Gregory D. Conradi Smith[1]

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RESEARCH INTERESTS

- Mathematical aspects of the life sciences, especially neuroscience and cell physiology.

CURRENT POSITIONS

- Professor, Department of Applied Science, William & Mary, 2013–present.
- Faculty affiliate of two interdisciplinary STEM programs
  - *Neuroscience*, 2001–present.
  - *Computational & Applied Mathematics & Statistics* (CAMS), 2012–present.

EDUCATION

- University of California at Davis. Ph.D. in Biophysics, Dec. 1996.
- Massachusetts Institute of Technology. B.S. as recommended by the Dept. of Biology, Feb. 1986.

PREVIOUS POSITIONS

- Associate Chair, Department of Applied Science, William & Mary, Fall 2023.
- Interim Chair, Department of Applied Science, William & Mary, Jan.–Sept. 2018.
- Director, William & Mary Biomathematics Initiative, 2009–15.
- Associate Professor, Department of Applied Science, William & Mary, 2005–13.
- Visiting Associate Professor, Mathematical Biosciences Institute, The Ohio State University, AY 2007–08.
- Assistant Professor, Department of Applied Science, William & Mary, 2001–05.
- Assistant Professor, Department of Mathematics, Arizona State University, AYs 1999–01.
- National Research Service Award (NEI) Individual Fellowship, Center for Neural Science, New York University, 1998–99. John Rinzel, post-doctoral advisor.
- Intramural Research Training Assistantship, Mathematical Research Branch, NIDDK, NIH, 1997–98. Arthur Sherman & John Rinzel, post-doctoral advisors.
- Research Assistant, The Institute for Theoretical Dynamics & Biophysics Graduate Group, University of California Davis, 1992–96. Joel E. Keizer, graduate advisor.
- Lab Assistant, Dept. of Pediatrics, University of California San Francisco, 1990–92.
- Teacher/Counselor, Learning Experiences, Inc., Coatesville, Pennsylvania, 1987–90.

HONORS, PRIZES, AND AWARDS

- Early faculty development (CAREER) award from the NSF Division of Molecular and Cell Biology.
- Recipient of a 2013 Plumeri Award for Faculty Excellence.
- Recipient of the 2011 Phi Beta Kappa Award for the Advancement of Scholarship.

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COURSES TAUGHT & OTHER EDUCATIONAL ACTIVITIES

- *Cellular Biophysics and Modeling* (APSC 351), Spring ′02, Spring ′03, Fall ′04 & 06, Fall ′08, Spring ′11 & 13, Fall ′14–19, Fall ′2025 (96 students). This required course in W&M's Neuroscience program typically has 70–100 students. I wrote the textbook published by Cambridge University Press in 2019 (see PUBLICATIONS).
- *Science & Authority* (APSC 453, COLL 400). Fall ′22 (14 students). Fall ′23 (11 students). Fall ′24 (15 students). Spring ′2026. Science as a legitimate cultural authority and case studies of science gone wrong. https://science-authority.com
- *Computational Neuroscience* (APSC 450, COLL 400). Fall ′10 & 12, Spring ′18–20, Spring ′23 (15 students). Spring ′24 (2 students) as an independent study (APSC 404) with weekly meetings. Spring ′25 (15 students). https://apsc450computationalneuroscience.wordpress.com/
- Co-organizer of the *Biomath Journal Club & Seminar*, Fall ′08–present (w/ Leah Shaw & Helen Murphy).
- Co-organizer of the *Mind/Brain/Wellness Seminar*, Spring ′22–present (w/Christopher Del Negro, Patton Burchett, & Mark McLaughlin).
- Lead organizer and instructor of the *Cold Spring Harbor Laboratory Computational Cell Biology International Summer School* (2008–13). A 3-week event w/ ∼25 graduate students and ∼20 lecturers.
- *Mathematical and Computational Methods I & II* (APSC 607/608), Fall ′20 & Spring ′21. Fall ′23 (overload, 10 students). These are 4-credit required courses in the Applied Science graduate program.
- *Matroid Theory: The Value of Abstraction* (APSC 371/MATH 380, CAMS elective). Spring ′17 (as topics course). EPC approved Fall ′21. Fall ′22 (3 students).
- *Mathematical Physiology I & II* (APSC 751). Fall ′03, 05, 11, Spring ′04, 06, 09, 10, 12 & 15.
- *Critical Neuroscience* (APSC 490). Fall ′17 & Spring ′18. Supervised readings for Emily Hauge, who was interested in how neuroscience (mis)informs clinical psychology.
- *Matlab and Data Analysis*. Six-hour tutorial for 20 EXTREEMS-QED research students in Summer ′13–16.
- *Writing in Neuroscience* (NEUR 300). Fall ′09 (1), Fall ′16 (1), Spring ′17 (3 students).
- *Networks in Systems Biology* (APSC 490/791 Topics). Spring ′16 (10 students).
- *Bioinformatics and Molecular Evolution* (APSC 654/454, BIO 454), Spring ′05, 07 & 09.
- *Introduction to Mathematical Modeling in Cellular Physiology and Neuroscience*, Mathematical Biosciences Institute, Ohio State University, October 1–4, 2007 (w/ David Terman).
- *Markov Chain Workshop*. Fall ′03 & Spring ′04 (w/ Li, Mathias & Schrieber).
- Coordinator and instructor, *Bioinformatics: Experiment and Theory* (APSC 691/490 Topics). Fall ′02 (w/ Saha, Trosset, Reece and Sasinowski).
- *Ordinary Differential Equations* (MAT 302). Fall ′02. Outreach to the Dept. of Mathematics.
- *Mathematical Methods for Genetic Analysis* (MAT 351), Arizona State University. Spring ′01.
- *Dynamic Phenomena in Cell Biology* (MAT 598), Arizona State University. Fall ′00.
- *Ordinary Differential Equations* (MAT 274), Arizona State University. Fall ′00.
- *Brief Calculus* (MAT 210), Arizona State University. Fall ′99 & Spring ′00.

PENDING RESEARCH FUNDING

- National Science Foundation, Division of Mathematical Sciences: Emerging Mathematics in Biology, **Mathematics of membraneless organelles: the postsynaptic density.** PIs: Greg Conradi Smith and Jennifer Bestman. $488K, 8/20–7/23. [Pending]

  Develop multicomponent free-energy functionals with explicit stoichiometric reaction equilibria and auxiliary multivalent interactions to model SynGAP/PSD-95 condensates. Formulate and analyze Cahn–Hilliard systems with membrane/cytosol exchange to characterize phase structure, binodal/spinodal regions, and tie-line geometry. Integrate these developments with quantitative in vitro LLPS assays of SynGAP isoforms and finite element simulations of constrained gradient-flow systems. Translate model predictions to synapse assembly and in vivo developmental analyses in the *Xenopus* retinotectal system.

RECENTLY DECLINED RESEARCH PROPOSALS

- Commonwealth Health Research Board. **Developing countermeasures against opioid-induced respiratory depression by perturbing the cellular and molecular neurophysiology of opioid signaling.** PIs: Christopher Del Negro and Greg Conradi Smith. $200K for 2 years. [Declined]
- R21 grant targeting PA-25-114 (May 30, 2025). **Membrane-delimited G protein signals mediate opioid-induced respiratory depression: a conjoint pre- and postsynaptic target for rescue**. PI: Christopher Del Negro, co-PI: Greg Conradi Smith. [Declined]
- NSF-NIH program **Collaborative Research in Computational Neuroscience (CRCSN) Research Proposal: Cellular and synaptic mechanisms underlying opioid-induced respiratory depression**. co-equal PIs: Christopher Del Negro and Greg Conradi Smith. $963K, 04/25–03/28. [Declined]
- National Science Foundation, **Mid-Career Advancement (MCA): Connecting genetic variability to proteome network regulation in calcium signaling and neuronal growth**. PI: Nadine Kabbani (George Mason University). Senior personnel: Greg Conradi Smith. Total $378K. Subcontract for $66k to W&M. 9/24–8/27. I am the collaborative partner chosen to enhance the interdisciplinary aspects of Prof. Kabbani's research. [Declined]
- NSF-NIH program **Collaborative Research in Computational Neuroscience (CRCSN): Cellular and synaptic mechanisms underlying opioid-induced respiratory depression**. co-equal PIs: Christopher Del Negro and Greg Conradi Smith. $930K, 10/24–9/27. [Declined]

PRIOR RESEARCH FUNDING (SELECTED)

- National Science Foundation, Division of Mathematical Sciences: Mathematical Biology, **Cycle representations of receptor complex signal transduction.** PI: Greg Conradi Smith. NSF DMS #1951646, $451K, 8/20–7/23 → 7/24.

  Development of a general mathematical formalism for the analysis of receptor complexes, with a specific focus on oligomeric G-protein-coupled receptors (GPCRs) and dimeric receptor tyrosine kinases (RTKs). The formalism will be extended to accommodate non-equilibrium phenomena mediated by nucleotide exchange. Software for the analysis of receptor oligomers will be disseminated and documented in a manner accessible to life scientists.

- National Science Foundation, Division of Integrative and Organismal Systems: Evolution of Developmental Mechanisms, **Collaborative Research: Mathematical and empirical investigation of a reaction-diffusion system for spot formation in hybrid Mimulus.** co-equal PIs: Josh Puzey, Greg Conradi Smith, and Arielle Cooley (Whitman College). NSF DEB #2031275 $300K. 3/21–2/24 → 12/25.

  We have identified spotting patterns in Mimulus hybrids that appear to meet the requirements of a reaction-diffusion model while also being shaped by positional cues associated with petal vasculature. We propose to use this unique hybrid-specific trait to mathematically and empirically investigate how reaction-diffusion, combined with positional specification, results in novel, spatially complex phenotypes. Aim 1 of our proposal is to develop a reaction-diffusion model that recreates the distribution of anthocyanin spotting phenotypes observed in our hybrid F2 genetic mapping population. Aim 2 utilizes Recombinant Inbred Lines (RILs) and transgenic experiments to test key predictions of a reaction-diffusion portion of the model. Aim 3 utilizes correlation analysis and chemical and transgenic manipulation of vein development to test whether vein location influences the positioning of anthocyanin spots.

- National Institutes of Health R21-NS134005. **Molecular characterization of expiratory breathing-related interneurons in mammals.** PI: Christopher Del Negro. coPIs: Greg Conradi Smith and Margaret Somosi Saha. Senior personnel: Maria Cristina D. Picardo. $300K. 06/23–05/25.

