Mathematical Modeling of Complex Systems</i> , Washington D.C
May 2025	Neuronal network computation in the developing visual cortex, <i>SIAM Dynamical Systems</i> , Denver, CO
Oct 2024	Modeling the activity-dependent effect of retinal waves on circuit formation in the visual cortex, <i>AMS Eastern Sectional Meeting</i> , Albany, NY
Jan 2023	Mathematical modeling in the brain: investigating the formation of network connections, <i>Joint Mathematics Meetings (JMM)</i> , Boston, MA
Jun 2021	Firing-rate models for analyzing spinal circuit motifs underlying chronic pain, <i>Society for Mathematical Biology (SMB) Annual Meeting</i> (Virtual)
Jul 2019	Modeling visual circuit development of mice through synaptic plasticity, <i>Society for Mathematical Biology (SMB) Annual Meeting</i> , Montreal, CAN

Selected Contributed Conference Presentations

Oct 2024	Mathematical Model of stage II retinal waves and their effect on the development of receptive fields for neurons in primary visual cortex (poster), <i>Society for Neuroscience (SfN) Annual Meeting</i> , Chicago, IL
Jun 2024	A functional role for stage II retinal waves on the receptive field development of neurons in primary visual cortex (poster), <i>International Conference on Mathematical Neuroscience</i> , Dublin, Ireland
Nov 2022	Mathematical modeling approach to investigating inhibitory plasticity in the visual cortex (poster), <i>Society for Neuroscience (SfN) Annual Meeting</i> , San Diego, CA
Aug 2022	Plasticity among neurons in the visual cortex during development: a mathematical modeling approach (poster), <i>MathFest</i> , Philadelphia, PA
Oct 2021	Mathematical modeling of neuronal networks, <i>Fall Faculty Forum</i> , Middlebury, VT

Awards & Honors

2023–Present	Jeanne Epp Barksdale Junior Faculty Fellowship (\$6,000 yearly development fund)
May 2023	Perkins Award for excellence in teaching (\$5,000 development fund)
Fall 2021	Middlebury CTRLR Pedagogy Enrichment Funds
2017–2020	NSF Mathematical Sciences Postdoctoral Fellowship (\$150,000, DMS-1703761)
May 2017	Joaquin B. Diaz Thesis Prize at Rensselaer Polytechnic Institute
Apr 2015	Student Paper Award at the 9th IMACS International Conference, Athens, GA

Organizing Activities

May 2025	Co-organizer, Minisymposium <i>Exploring Functional Roles of Neuronal Network Dynamics in Brain Computation</i> , SIAM Conference on Applications of Dynamical Systems, Denver, CO
May 2023	Co-organizer, Minisymposium <i>Novel Insights into the Dynamics and Computation of Neuronal Networks</i> , SIAM Conference on Applications of Dynamical Systems, Portland, OR
Jan 2023	Co-organizer, Panel Session <i>Advancing your Career: Integrating Scholarship, Teaching, and Service</i> , Joint Mathematics Meetings, Boston, MA
May 2021	Co-organizer, Minisymposium <i>New dynamical systems frameworks for investigating neuronal network computations</i> , SIAM DS, Virtual
June 2021	Co-organizer, Minisymposium <i>Mathematical modeling approaches to understanding pain processing and chronic pain therapies</i> , SMB Annual Meeting (Virtual)
Jul 2019	Co-organizer, Minisymposium <i>Mathematical modeling of neuronal networks</i> , SMB Annual Meeting, Montreal, CAN
May 2019	Co-organizer, Minisymposium <i>Neuronal Computations in Brain Networks</i> , SIAM DS, Salt Lake City, UT
Aug 2018	Co-organizer, Minisymposium <i>Information Processing in Neuronal Networks</i> , SIAM LS, Minneapolis, MN
May 2017	Co-organizer, Minisymposium <i>Computational models of neuronal connectivity in the brain</i> , SIAM DS, Salt Lake City, UT

Service & Outreach

May 2025	Judge for student and postdoc poster session at SIAM DS
April 2025	Judge for student presentations at Middlebury's DATAFest
Dec 2024	Judge for SCUDEM undergraduate mathematical modeling competition
2022–Present	Middlebury AWM Student Chapter Faculty Advisor
Aug 2022	Judge for MathFest undergraduate poster session
Jun 2022	Panelist for CTRLR Graduate School Panel
May 2022	External committee member for thesis student Majd Hamdan (Physics, Middlebury)
Apr 2021	Judge for Middlebury Hackathon
Apr 2021	Intro to mathematical modeling talk for Middlebury Math Club
2020–2021	College Street Children's Center Board Member

2020–2021	1000 Girls 1000 Futures Mentor
Apr 2019	Mathematical Modeling course at Courant Splash! (for high school students)
Mar 2018	Keynote Speaker at Marist College Pi Mu Epsilon Honor Society Induction
2017–2020	NYUrWIS Girls Mentor

Journal Referee Service

PAIN, PLoS Computational Biology, Physical Review E, Cognitive Neurodynamics, PLoS ONE, SIAM Journal on Applied Dynamical Systems.

Professional Development and workshops

Spring 2024	Engaged Listening Project (ELP) Fellow
Oct 2024	OCCTIVE Workshop: teaching computing outside of computer science courses, Union College, Schenectady, NY
2022–2023	MAA Project NExT Fellow
Summer 2022	WRP Anti-Racist Pedagogy Fellow
Fall 2021	National Center for Faculty Development and Diversity (NCFDD) Faculty Success Program
Jun 2021	SIMIODE Developer’s Workshop: Differential Equations Model and Resource Creators, SIMIODE (Virtual)
Mar 2021	Mathematical and computational approaches to social justice, ICERM at Brown University, Providence, RI (Virtual)
Jan 2021	CTLR Contemporary Teaching in the Liberal Arts Series: Pandemic Teaching
Jul 2020	DLINQ Camp Design Online