  Breathing consists of inspiratory and expiratory pumping moving movements that ventilate the lungs but the neural bases for expiration are not well understood. This project would provide foundational new knowledge via genomic data science with in vivo functional studies to advance understanding of the cellular neural origins of expiratory breathing movements.

- Office of Provost, William & Mary. 2023 Faculty Research Seed Grant. **Cellular and molecular characterization of brainstem interneurons that generate expiratory breathing behavior in mammals.** PI: Christopher Del Negro. coPIs: Greg Conradi Smith and Margaret Somosi Saha. Senior personnel: Maria Cristina D. Picardo. $30K. 06/23–05/25.

  This project aims to use single-cell RNA sequencing from neurons obtained from the parafacial region of the brainstem to differentiate expiratory breating-related neurons from other cells in the area that serve non-respiratory functions like orofacial motor control, central chemosensitivety, and autonomic reflexes.

- Office of Provost, William & Mary, Interdisciplinary Research Innovation Fund. 2023 Faculty Research Initiation Grant. **Unraveling contemplative practices: A holistic interdisciplinary approach.** co-PIs: Adrian Bravo, Patton Burchett, Christopher Del Negro, Cheryl Dickter, Matthew Haug, Kevin Vose. Key Collaborators: Kelly Crace, Mark McLaughlin, Christy Porter, Greg Conradi Smith. $75K. 06/23–05/25.

  This project aims to clarify whether or not meditative mind-body practice confers mental health benefits.

- National Center for Complementary & Integrative Health 1R01AT010816, awarded through the joint NSF-NIH program *Collaborative Research in Computational Neuroscience*, **Discovering the neural mechanisms of breathing rhythms - eupnea and sigh.** PIs: Christopher Del Negro and Greg Conradi Smith. 1R01AT01816, $522K, 8/19–7/22 → 1/23.
- NSF Mathematical Biology, **A new class of whole cell models with bidirectional coupling of local (subcellular) and global (cellular) calcium responses.** PI: Smith GD. #1121606. $350K. 10/11–9/14 → 9/16.
- NSF **CSUMS: Theory, techniques, and research in computational mathematics**. PI: C-K Li. coPIs: A Stathopoulos, J Shi, R Lewis, V Torczon, S Day, D Lutzer, D Phillips, and GD Smith. #DMS-0703532. $884K. 9/07–8/12 → 8/13.
- Joint NSF/NIGMS Initiative in Mathematical Biology, **Ensemble density analysis of stochastic models of cardiac excitation-contraction coupling.** PIs: MS Jafri, GD Smith, and E Sobie. #DMS-0443843. Total $2M. Subcontract for $660k to W&M from George Mason University. 2/05–1/10 → 2/11.
- NSF **CAREER: The dynamics of IP_3-dependent Ca^{2+} release sites.** PI: GD Smith. #MCB-0133132. $500K. 6/02–6/07 → 6/08.
- NSF **The effect of feedback inhibition on sensory relay by visual thalamus.** PI: GD Smith. #IBN-00079931 (ASU) → 0228273 (W&M). $262K. 8/00–8/04.
- Commonwealth Technology Research Fund, **Bringing the future of bioinformatics to Virginia.** PIs: DM Manos, RG Voigt, MS Saha, GD Smith. $3.2M. 11/01–10/04 → 6/06.
- Jeffress Memorial Trust, **The dynamics of IP_3-dependent Ca^{2+} release sites.** PI: GD Smith. #J-640. $27K. 1/02–12/02 → 12/03.

PUBLICATIONS

2 book, 63 articles, 7 chapters, 5 proceedings and 7 others
over 3900 citations, h-index: 31, i10-index: 58

BOOKS (2)

2. Conradi Smith GD. **Receptor Modeling Jupyter Book**, 2025.
   https://gregconradismith.github.io/receptor-modeling-jupyter-book/intro.html
   Exposition of how cell surface receptors can be modeled using Sagemath, an open-source mathematics software system. The focus is on algebraic analysis of conformational coupling in oligomeric receptor models. [An unrefereed deliverable supported by NSF DMS grant #1951646, *Cycle representations of receptor complex signal transduction.*]

1. Conradi Smith GD. **Cellular Biophysics and Modeling: The Computational Biology of Excitable Cells**. Cambridge University Press. March 2019. 394 pages. ISBN-10: 0521183057. ISBN-13: 978-0521183055. [doi:10.1017/9780511793905] [Amazon]

MANUSCIPTS UNDER REVIEW OR IN PREPARATION (3)

3. Sakly S, Conradi Smith GD. **Phase separation dynamics of SynGAP & PSD-95 in post-synaptic densities.** *In preparation.*
2. Kalajian EJ, Stettler MK, Conradi Smith GD, Del Negro CA. **μ-opioid receptor signaling enhances Kir3 currents in glutamatergic preBötzinger complex neurons**. Under review at *J. Physiol.*
1. Cooley AM, Schlutius C, Matthews M, Simmons E, Zheng X, Thomas D, Edger PP, Platts AE, LaFountain A, George L, Williams A, Hundley D, Conradi Smith GD, Yuan Y-W, Twyford A and Puzey JR. **Genetic architectures of floral pigment and patterning in hybrid monkeyflowers.** Under review at *Genetics.*

REFEREED RESEARCH ARTICLES (63)[2]

63. Borrus DS, Stettler MK, Grover CJ, Kalajian EJ, Gu J, Conradi Smith GD*, Del Negro CA*. **Inspiratory and sigh breathing rhythms depend on distinct cellular signaling mechanisms in the preBötzinger complex**. *The Journal of Physiology (London)* 602: 809–834, 2024. [10.1113/JP285582] *Contributed equally.

62. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. **A multigenerational Turing model reproduces transgressive petal spot phenotypes in hybrid *Mimulus***. *Bulletin of Mathematical Biology* 85:120 (2023). [10.1007/s11538-023-01223-7]

61. David CK, Sugimura YK, Kallurkar PS, Picardo MCD, Saha MS, Conradi Smith GD, Del Negro CA. **Single cell transcriptome sequencing of inspiratory neurons of the preBötzinger complex in neonatal mice.** *Scientific Data* 9:457, 2022. [10.1038/s41597-022-01569-y]

60. Smith RD, Puzey JR, Conradi Smith GD. **Population genetics of transposable element load: a mechanistic account of observed overdispersion.** *PLOS ONE* 17(7):e0270839, 2022. [10.1371/journal.pone.0270839]

59. Kallurkar PS, Picardo MCD, Sugimura YK, Saha MS, Conradi Smith GD, Del Negro CA. **Transcriptomes of electrophysiologically recorded Dbx1-derived respiratory neurons of the preBötzinger complex in neonatal mice.** *Scientific Reports* 12:2923, 2022. [10.1038/s41598-022-06834-z]

58. Kinser TJ, Smith RD, Lawrence AH, Cooley AM, Vallejo-Marin M, Conradi Smith GD, and Puzey JR. **Endosperm-based incompatibilities in hybrid monkeyflowers.** *The Plant Cell*, koab117, 2021. [10.1093/plcell/koab117]

57. Zheng X, Om K, Stanton KA, Thomas D, Cheng PA, Eggert A, Simmons ESG, Yuan Y-W, Conradi Smith GD, Puzey JR*, Cooley AM*. **The regulatory network for petal anthocyanin pigmentation is shaped by the MYB5a/NEGAN transcription factor in *Mimulus*.** *Genetics*. 217(2), iyaa036, 2021. [10.1093/genetics/iyaa036]

56. Borrus DS, Conradi Smith GD*, Del Negro CA*. **Role of synaptic inhibition in the coupling of the respiratory rhythms that underlie eupnea and sigh behaviors.** *eNeuro*, 7(3):1-20, 2020. *Contributed equally. [10.1523/ENEURO.0302-19.2020] [PMID:32393585]

55. Conradi Smith GD. **Allostery in oligomeric receptor models.** *Mathematical Medicine and Biology: A Journal of the Institute of Mathematics and its Applications*. 37:313–333, 2020. [10.1093/imammb/dqz016] [PMID:31822901]

54. Smith RD, Kinser TJ, Conradi Smith GD and Puzey JR. **A likelihood ratio test for changes in homeolog expression bias.** *BMC Bioinformatics*. 20:149, 2019. [doi:10.1186/s12859-019-2709-5] [PMID:30894122]

53. Edger PP, Smith R, McKain MR, Cooley AM, Vallejo-Marin M, Yuan Y, Bewick AJ, Ji L, Platts AE, Bowman MJ, Childs KL, Schmitz RJ, Smith GD, Pires JC, Puzey JR. **Subgenome dominance in an interspecific hybrid, synthetic allopolyploid, and a 140 year old naturally established neo-allopolyploid monkeyflower.** *The Plant Cell* 29(9):2150–2167, 2017. [doi:10.1105/tpc.17.00010] [PMID:28814644]

52. Hayes JA, Kottick A, Picardo MCD, Halleran AD⋆, Smith RD, Smith GD, Saha MS, Del Negro CA. **Transcriptome of neonatal preBötzinger complex neurons in Dbx1 reporter mice.** *Scientific Reports* 7(1):8669, 2017. [doi:10.1038/s41598-017-09418-4] [PMID:28819234]

51. Hammack RH and Smith GD. **Cycle bases of reduced powers of graphs.** *ARS Mathematica Contemporanea* 12(1)183–203, 2017. [10.26493/1855-3974.856.4d2]

50. Wang X, Hardcastle K⋆, Weinberg SH, Smith GD. **Population density and moment-based approaches to modeling domain Ca^{2+}-mediated inactivation of L-type Ca^{2+} channels.** *Acta Biotheoretica* 64(1):11-32, 2016. [doi:10.1007/s10441-015-9271-y]

49. Wang X, Hao Y, Weinberg SH and Smith GD. **Ca^{2+}-activation kinetics modulate successive puff/spark amplitude, duration and inter-event interval correlations in a Langevin model of stochastic Ca^{2+} release.** *Mathematical Biosciences* 264:101–107, 2015. [doi:10.1016/j.mbs.2015.03.012]

48. Wang X, Weinberg S, Hao Y, Sobie EA and Smith GD. **Calcium homeostasis in a local/global whole cell model of permeabilized ventricular myocytes with a Langevin description of stochastic calcium release**. *American Journal of Physiology: Heart and Circulatory Physiology*. 308(5):H510-H523, 2015. [doi:10.1152/ajpheart.00296.2014] [PMID: 25485896]

[2]Undergraduate research students are indicated by ⋆. Graduate students who were under my supervision are underlined.

47. Weinberg S and Smith GD. **The influence of Ca^{2+} buffers on free [Ca^{2+}] fluctuations and the effective volume of Ca^{2+} microdomains.** *Biophysical Journal* 106(12):2693-–2709, 2014. [doi:10.1016/j.bpj.2014.04.045] [PMID: 24940787]

46. Weinberg S and Smith GD. **Discrete-state stochastic models of calcium-regulated calcium influx and subspace dynamics are not well-approximated by ODEs that neglect concentration fluctuations.** *Computational and Mathematical Methods in Medicine: Special issue on Cardiovascular System Modeling.* Volume 2012, Article ID 897371. [doi:10.1155/2012/897371]

45. Siegal-Gaskins D, Mejia-Guerra MK, Smith GD, and Grotewold E. **Emergence of switch-like behavior in a large family of simple biochemical networks.** *PLoS Comput. Bio.* 7(5):e1002039, 2011. [doi:10.1371/journal.pcbi.1002039] [PMID: 21589886]

44. LaMar MD, Kemper P, and Smith GD. **Reduction of calcium release site models via moment fitting of phase-type distributions.** *Phys. Biol.* 8:026015, 2011. [doi:10.1088/1478-3975/8/2/026015]

43. Lamprecht R, Smith GD, and Kemper P. **Stochastic Petri net models of signaling complexes and their analysis**. *Natural Computing. Special Issue: Petri Nets and BioSystems* 10:1045–75, 2011. [doi:10.1007/s11047-009-9143-y]

42. Hartman JM*, Sobie EA, and Smith GD. **Spontaneous calcium sparks and homeostasis in a minimal model of local and global calcium responses in quiescent ventricular myocytes.** *American Journal of Physiology: Heart and Circulatory Physiology* 299(6):H1996–2008, 2010. [doi:10.1152/ajpheart.00293.2010] [PMID: 20852058]

41. Huertas MA, Smith GD, and Györke S. **Calcium alternans in a cardiac myocyte model that uses moment equations to represent heterogenous junctional SR calcium.** *Biophys. J.* 99(2):377–387, 2010. [doi:10.1016/j.bpj.2010.04.032] [PMID: 20643055]

40. Williams GSB, Sobie EA, Smith GD, Jafri MS. **Models of cardiac excitation-contraction coupling in ventricular myocytes**. *Mathematical Biosciences.* 226:1–15, 2010. [doi:10.1016/j.mbs.2010.03.005]

39. LaMar MD and Smith GD. **The effect of node-degree correlation on synchronization of identical pulse-coupled oscillators**. *Physical Review E.* 84(4):046206, 2010. [doi:10.1103/PhysRevE.81.046206]

38. Thul R, Smith GD, Coombes S. **Sensitisation waves in a bidomain fire-diffuse-fire model of propagating calcium waves**. *Physica D: Nonlinear Phenomena* 238(21):2142–2152, 2009. [doi:10.1016/j.physd.2009.08.011]

37. Siegal-Gaskins D, Grotewold E, and Smith GD. **The capacity for multistability in gene regulatory motifs.** *BMC Systems Biology* 3:96, 2009. [doi:10.1186/1752-0509-3-96]

36. Hao Y, Kemper P, and Smith GD. **Reduction of calcium release site models via fast/slow analysis and iterative aggregation/disaggregation.** *Chaos* 19:037107, 2009. Focus issue: *Intracellular* Ca^{2+} *Dynamics—A Change of Modeling Paradigm?* [doi:10.1063/1.3223663]

35. Goyal R, Angermann JE, Ostrovskaya O, Buchholz JN, Smith GD, Wilson SM. **Enhanced capacitative calcium entry and sarcoplasmic-reticulum calcium storage capacity with advanced age in murine mesenteric arterial smooth muscle cells.** *Exp. Gerontol.* 44(3):201–7, 2009. [doi:10.1016/j.exger.2008.10.007]

34. Goyal R, Creel KD, Chavis E, Smith GD, Longo LD, Wilson SM. **Maturation of intracellular calcium homeostasis in sheep pulmonary arterial smooth muscle cells.** *American Journal of Physiology: Lung Cellular and Molecular Physiology* 295(5):L905–14, 2008. (22) [doi:10.1152/ajplung.00053.2008]

33. DeRemigio H, LaMar MD, Kemper P, and Smith GD. **Markov chain models of coupled intracellular calcium channels: Kronecker structured representations and iterative solution methods**. *Physical Biology* 5(3):36003, 2008. [doi:10.1088/1478-3975/5/3/036003] [PMID: 18626127]

32. Williams GSB, Huertas MA, Sobie EA, Jafri MS, and Smith GD. **Moment closure for local control models of Ca^{2+}-induced Ca^{2+} release in cardiac myocytes.** *Biophys. J.* 95(4):1689–703, 2008. [doi:10.1529/biophysj.107.125948] [PMID: 18487291]

31. Groff JR and Smith GD. **Ryanodine receptor allosteric coupling and the dynamics of Ca^{2+} sparks.** *Biophys. J.* 95:135–154, 2008. [doi:10.1529/biophysj.107.119982] [PMID: 18359795]

30. Groff JR and Smith GD. **Calcium-dependent inactivation and the dynamics of calcium puffs and sparks.** *J. Theor. Biol.* 253(3):483–99, 2008. [doi:10.1016/j.jtbi.2008.03.026] [PMID: 18486154]

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28. DeRemigio H, Groff JR, and Smith GD. **Calcium release site ultrastructure and the dynamics of puffs and sparks.** *Mathematical Medicine & Biology.* 25(1):65–85, 2008. [doi:10.1093/imammb/dqn004] [PMID: 18359948]

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24. Means S, Smith AJ, Shepard J, Shadid J, Fowler J, Wojcikiewicz R, Mazel T, Smith GD, and Wilson BS. **Reaction diffusion modeling of calcium dynamics with realistic ER geometry.** *Biophys. J.* 91(2):537-57, 2006. [doi:10.1529/biophysj.105.075036]

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22. Zhao X, Outlaw RA, Wang JJ, Zhu MY, Smith GD, and Holloway BC. **Thermal desorption of hydrogen from carbon nanosheets.** *J. Chem. Phys.* 124(19):194704, 2006. [DOI:10.1063/1.2187969]

21. Huertas MA, Groff JR, and Smith GD. **Feedback inhibition and throughput properties of an integrate-and-fire-or-burst network model of retinogeniculate transmission.** *J. Comput. Neurosci.* 19(2):147–180, 2005. [doi:10.1007/s10827-005-1084-6] [PMID: 16133817]

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19. Mazzag B, Tignanelli C* and Smith GD. **The effect of residual Ca^{2+} on the stochastic gating of Ca^{2+}-regulated Ca^{2+} channel models.** *J. Theor. Biol.* 235(1):121–150, 2005. [doi:10.1016/j.jtbi.2004.12.024]

18. Nguyen VD*, Mathias R, and Smith GD. **A stochastic automata network descriptor for Markov chain models of instantaneously-coupled intracellular Ca^{2+} channels.** *Bull. Math. Biol.* 67(3):393–432, 2005. [doi:10.1016/j.bulm.2004.08.010] [PMID: 15820736]

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16. Smith GD and Sherman SM. **Detectability of excitatory vs. inhibitory drive in a thalamocortical relay neuron model.** *J. Neurosci.* 22(23):10242–10250, 2002. http://www.jneurosci.org/cgi/reprint/22/23/10242 [PMID: 12451125]

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CONFERENCES, ABSTRACTS, AND INVITED SEMINARS[3]

- **2026 Joint Mathematics Meetings session on Stochastic Processes in Biology**, Washington, DC, 4/26. Sakly S, Conradi Smith GD. Phase-field modeling of the biological physics of membraneless organelles (*invited speaker*)

  Membraneless organelles (MLOs) formed by liquid-liquid phase separation (LLPS) exemplify how cells achieve robust spatial organization in the presence of pervasive molecular noise. These condensates arise from multivalent interactions among proteins and nucleic acids, exhibiting dynamic, reversible compartmentalization without membrane boundaries. Their existence raises fundamental mathematical questions at the interface of stochasticity, self-organization, and cellular regulation.

  We present modeling approaches that connect molecular interactions to mesoscale organization in synaptic condensates such as the post-synaptic density. At the equilibrium level, Flory-Huggins free energy theory

[3]Selected abstracts are included. Presenting authors other than myself are underlined. Undergraduate research students are indicated by ⋆.

provides a statistical-mechanical framework for how heterotypic and homotypic interactions drive LLPS and define binodal and spinodal regions of stability. Building on this, Cahn-Hilliard-type phase-field PDEs describe the spatiotemporal evolution of concentration fields, capturing nucleation, coarsening, and the influence of fluctuations. Extensions of these models may incorporate post-translational modifications (e.g., phosphorylation), regulation by intracellular calcium signaling, and mutations that alter interaction parameters, thereby reshaping phase boundaries and condensate dynamics.

By integrating statistical thermodynamics with continuum PDE models, this work highlights a central challenge in mathematical biology and soft-matter physics: how microscopic stochastic interactions and nonlinear spatiotemporal dynamics yield reliable mesoscale structures. The formation and dissolution of condensates such as membraneless organelles (MLOs) underscore the role of noise in both destabilizing and enabling functional cellular organization, with broad implications for synaptic plasticity and intracellular signaling.

- **2026 Joint Mathematics Meetings**, Washington, DC, 4/26. Sakly S, Conradi Smith GD. Phase separation dynamics of SynGAP & PSD-95 in post-synaptic densities. (*poster*)

  The post-synaptic density (PSD) is a dense assembly of proteins at excitatory synapses that regulates receptor trafficking, signaling pathways, and synaptic plasticity. Dysfunction of the PSD is associated with neurodevelopmental, and neurodegenerative diseases. One of the most abundant PSD proteins, SynGAP, regulates receptors through its association with the scaffolding protein PSD-95. Mutations within the SynGAP protein weaken these interactions, and are linked to intellectual disability, epilepsy, and autism spectrum disorder.

  To investigate possible mechanisms of SynGAP haploinsufficiency, we analyzed a three-component Flory-Huggins model (SynGAP, PSD-95, and solvent) of liquid-liquid phase separation-mediated PSD organization [Lin et al., Biophys. J. 121:1, 2022]. Assuming energetically favored interactions between SynGAP and PSD-95, as well as PSD-95 with itself, the model reproduces the emergence of PSD-95-dense and -dilute phases within an excitatory synaptic bouton. The model also reproduces the experimentally observed phenomenon of SynGAP dispersal following long-term potentiation (LTP), which is modeled as a change in Flory-Huggins interaction parameter representing the energetics of SynGAP/PSD-95 interaction. We have implemented numerical simulations of the Cahn-Hilliard system of partial differential equations based on the equilibrium Flory-Huggins model. Using this framework, we are exploring the spatiotemporal dynamics of escape of SynGAP from the PSD after LTP and how this process may be disrupted by insufficient SynGAP concentration.

- **2025 Cure SYNGAP Conference**, Atlanta GA, 12/25. Sakly S and Conradi Smith GD. (*attendees*)
- **Biomath Seminar**, William & Mary, 9/25. Conradi Smith GD. Parking functions. (*speaker*)

  At the crossroads of many deep ideas in combinatorics is the concept of a *parking function*, which can be introduced as a playful puzzle about cars trying to find spaces along a one-way street. Beyond the puzzle, parking functions connect to trees, networks, and chip-firing dynamics – mathematical structures that also appear in models of biological systems, from signaling cascades to self-organized criticality.

- **Biomath Seminar**, William & Mary, 2/25. Conradi Smith GD. Quantifying and maximizing diversity. (*speaker*)

  How can we quantify diversity in a meaningful and logical way? The most common meaning given to (bio)diversity is simply the number of species present, but this quantity is not always very informative. For instance, the number of species of great ape on the planet is 8 (Human, Bonobo, Chimpanzee, Eastern and Western gorilla, and Bornean, Sumatran, and Tapanuli orangutan), but 99.99% of all great apes belong to just one species: us. In terms of global ecology, it is arguably more accurate to say that there is effectively only one species of great ape. A more informative definition of diversity includes a spectrum of viewpoints, indexed by a real parameter q that specifies the greater or lesser importance given to rare species. When this mathematical approach to diversity is extended to include the similarities and differences between species, a natural question is what probability distribution maximizes diversity for a fixed similarity matrix Z. In principle, both the maximizing distribution and the value of the maximum diversity depend on q. However, it is a theorem that neither does. Every similarity matrix has an unambiguous maximum diversity, independent of q, and a distribution that maximizes the diversity of all orders q simultaneously. This talk is an exposition of recent work by Tom Leinster (https://www.maths.ed.ac.uk/~tl/).

- **SEPEEG 2024 - SouthEastern Population Ecology and Evolutionary Genetics Conference**, Clemson, SC, 10/24. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. Hybridization and phenotypic diversity in *Mimulus* petal patterns. (*speaker*)

  Hybridization can unlock unexpected phenotypic diversity, raising fundamental questions about how genetic interactions shape evolution. In this talk, we investigate the mechanisms underlying the explosion of

phenotypic diversity seen in hybridization between Mimulus species. We developed a mathematical model for multigenerational inheritance of Turing patterns, which indicates that allelic interactions in hybrids produce dramatically more phenotypic diversity compared to homozygous populations. To validate this hypothesis empirically, we developed a population of recombinant inbred lines (RILs) and crossed individuals with different petal patterns to study the genetic interactions responsible for their diversity. Our findings support the hypothesis put forth in our mathematical model and furthermore indicate that more complex genetic mechanisms are at play than we previously understood.

- **Virginia Soft Matter Workshop IX**, James Madison University, Harrisonburg VA, 10/24. Sakly S and Conradi Smith GD. (*attendee*)
- **Biomath Seminar**, William & Mary, 9/24. Conradi Smith GD. Membraneless organelles and the Cahn-Hilliard equation for liquid-liquid phase separation. (*speaker*)

  Living cells contain distinct subcompartments that facilitate spatiotemporal regulation of biological reactions. Examples of this compartmentalization include membrane-bound organelles such as secretory vesicles and endoplasmic reticulum. In addition, cells contain many organelles that do not have an enclosing membrane yet remain coherent structures. Examples of membraneless organelles include cytoplasmic structures such as stress granules, P-bodies, and germ granules, as well as nuclear assemblies such as the nucleolus, Cajal bodies, and nuclear speckles.

  Membraneless organelles (MLOs) exhibit remarkable liquid-like features. As with conventional liquids, they typically adopt round morphologies, coalesce into a single droplet upon contact with one another, and wet intracellular surfaces such as the nuclear envelope. Moreover, component molecules of MLOs exhibit dynamic exchange with the surrounding nucleoplasm and cytoplasm. These findings suggest that MLOs are liquid-phase condensates, which form via biologically regulated liquid-liquid phase separation.

  My talk on Friday will include a brief overview of membraneless organelles followed by a more detailed presentation of the Cahn–Hilliard equation. This partial differential equation describes the process of liquid-liquid phase separation. Along the way, I will disclose recent developments in my love-hate relationship with generative AI.

- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/24. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. Reaction-diffusions system simulated on irregular shapes and surfaces model petal spot patterns in monkeyflower hybrids. (*speaker*)

  The origin of phenotypic novelty is a perennial question in evolutionary genetics, as it is fundamental to both adaptive evolution and intergenerational phenotypic change. However, few studies of biological pattern formation specifically address multigenerational aspects of inheritance and phenotypic novelty. Previous research in Mimulus (monkeyflowers) has shown that a gene regulatory network subserves a Turing-type pattern formation mechanism (Ding et al., 2020). Subsequently, we developed a model demonstrating that heterozygosity can produce novel pigment patterns in petals, resulting from the interaction between different allele forms (Simmons et al., 2023). However, petals are not uniform spaces for pattern formation, as pigment spots are differentially expressed across the petal, along veins, and between edge and central locations. To investigate the possible roles of petal shape and vein tissue, we incorporated a petal-shaped mask and non-uniform capacities and diffusion rates according to the method put forth by Calhoun and LeVeque (1999). In future work, we plan to compare our model's results with empirical results from a population of recombinant inbred lines. Our findings provide insights into the genetic control of phenotypic novelty and the role of heterozygosity in trait evolution, with potential implications for the study of evolutionary genetics and mathematical biology.

- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/24. Morandi Zerpa D*, Zhao J*, Del Negro CA*, Conradi Smith GD*. Assessing the pre- and post-synaptic effects of opioids on inspiratory rhythmogenesis. (*poster*) *Contributed equally.

  The preBötzinger complex (preBötC), in the lower brainstem, functions as the rhythm generator for breathing in humans and all mammals. Neurons of the preBötC comprise the respiratory central pattern generator, producing the rhythm for inspiratory breathing movements. Despite the evolutionary conservation and robustness of this neural oscillator, its Achilles heel is sensitivity to opioid drugs. Here, we present parallel projects assessing two aspects of preBötC function relevant to opioid-induced respiratory depression (OIRD). Previously, we presented a firing rate activity model of the preBötC that exhibits episodic bursting mediated by the combination of recurrent excitation, synaptic depression, and cellular adaptation (Borrus et al., 2024). To investigate the pre-synaptic and post-synaptic effects of opioids on the preBötC, we extended this model to include two populations that either lack or express the mu-opioid receptor (μOR− and μOR+, respectively). Parameter studies explore how pre-synaptic suppression of excitation, post-synaptic decreases in excitability, and μOR± population sizes may contribute to OIRD.

Previous studies suggest that μORs may target G protein-coupled inward rectifiers (GIRKs), KCNQ channels that give rise to M-current (I_M), or a slowly inactivating A-current (I_A). GIRK and I_M have obvious roles in controlling baseline membrane potential. But how about I_A? To investigate the possible influence of I_A on OIRD, we developed a conductance-based network model of the preBötC in which I_A is included in the dendritic compartment of 500 Pinsky-Rinzel-type in silico neurons. Preliminary simulations with single-compartment neurons confirm that increased I_A conductance results in delayed excitation and lower burst frequency. Here, we present an extended analysis using a preBötC network model composed of two-compartment (somatic & dendritic) neurons, elucidating how opioid modulation of I_A can impact network rhythmogenesis. These parallel projects provide a fresh perspective regarding basic biophysical mechanisms underlying OIRD, which is important foundational knowledge for developing resuscitation strategies and treatment of opioid addiction.

- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/24. Chen R*, Del Negro CA*, Conradi Smith GD*. Spike timing-dependent plasticity and synaptic scaling invoke episodic bursting in an excitatory recurrent neuronal population. (*poster*) *Contributed equally.

  Synaptic plasticity is regarded as the biological foundation of learning and memory, but what other brain computations or functions might it contribute to? Spike-timing-dependent plasticity (STDP) is a neurophysiological process that modulates long-term synaptic strengths. Consistent with Hebbian learning principles, theories of STDP emphasize the asymmetric impact of precise temporal correlations between the spikes of pre- and post-synaptic neurons on changes in synaptic efficacy. Considering that a recurrently connected network also repetitively represents synaptic drive to its constituent neurons, we investigated STDP within that context by employing mathematical analysis and computational simulations. Alongside synaptic scaling, we utilize a pair-based STDP model implemented with a spectrum of weight dependence. We assume neuronal spiking follows a time-inhomogenous Poisson point process, incorporating a nonlinear rate function derived from a minimal spiking network model of the brainstem preBötzinger complex (preBötC), which generates the inspiratory breathing rhythm. Our exploration focuses on how STDP rules (e.g., additive versus multiplicative update) affect the activity and connectivity dynamics of the excitatory neuron population. We find that the dynamics of STDP, in conjunction with synaptic scaling, can evoke episodic bursting patterns. We discuss how this observation relates to the notion that the synchronization of rhythmogenic neurons underlies the inspiratory rhythm of the preBötC (i.e., burstlets). The possible role of STDP in generating rhythmicity in an excitatory recurrently connected network could be important to understanding the neural bases for mammalian motor behaviors like breathing, walking, and swimming, where the underlying neural rhythm comes from an excitatory recurrent network.

- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/24. Rinker CA*, Simmons ESG, Puzey JR, Conradi Smith GD. The mathematical beauty of type-B Turing pattern development in monkeyflowers. (*poster*)

  Development of novel phenotypes across generations is a core topic in evolution and genetics, and developing mathematical models can enhance understanding of their emergence. For example, second-generation hybrid offspring can display more extreme phenotypes than the most extreme parental phenotypes. This project explores a multi-generational Turing model for a reaction-diffusion system that gives rise to transgressive patterned phenotypes in hybrid monkeyflowers (Simmons et al., 2023). It is well-known that two types of Turing models can be distinguished by the sign of the interactions between activator and inhibitor. In both types of Turing bifurcation, the activator up regulates itself and the inhibitor down regulates itself. Simmons et. al. 2023 presents a multi-generation Turing model in which the activator up regulates the inhibitor and the inhibitor down regulates the activator, i.e., the qualitative Jacobian of the linearized reaction terms is $J = [+-;+-]$. This project examines the alternative case in which the activator down regulates the inhibitor and the inhibitor up regulates the activator ($J = [++;--]$). Results are compared with Simmons et al. 2023 to examine the differences in F2 patterning that emerge from these distinct Turing bifurcations.

- **Mind/Brain/Wellness Seminar**,William & Mary, 4/24. Conradi Smith GD. High-ventilation breathwork and respiratory gas exchange. (*speaker*)

  Breathwork practices invariably involve patterns of volitional breathing. But what are the physiological mechanisms downstream from controlled respiration? Given the claims that breathwork can relieve various forms of psychological distress, we ought to have some understanding of the effect of these practices on respiratory gas exchange, blood gases, and brain state. On Friday, we will discuss this question in the context of high-ventilation breathwork practices such as holotropic breathing. Presumably, the pathway from increased ventilation rate/depth to neurophysiology begins with eliminating carbon dioxide (CO_2) from the blood. An increase in blood alkalinity leads to cerebral vasoconstriction and a shifting of the oxyhemoglobin dissociation curve, which reduces oxygen supply to the brain. Fincham et al. 2023 suggest

that in this hypoxic environment, neuronal metabolism shifts towards glycolysis, which causes lactate accumulation and stimulation of adrenergic locus coeruleus. In parallel, alkalosis/hypocapnia impairs GABAergic inhibition of excitatory neurons leading to disruption of gamma oscillatory networks, hyperexcitability of neurons, and increased neurometabolic demands, which cannot be matched by adequate oxygen (O_2) supply. Readings: Fincham et al. 2023 and "Physiological mechanisms involved in holotropic breathwork," Ch. 9 in *Holotropic Breathwork: A New Approach to Self-Exploration and Therapy* by Stanislav Grof and Christina Grof (SUNY Press, 2023).

- **SEPEEG 2023 - SouthEastern Population Ecology and Evolutionary Genetics Conference**, Blacksburg, VA, 9/23. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. A multigenerational Turing model reproduces transgressive hybrid phenotypes. (Awarded best *poster* by a graduate student.)
- **Biomath Seminar**, William & Mary, 9/23. Conradi Smith GD. Burnside's lemma and the alpha7 nicotinic acetylcholine receptor. (*speaker*)

  How does one count objects taking account of symmetry? For example, when drawing a triangle with edges that can be either back or red, there are $2^3 = 8$ different possibilities. However, up to symmetry, there are only 4 distinct types, which can be indexed by the number of red edges (0, 1, 2, or 3). Easy! How about this slightly harder question from a conversation earlier this week with Prof. Nadine Kabbani (GMU)?

  The α7 nicotinic acetylcholine receptor (nAChR) is a ligand-gated ion channel that plays an important role in cellular calcium signaling and contributes to several neurological diseases. Functional α7 nAChRs are formed through the arrangement of five subunits into homopentameric channels that conduct Na^+, K^+, and Ca^{2+} ions across the plasma membrane. Agonist binding to the α7 nAChR induces fast channel activation followed by inactivation and prolonged desensitization while triggering long-lasting calcium signaling.

  When one tries to understand the nAChR as composed of 5 identical α7 subunits, each of which can be in one of three states (resting, activated, inactivated), a natural question is 'How many fundamentally distinct molecular conformations are there?' (The answer is far less than $3^5 = 243$ due to the dihedral symmetry of the nAChR.)

  My talk on Friday will focus on a result from group theory known as Burnside's lemma, which is often helpful when counting objects up to symmetry. Let G be a finite group that acts on a finite set X. For each $g \in G$, let X_g denote the set of elements in X that are fixed by g, that is, $X_g = \{x \in X | gx = x\}$. Burnside's lemma counts orbits, which is the same thing as counting distinct objects taking account of symmetry, as the average over $g \in G$ of $|X_g|$, the number of elements of Xg.

- **Society for Mathematical Biology**, Columbus, OH, 7/23. Minisymposium: Stochastic Cellular Dynamics. Conformational coupling of receptor dimers. (*invited speaker*)

  Quantitative pharmacologists construct Markov chain models to give insight into the relationship between ligand concentration and the fraction of cell surface receptors in each of several molecular conformations. Pharmacologists use these stochastic models to understand the action of natural ligands and drugs on receptor-mediated cell responses. When receptors function as two or more similar protein subunits working in concert (i.e., homodimers or oligomers), receptor models must (i) account for symmetry, (ii) satisfy thermodynamic constraints, and (iii) properly account for subunit interactions (allostery) mediated by conformational coupling. The modeling framework that satisfies these three requirements will be explicated in the context of models of G protein-coupled receptors (GPCRs), such as metabotropic glutamate receptors, that function as multi-molecule signaling complexes. For equilibrium models of receptor dimers, this approach facilitates the inference of a parsimonious subset of allosteric interactions leading to conformational coupling and dependence of receptor subunits.

- **Society for Mathematical Biology**, Columbus, OH, 7/23. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. A multigenerational Turing model reproduces transgressive hybrid phenotypes. (Award-winning *poster*.)

  The origin of phenotypic novelty is a perennial question of genetics and evolution. To date, few studies of biological pattern formation specifically address multigenerational aspects of inheritance and phenotypic novelty. For quantitative traits influenced by many segregating alleles, offspring phenotypes are often intermediate to parental values. In other cases, offspring phenotypes can be transgressive to parental values. For example, in the model organism *Mimulus* (monkeyflower), the offspring of parents with solid-colored petals exhibit novel spotted petal phenotypes. These patterns are controlled by an activator-inhibitor gene regulatory network with a small number of loci. Here we develop and analyze a model of hybridization and pattern formation that accounts for inheritance in diploid gene regulatory networks composed of either homozygous or heterozygous alleles. We find that the resulting model of multigenerational Turing-type pattern formation can reproduce the transgressive petal phenotypes observed in *Mimulus*. The model gives insight into how non-patterned parent phenotypes can yield phenotypically transgressive, patterned offspring, aiding in the development of empirically testable hypotheses.

- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/23. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. Reaction-diffusion system on irregular boundaries reproduces multiple generations of petal spot patterns in monkeyflower hybrids. (*poster*)

- **Motor Control: Spinal Circuits and Beyond**, University of St Andrews, 6/23. Stettler M, Gu J, Borrus D, Grover C, Kam K, Conradi Smith GD, Del Negro CA. Manipulation of intracellular calcium storage and release mechanisms regulates sigh breathing rhythms. (*poster*)
- **Biomath Seminar**, William & Mary, 2/23. Conradi Smith GD. Bursting in excitatory neural networks – do spikes matter? (*speaker*)

  A mechanistic account of neuronal activity can be made concrete as a low-dimensional firing-rate model or a high-dimensional network model consisting of individual spiking neurons. What are the pros and cons of these two levels of abstraction? Under what conditions can the activity of a spiking network be accurately represented by a firing-rate model? Which modeling framework provides more insight into mechanisms and experimentally testable predictions?

  We will discuss these questions in the context of preBötzinger Complex (preBötC), the brainstem center that generates the inspiratory breathing rhythm. At least seven competing models have been advanced to explain preBötC rhythmogenesis, but key experiments falsify most. Del Negro, Conradi Smith, and trainees have developed a network model of the preBötC that consists of individual spiking neurons and reproduces several important empirical benchmarks. The reduced firing-rate version of the model yields counter-intuitive predictions that have subsequently been confirmed by experiment.

- **CRCNS Principal Investigators Meeting**, Atlanta, GA, 10/22. Borrus DS, Grover CJ, Kam K, Conradi Smith GD, Del Negro CA. Inspiratory and sigh breathing rhythms emerge via distinct mechanisms within a single neuron population. (*poster*)

  The brainstem preBötzinger Complex (preBötC) generates two breathing-related rhythms: one for inspiration on a timescale of seconds and another for sighs on the order of minutes. We posit that these disparate rhythms emerge in tandem from a single neuron population; there is no need for separate rhythmic populations, gliotransmission, hyperpolarization-activated mixed cationic current (Ih) in neurons, or synaptic inhibition as previously thought. We formulated a mathematical model that instantiates our hypothesis. Experimental tests of prior model predictions validate the single-population rhythmogenic framework, reproducing disparate breathing-related frequencies and the ability for inspiratory and sigh rhythms to be separately regulated in support of respiration under a wide array of conditions. Here we show how a single neuron population exploits two cellular tool kits: one involving voltage-dependent membrane properties and synaptic excitation for inspiratory breathing (eupnea) and an intracellular biochemical oscillator for sighs, which ventilate and maintain optimal function in compliant mammalian lungs with alveoli.

- **Biomath Seminar**, W&M, 9/22. Conradi Smith GD. Epistemic networks for the misinformation age. (*speaker*)

  I will introduce the notion of an epistemic network model and discuss how simulations of epistemic networks might contribute to our understanding of political and/or scientific polarization. Does the structure of epistemic networks influence how quickly and accurately members of groups obtain true beliefs? Does the social pressure to conform have a negative effect on a community's ability to reach accurate consensus? Why do people who disagree about one subject tend to disagree about other subjects as well? As preparation for Friday's talk, read the equation-free book chapter: Singer, D. J., Grim, P., Bramson, A., Holman, B., Jung, J., & Berger, W. J. (2021). Epistemic networks and polarization. In The Routledge Handbook of Political Epistemology (pp. 133-144).

- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/22. Wood SE, Stolting L*, Conradi Smith GD. Automated fitting of allosteric parameters in receptor oligomer models.
- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/22. Simmons ESG, Cooley AM, Puzey JR, Conradi Smith GD. Genetically explicit model may explain multigenerational control of emergent Turing patterns in hybrid *Mimulus*. (*poster*)
- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond, VA, 5/22. Grover CJ, Del Negro CA, Conradi Smith GD. Scale-free network properties influence breathing rhythmogenesis. (*poster*)
- **Biomath Seminar**, William & Mary, 2/22. Conradi Smith GD. Genetic algebras. (*speaker*)

  This expository talk explores the non-associative algebraic structure that is naturally associated with Mendelian genetics. The notion of a 'genetic algebra' was formalized in the 1940s by Ivor M. H. Etherington (1908–1994) and pursued by Bernstein, Gonshor, Guzzo, Hetzel, Holgate, Perezi, Schafer, Walcher, Wörz-Busekros, and many others, including J. B. S. Haldane (one of the three major figures to develop the mathematical theory of population genetics, along with Ronald Fisher and Sewall Wright). In Friday's Biomath Seminar, we will begin with the standard multiplication tables used by geneticists to represent gametic and zygotic inheritance, and show how these tables define the structure constants of a finite-dimensional algebra. We will discuss known properties of a genetic algebra such as the rank equation, the transformation matrix, weight functions, change of basis, and commutative duplication. Along the way, we will illustrate the use of genetic algebra in the mathematical analysis of self-fertilization and polyploidy.

- **CRCNS Principal Investigators Meeting**, New York, NY, 10/21. Borrus DS, Grover CJ, Conradi Smith GD, Del Negro CA. The preBötzinger complex generates inspiratory rhythm through recurrent excitation and sigh rhythm via calcium oscillations. (*poster*)
- **Experimental Biology**, 4/21. Kallurkar P, Picardo MCD, Conradi Smith GD, Saha MS, Del Negro CA. Patch-seq analysis of dbx1-derived respiratory neurons of the preBötzinger complex in neonatal mice. (*abstract*)
- **Botany**, Tucson, AZ, 7/19. Zheng X, Davies L, Yuan W, Puzey JR, Conradi Smith GD. Reaction-diffusion dynamics of complex petal pigmentation patterning in hybrid *Mimulus*. (*poster*)
- **Botany**, Tucson, AZ, 7/19. Zheng X, Yuan W, Cooley AM, Puzey JR, Conradi Smith GD. Modeling petal spot pattern formation in *Mimulus*. (*lightning talk*)
- **Society for Neuroscience**, Chicago, IL, 11/19. Borrus DS, Conradi Smith GD, Del Negro CA. Role of synaptic inhibition in the coupling of the respiratory rhythms that underlie eupnea and sigh behaviors. (*poster*)
- **Biophysical Society**, Baltimore, MD, 3/19. Conradi Smith GD. Allosterism in oligomeric receptor models: cycle bases of reduced graph powers provide a theoretical framework for conformational coupling. (*poster*)
- **Biophysical Society**, Baltimore, MD, 3/19. Conradi Smith GD. *Cellular Biophysics and Modeling*: A required course in the neuroscience program at William & Mary. (*poster*)
- **Botany**, Rochester, MI, 7/18. Kinser T, Smith RD, Lawrence AH, Smith GD, Puzey JR. Endosperm development of the triploid bridge to a *Mimulus* allohexaploid: insights into genomic imprinting.
- **Biophysical Society**, San Francisco, CA, 2/18. Hammack RH and Conradi Smith GD. Allosteric modulation and thermodynamic constraints in occupancy models of oligomeric G protein-coupled receptors. (*poster*)
- **Society for Neuroscience**, Washington, DC, 11/17. Hammack RH and Conradi Smith GD. Allosteric modulation and thermodynamic constraints in occupancy models of oligomeric G protein-coupled receptors. (*poster*)
- **Mathematics Department Seminar**, Virginia Commonwealth University, Richmond, VA, 11/17. Wang algebra and spanning trees of receptor dimer models. (*invited speaker*)
- **Biomath Seminar**, 10/17. Conradi Smith GD, Smith RD, Puzey JR. Population genetics of transposable elements. (*speaker*)
- **Mathematics Department Seminar**, Virginia Commonwealth University, Richmond VA, 11/16. Population density models of local control of calcium release in cardiac myocytes. (*invited speaker*)
- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond VA, 5/16. Smith RD, Smith GD, Puzey JR. Homeologue expression bias. (*poster*)
- **Biology and Medicine through Mathematics**, Virginia Commonwealth University, Richmond VA, 5/16. Hammack R and Smith GD. Hill's diagrammatic method and reduced graph powers. (*poster*)
- **American Mathematical Society: Special Session on Graph Products**, Joint Mathematics Meetings, Seattle, WA, 1/16. Hammack RH and Smith GD. Cycle bases of reduced powers of graphs. (*invited speaker*)
- **Mathematics Colloquium**, Virginia Commonwealth University, Richmond VA, 11/15. Mathematical modeling of intercellular calcium dynamics. (*invited speaker*)
- **Mathematics Colloquium & Biomath Seminar**, W&M, 10/15. Hill's diagrammatic method, concerted channel gating, and reduced graph products. (*speaker*)
- **Society for Mathematical Biology, Minisymposium: Modeling calcium signaling in cardiomyocytes**, Atlanta, GA, 6/15. Weinberg SH, Smith GD. Calcium buffers do not suppress and may enhance calcium fluctuations in the cardiac dyadic subspace. *(speaker)*
- **The Ninth Q-bio Summer School**, University of New Mexico, Albuquerque, NM, 7/15. Hancock DI. Modeling calcium-mediated calcium release as a Markov process. *(poster)*
- **Society for Mathematical Biology**, Atlanta, GA, 6/15. Hancock DI and Smith RD. *(attendees)*
- **EXTREEMS-QED Seminar**, Department of Mathematics, W&M, 3/15. Conway's orbifold notation for the 17 symmetry types of repeating planar patterns. (*speaker*)

  > An introduction to the 17 symmetry types for repeating patterns in the plane (a.k.a., the plane crystallographic groups) and Conway's "orbifold notation" that draws on work of William Thurston and Macbeath. References: The orbifold notation for two-dimensional groups. Conway JH, Huson DH. Structural Chemistry 13:(3–4)247–257, 2002. Conway JH, Burgiel H, Goodman-Strauss C. *The Symmetries of Things*. A K Peters/CRC Press, 2008.

- **Biomath Seminar**, W&M, 2/15. Smith GD. Conway's orbifold notation for the 17 symmetry types.... (*speaker*)
- **Williamsburg Montessori School**, 2/15. Smith GD. The symmetries of repeating patterns. (*guest instructor*)
- **Society for Neuroscience**, Washington, DC, 11/14. (1) Smith GD, Weinberg SH. Calcium buffers do not suppress (but may enhance) intrinsic free calcium concentration fluctuations in calcium microdomains. (2) Wang X, Hardcastle K*, Weinberg SH, Smith GD. A population density and moment-based approach to modeling domain calcium-mediated inactivation of L-type calcium channels. (*posters*)
- **Biomath Seminar**, Virginia Commonwealth University, Richmond VA, 10/14. Smith GD. Modeling the stochastic dynamics of localized calcium elevations and whole cell calcium responses. (*invited speaker*)

- **Biomath Journal Club**, W&M, 9/14. Smith GD. (*presenter*). Chalancon et al. Interplay between gene expression noise and regulatory network architecture. *Trends Genet.* 28(5):221–32, 2012.
- **Frontiers in Applied and Computational Mathematics**, New Jersey Institute of Technology, 5/14. Smith GD. Modeling the bidirectional coupling of localized calcium elevations and whole cell calcium responses. (*invited speaker*)
- **Biomath Journal Club**, W&M, 4/14. Smith GD. (*presenter*) Advantages and limitations of current network inference methods. De Smet R, Marchal K. *Nat Rev Microbiol.* 8(10):717-29, 2010.
- **Student Capstone Conference, Virginia Modeling, Analysis and Simulation Center**, Old Dominion University, Suffolk, VA, 2/13. Wang X, Weinberg SH, Hao Y, Sobie EA, Smith GD. Calcium homeostasis in a local/global whole cell model of permeabilized ventricular myocytes.... (*speaker*)
- **Nonlinear dynamics and stochastic methods: From neuroscience to other biological applications**, University of Pittsburgh, Pittsburgh, PA, 3/14. (*attendee*)
- **Krasnow Institute for Advanced Study Seminar**, George Mason University, Fairfax, VA, 10/13. Smith GD. Modeling the bidirectional coupling of localized calcium elevations and whole cell calcium responses. (*invited speaker*)
- **Cardiac Physiome Workshop**, Bar Harbor, ME, 10/13. Smith GD. Modeling the bidirectional coupling of localized calcium elevations and whole cell calcium responses. (*invited speaker*)
- **Biomedical Engineering Society**, Seattle, WA, 9/13. Weinberg SH, Smith GD. Fluctuations in calcium concentration influence calcium spark dynamics in cardiac myocytes. *(poster)*
- **Biomath Seminar**, W&M, 9/13. Smith GD. RNA-Seq and differential expression analysis (*speaker*)
- **Society for Mathematical Biology, Minisymposium: Modeling ionic flows in biological cells**, Tempe, AZ, 6/13. Weinberg SH, Smith GD. Influence of calcium concentration fluctuations on the dynamics of calcium-regulated calcium channels. *(speaker)*
- **Mathematical Biosciences Institute Workshop**, Columbus, OH, 4/13. Smith GD. Modeling the bidirectional coupling of localized calcium elevations and whole cell calcium responses. *(invited speaker)*
- **Computational Cell Biology: The interplay between models and experimentation**, Cold Spring Harbor, NY, 3/13. Weinberg SH, Smith GD. Influence of calcium buffers on concentration fluctuations and stochastic dynamics of calcium-triggered calcium release. *(speaker)*
- **Biophysical Society**, Philadelphia, PA, 2/13. (1) Hardcastle H*, Weinberg SH, Smith GD. A population density domain model for calcium-inactivation of L-type calcium channels. (*poster*) (2) Wang X, Hao Y, Weinberg SH, Sobie EA, Smith GD. Analysis of spark versus non-spark mediated SR calcium leak using a Langevin description of stochastic calcium release. (*poster*) (3) Weinberg SH, Smith GD. Calcium concentration fluctuations and subspace volume influence calcium-regulated calcium channel gating and subspace dynamics. (*platform presentation*)
- **Society for Neuroscience**, New Orleans, LA, 10/12. Hardcastle K*, Smith GD, Burk JA. A population activity model of cortico-striatal circuitry underlying behavioral inhibition in rats. (*poster*)
- **Biomath Journal Club**, W&M, 9/12.Smith GD. (*presenter*) Subcellular calcium dynamics in a whole-cell model of an atrial myocyte. Thul R, Coombes S, Roderick HL, Bootman MD. *Proc Natl Acad Sci USA* 109(6):2150–5, 2012.
- **Federation of American Societies for Experimental Biology: Calcium and Cell Function**, Snowmass Village, CO. 6/12. Smith GD, Zwartz G, Espinoza F, Byars J, Lidke K, McKinstry S*, Wilson BS. Spatial dynamics of Orai1 diffusion, Stim1 coupling and Ca^{2+} transport in FcϵRI-stimulated mast cells. (*poster, selected for contributed talk*)
- **The New Mexico Center for the Spatiotemporal Modeling of Cell Signaling**, University of New Mexico School of Medicine, Albuquerque, NM, 5/12. Smith GD, Zwartz G, Espinoza F, Byars J, Lidke K, McKinstry S*, Wilson BS. Spatial dynamics of Orai1 diffusion... (*invited speaker*)
- **Cold Spring Harbor Laboratory Meeting on Computational Cell Biology**, Cold Spring Harbor, NY, 3/12. Morohashi K, Pomeranz M, Smith GD and Grotewold E. An incoherent feed forward loop defines discrete expression patterns during early *Arabidopsis thaliana* trichome development. (*poster*)
- **Society for Neuroscience**, Washington, DC, 11/11. Hardcastle K*, Smith GD, Burk JA. A population activity model of cortico-striatal circuitry underlying behavioral inhibition in rats. (*poster*)
- **Center for the Spatiotemporal Modeling of Cell Signaling**, University of New Mexico School of Medicine, Albuquerque, NM, 10/11. Smith GD Modeling the stochastic dynamics of localized Ca^{2+} elevations and whole cell Ca^{2+} responses. (*invited speaker*)
- **NHLBI-VCU World Congress on Mathematical Modeling and Computational Simulation of Cardiovascular and Cardiopulmonary Dynamics**, Williamsburg, VA, 6/11. Co-organizer of *Modeling normal and pathological calcium signaling pathways in the heart* session (w/ Sobie EA and Jafri MS). Modeling the bidirectional coupling between localized Ca^{2+} elevations and whole cell Ca^{2+} responses Huertas MA, Sobie EA, Györke S, and Smith GD. (*invited speaker*)
- **Biomath Journal Club**, W&M, 4/11. Smith GD. (*presenter*) Alternans and arrhythmias: from cell to heart. Weiss JN, Nivala M, Garfinkel A, Qu Z. *Circ Res.* 108(1):98–112, 2011.

- **Cold Spring Harbor Laboratory Meeting on Computational Cell Biology**, Cold Spring Harbor, NY, 4/11. Tuan HTM, Williams GSB, Smith GD, Jafri MS. A GPU-enabled ultrafast Monte Carlo simulation algorithm applied to the molecular events of calcium signaling in the heart.
- **AMS-SIAM Special Session on Applications of Stochastic Processes in Neuroscience**, Joint Mathematics Meetings, New Orleans, LA, 1/11. Huertas MA and Smith GD. Modeling the stochastic dynamics of localized Ca^{2+} elevations and whole cell Ca^{2+} responses. (*invited speaker*)
- **Krasnow Institute for Advanced Study Seminar**, George Mason University, Fairfax, VA, 12/10. (*invited speaker*)
- **Mathematical Biology Seminar**, Dept. of Mathematics, VCU, 11/10. (*invited speaker*)
- **AMS Southeastern Sectional Meeting**, Special Session on Differential Equations and Applications to Physics and Biology, Richmond, VA, 11/10. Hao Y and Smith GD. A Langevin description of the stochastic dynamics of calcium release sites composed of multiple intracellular channels. (*invited speaker*)
- **Biomath Journal Club**, W&M, 9/10. Smith GD. (*presenter*)
- **SIAM Conference on the Life Sciences**, Pittsburgh, PA, 7/10. Huertas MA, Williams GSB, Sobie EA, Jafri MS, Györke S, Smith GD. Stochastic dynamics of local and global Ca^{2+} responses in cardiac myocytes. (*speaker*)
- **Ohio Collaborative Conference on Bioinformatics**, Columbus, OH, 6/10. Siegal-Gaskins D, Smith GD, and Grotewold E. Identification of novel genetic switch topologies in a large class of biochemical networks
- **Mathematical Biosciences Institute Postdoc Seminar**, Columbus, OH, 4/10. Siegal-Gaskins D, Grotewold E, and Smith GD. Emergence of switch-like behavior in a large family of simple biochemical networks.
- **Biomath Seminar**, W&M, 9/10. Smith GD. Reduction methods for compositionally-defined continuous time Markov chains. (*speaker*)
- **Biophysical Society**, San Francisco, CA, 2/10. α: Hartman JM*, Sobie EA, Smith GD. Calcium sparks and homeostasis in a minimal model of local and global calcium responses in quiescent ventricular myocytes. β: Hao Y, Kemper P, Smith GD. Automated reduction of calcium release site models via state aggregation. γ: Carpenter RM, Györke S, Smith GD. Modeling the effect of genetic manipulation of calsequestrin on local Ca^{2+} release and depletion in cardiac myocytes. δ: Williams GSB, Chikando A, Smith GD, Jafri MS. A technique to accelerate stochastic Markov chain Monte Carlo simulation of calcium-induced calcium release in cardiac myocytes. (*4 posters*)
- **Society for Neuroscience**, Chicago, IL, 12/09. Kaplan C*, Smith GD, Burk JA. Computational modeling of attention task performance decrements induced by M1 receptor blockade or PKC inhibition in rats. (*poster*)
- **Biomath Journal Club**, W&M, 9/09. Smith GD. (*presenter*)
- **Society for Mathematical Biology International Conference on Mathematical Biology**, University of British Columbia, Vancouver, 7/09. Hartman JM* and Smith GD. Calcium sparks and calcium homeostasis in a hybrid model of local and global calcium responses. (*speaker*)
- **GMU-WM CSUMS Spring Workshop**. Williamsburg, VA. 3/09.
- **Biophysical Society**, Boston, MA, 3/09. (1) Huertas MA, Smith GD, and Györke S. Analysis of calcium alternans in a cardiac myocyte model that uses moment equations to represent heterogenous junctional SR calcium. (2) Williams GSB, Huertas MA, Sobie EA, Smith GD, and Jafri MS. A local control model for cardiac excitation-contraction coupling in rat ventricular myocytes: Insights into dynamic phenomena involving calcium release. (3) DeRemigio H, Kemper P, LaMar MD, and Smith GD. Markov chain models of coupled intracellular calcium channels: Kronecker structured representations and benchmark stationary distribution calculations. (*3 posters*)
- **Taiwanese Mathematics Society**, National Tsing Hua University, Hsinchu City, Taiwan, 12/08. (*invited speaker*)
- **Mathematics Department Seminar**, National Chung Cheng University, Chia Yi, Taiwan, 12/08. (*invited speaker*)
- **Biology Department Seminar**, National Chung Cheng University, Chia Yi, Taiwan, 12/08. (*invited speaker*)
- **International Workshop on Mathematical Biology: Modeling and Analysis**, Department of Mathematics, National Taiwan Normal University, Taipei, Taiwan, 12/08. (*invited speaker*)
- **Mathematical and Computational Models in Biological Networks**, Mathematical Biology Institute Focus Group Meeting, The Ohio State University. 10/08.
- **Dynamical Systems in Physiological Modeling**, Purdue University, West Lafayette, IN. 10/08. (*invited speaker*)
- **Gordon Conference on Theoretical Biology and Biomathematics**, Il Ciocco, Lucca (Barga), Italy, 6/08. (*co-vice chair and session chair*)
- **Frontiers in Applied and Computational Mathematics**, NJIT, 5/08. (*invited speaker*)
- **AMS Southeastern Sectional Meeting**, Baton Rouge, LA, 3/08. DeRemigio H, Kemper P, LaMar MD, and Smith GD. Markov chain models of calcium release sites: Kronecker representations with exact and approximate solution methods. (*speaker*)
- **Quantitative Biology Institute Seminar**, Ohio University, Athens, OH. 2/08. (*invited speaker*)
- **Biophysical Society**, Long Beach, CA, 2/08. Huertas MA, Williams GSB, Sobie EA, Jafri MS, and Smith GD. A moment closure approach to modeling local control models of Ca^{2+}-induced Ca^{2+} release in cardiac myocytes. (*poster*)

- **Pacific Symposium on Biocomputing**, The Big Island of Hawaii, 1/08. DeRemigio H, Kemper P, LaMar MD, and Smith GD. Markov chain models of coupled intracellular calcium channels: Kronecker structured representations and benchmark stationary distribution calculations. (*speaker*)
- **Mathematical Biology Institute Seminar**, The Ohio State University, 12/07. Modeling local control of calcium-induced calcium release in cardiac myocytes. (*invited speaker*)
- **MBI Workshop: Information Processing in the Visual System**, OSU. 4/07. (*invited speaker*)
- **MBI Workshop for Young Researchers in Mathematical Biology**, OSU. 3/07. α: DeRemigio H and Smith GD. The spatial organization of Ca^{2+} release sites and the dynamics of puffs and sparks. β: Groff JR and Smith GD. A computational investigation of the effects of allosteric coupling between ryanodine receptors on the dynamics of calcium sparks. (*2 posters*)
- **Cold Spring Harbor Laboratory Meeting on Computational Cell Biology**, NY, 3/07. Smith GD. A probability density approach to modeling local control of calcium-induced calcium release in cardiac myocytes. (*speaker*)
- **Biophysical Society**, Baltimore, MD, 3/07. α Huertas MA and Smith GD. Moment closure approximations for a new class of whole cell models of Ca^{2+} handling representing heterogeneous domain Ca^{2+} concentrations. β DeRemigio H and Smith GD. The spatial organization of Ca^{2+} release sites and the dynamics of puffs and sparks. γ Williams GSB, Huertas MA, Sobie EA, Jafri MS, and Smith GD. A probability density approach to modeling local control of calcium-induced calcium release in cardiac myocytes. δ Groff JR and Smith GD. A computational investigation of the effects of allosteric coupling between ryanodine receptors on the dynamics of calcium sparks. (*4 posters*)
- **Society for Neuroscience**, Atlanta, GA, 10/06. Huertas MA and Smith GD. A multivariate population density model of the dLGN/PGN relay. (*poster*)
- **MBI Workshop: Cardiac Electrophysiology and Arrhythmia**, OSU. 9/06. (*invited speaker*)
- **Bioinformatics and Computational Biology Colloquium**, George Mason University, 9/06. (*invited speaker*)
- **Joint SIAM-SMB Conference on the Life Sciences**, Raleigh, NC, 7/06. Minisymposium: Stochastic aspects of Ca^{2+} signaling. (*organizer*) α: Smith GD. Stochastic gating of instantaneously coupled Ca^{2+}-regulated Ca^{2+} channels. (*speaker*) β: Williams GSB, Huertas MA, and Smith GD. Probability Density Approaches to Modeling Local and Global Intracellular Calcium Dynamics. (*poster*) γ: Huertas H and Smith GD. The effect of luminal depletion on the dynamics of Ca^{2+}-regulated Ca^{2+} channels. (*speaker*) δ: Mazzag B, Tignanelli C*, and Smith GD. Analysis of the effect of residual calcium on the gating of Ca^{2+}-regulated Ca^{2+} channels. (*speaker*)
- **Gordon Conference on Theoretical Biology and Biomathematics**, Tilton, NH, 6/06. (*invited speaker*)
- **Workshop on Molecular Evolution**, Marine Biological Laboratory, Woods Hole, MA, 6/06.
- **Mathematical Modeling of Cellular Calcium Signals Meeting**, Univ. of Nottingham, 4/06. (*invited speaker*)
- **Computational Biology Seminar**, Dept. of Applied Mathematics, Oxford University, UK, 4/06. (*invited speaker*)
- **Center for Cardiovascular Bioinformatics and Modeling Seminar**, Department of Biomedical Engineering and Institute for Computational Medicine, Johns Hopkins University, Baltimore, MD, 4/06. (*invited speaker*)
- **Biophysical Society Annual Meeting**, Salt Lake City, UT, 2/06. α: Williams GSB, Huertas MA, Sobie EA, Jafri MS, and Smith GD. A probability density model of stochastic functional unit activity in cardiac myocytes. β: Williams GSB and Smith GD. A probability density approach to modeling local and global Ca^{2+} dynamics in cells with diffusely distributed intracellular Ca^{2+} channels. γ: DeRemigio H and Smith GD. The dynamics of stochastic attrition viewed as an absorption time on a terminating Markov chain. (*3 posters*)
- **Biophysical Society**, Salt Lake City, UT, 2/06. Huertas MA and Smith GD. The effect of luminal depletion on the dynamics of Ca^{2+}-regulated Ca^{2+} channels. (*poster*)
- **Mathematics Department Seminar**, University of Pittsburgh, 12/05. (*invited speaker*)
- **Society for Neuroscience**, Washington, DC, 11/05. α: Huertas MA and Smith GD. The response of a two-dimensional population density model of the lateral geniculate nucleus/perigeniculate nucleus network to optic tract stimulation. β: Groff JR and Smith GD. The effect of interneuron feed-forward inhibition on detectability and stimulus reconstruction using stochastic thalamocortical relay cell model responses. (*2 posters*)
- **Computational Neuroscience Meeting**, Madison, WI, 7/05. α: Huertas MA and Smith GD. A two-dimensional probability density approach to modeling the dLGN/PGN network. β: Groff JR and Smith GD. Effect of interneuron feedforward inhibition via the F2 terminal on retinogeniculate transmission. (*2 posters*).
- **SIAM Conference on Applications of Dynamical Systems: New twists on solitary waves in excitable media**, Snowbird UT, 5/05. α: Ca^{2+} diffusion, dynamics, and domains. (*speaker*) β: Mazzag B, Tignanelli C*, and Smith GD. Analysis of the effect of residual Ca^{2+} on the gating of Ca^{2+}-regulated Ca^{2+} channels. (*poster*)
- **Third Symposium on Computational Cell Biology**, Lenox, MA. 3/05. α: Mazzag B, Tignanelli C*, Smith GD. Analysis of the effect of residual Ca^{2+} on the gating of Ca^{2+}-regulated Ca^{2+} channels. β: Means SA, Mazel T, Smith AJ, Shadid J, Smith GD, and Wilson BS. Reaction-diffusion modeling of endoplasmic reticulum calcium dynamics with realistic geometry: effects of IP_3R Ca^{2+} channel clustering. (*2 posters*)
- **Mathematical Biology Seminar**, The University of Utah, 9/04. Mazzag B, Tignanelli C*, and Smith GD. The feedback of a localized calcium domain on calcium-gated channels. (*invited speaker*)

- **Cortical Function: A View from the Thalamus**, Madison, WI. 9/04. A celebration of the career of RW Guillery organized by VA Cassagrande and SM Sherman.
- **Mathematical Biology Seminar**, The University of Utah, 9/04. A stochastic automaton network... (*invited speaker*)
- **SMB Mathematics in Biology and Medicine**, Ann Arbor, MI. 7/04. Mazzag B, Tignanelli C*, Smith GD. Analysis of the effect of residual Ca^{2+} on the gating of Ca^{2+}-regulated Ca^{2+} channels. (*poster*).
- **Computational Neuroscience**, Baltimore, MD, 8/04. Huertas MA, Groff JR, Smith GD. The effect of feedback inhibition in network simulations of retinogeniculate transmission. (*poster*).
- **Workshop on Cellular and Sub-cellular Models of Excitable Cells**, Baltimore, MD, 8/04. Stochastic automata network models of instantaneously-coupled intracellular Ca^{2+} channels. (*invited speaker*).
- **Laboratory of Biological Modeling, NIDDK, NIH**, Bethesda, MD, 6/04. Stochastic automata network models of instantaneously-coupled intracellular Ca^{2+} channels. (*invited speaker*)
- **Biophysical Society Annual Meeting**, Baltimore, MD, 2/04. α: Zhang J, Nguyen VD*, Smith GD. Direct calculation of puff statistics from stochastic automata network models of instantaneously-coupled intracellular Ca^{2+} channels. β: **Biophysical Society Annual Meeting**, Baltimore, MD, 2/04. Mazzag B, Tignanelli C*, Smith GD. Analysis of the effect of residual Ca^{2+} on the gating of Ca^{2+}-regulated Ca^{2+} channels. (*2 posters*)
- **MBI Workshop: Signal Transduction: The many roles of calcium**, OSU, 1/04. (*invited speaker*)
- **Dynamical Neuroscience Satellite Symposium**, Neuronal Variability and Noise, New Orleans, LA. 11/03.
- **Society for Neuroscience**, New Orleans, LA, 11/03. Huertas MA, Groff JR, Smith GD. The effect of feedback inhibition in network simulations of retinogeniculate transmission. (*poster*)
- **SIAM Conference on Applied Linear Algebra**, W&M, 7/03.
- **MBI Workshop: Nonlocal Integro-Differential Equations in Mathematics and Biology**, OSU, 3/03.
- **NSF-NIH Joint Math Symposium: Accelerating Mathematical-Biological Linkages**, Bethesda, MD. 2/03.
- **Biophysical Society**, San Francisco, CA, 2/02. α: Wilson SM, Smith GD, Johnston L, and Hume JR. Activation of capacitative Ca^{2+} entry in pulmonary arterial smooth muscle cells. β: Smith GD, Dai L, Muira R, Sherman A. Asymptotic analysis of buffered Ca^{2+} diffusion near a point source. (*2 posters*)
- **Society for Neuroscience**, San Diego, CA, 11/01. Smith GD and Sherman SM. Detectability of excitatory versus inhibitory drive in a stochastic thalamocortical relay neuron model. (*poster*)
- **Society for Neuroscience**, San Diego, CA, 11/01. Williams JC, Smith GD, Vetter RJ, and Kipke DR. Correlation analysis of electrical interface properties of chronic neural implants. (*poster*)
- **Seminar**, Catholic University of America, Dept. of Bioengineering, Washington, DC, 4/01. (*invited speaker*)
- **Seminar**, Georgetown University, Dept. of Mathematics, Washington, DC, 3/01. (*invited speaker*)
- **Neuroscience Seminar**, Georgetown University Medical Center, Department of Neuroscience, 3/01. (*invited speaker*)
- **Defense Advanced Research Projects Agency BioFutures Kickoff**, Washington, DC, 11/00. Mathematical models of cortical stimulation, recording, impedance spectra and a microcapillary bioreactor cell culture. (*poster*)
- **Gordon Research Conference on Theoretical Biology & Biomathematics**, Tilton, NH, 6/00. (*invited speaker*)
- **Special Seminar**, Institute for Theoretical Dynamics, Davis, CA, 5/00. Asymptotic analysis... (*invited speaker*)
- **Nonlinear Dynamics of Calcium in Living Organisms**, Santa Fe, NM, 3/00. (*invited speaker*)
- **Society for Neuroscience**, Miami Beach, FL, 10/99. Smith GD, Cox CL, Sherman SM, and Rinzel J. Spike-frequency adaptation... (*poster*)
- **Nonlinear Dynamics in Biology and Chemistry**, University of California Davis, 9/99. A symposium to honor Joel E. Keizer and his three decades in science. (*speaker*)
- **Biophysical Society: Computational Cell Biology Workshop**, Baltimore, MD, 2/99. (*invited speaker*)
- **Society for Neuroscience**, Los Angeles, CA, 11/98. Smith GD, Cox CL, Sherman SM, and Rinzel J. Fourier analysis... (*poster*)
- **Waves and Continuation Methods in Biology**, Univ. of Pittsburgh, 9/98. Fourier analysis... (*poster*).
- **Computational Neuroscience**, Santa Barbara, CA, 7/98. Fourier analysis... (*poster*).
- **Introduction to Computational Genomics**, SIAM Short Course, Toronto, Canada, 7/98.
- **Mini-symposium on Mathematical Modeling in Physiology**, SIAM Annual Meeting, Toronto, 7/98. (*speaker*)
- **Workshop on Neural Modeling of Brain and Cognitive Disorders**, University of Maryland, 6/98.
- **Calcium Dynamics in Cells**, IMA Workshop on Emerging Applications of Dynamic Systems, University of Minnesota, 2/98. A simple numerical model... (*speaker*)
- **Computational Neuroscience**, IMA Workshop on Emerging Applications of Dynamic Systems, 1/98.
- **Society for Neuroscience**, New Orleans, LA, 10/97.
- **Computational Neuroscience**, Big Sky, MT, 7/97.
- **Ca^{2+} Fertilization Wave Workshop**, South Lake Tahoe, CA, 4/97. (*speaker*)
- **Methods in Computational Neuroscience Course**, Marine Biological Laboratory, Woods Hole, MA, 8/96.
- **Minisymposium on Ca^{2+} Oscillations and Waves**, University of Utah, 3/96. (*speaker*)

- **Workshop on Nonlinear Dynamics of Networks of Neurons**, Scripps Institution of Oceanography, University of California San Diego, 12/95.
- **International Conference on Receptor Regulated Ca^{2+} Influx**, Asilomar Conference Center, Pacific Grove, CA, 5/95. The effect of Ca^{2+} influx... Smith GD, Lee RJ, Oliver JM, and Keizer J. (*poster*)
- **Biophysical Society Annual Meeting**, San Francisco, CA, 2/95. Validity of the rapid buffering approximation... Smith GD, Wagner J, and Keizer J. (*poster*)
- **Mechanisms of Ca^{2+} Oscillations and Waves**, Marconi Conference Center, Marshall, CA, 12/93.
- **CRM-UBC Summer School on Mathematical Biology**, University of British Columbia, Vancouver, BC, Canada, 7/93.

GRADUATE AND POST-DOCTORAL TRAINING

Research Associates Supported and Supervised

- **Seth Weinberg** Spring ′12–14. Seth is currently Associate Professor, Biomedical Engineering at The Ohio State University (https://comphysiolab.engineering.osu.edu) and the College of Engineering Associate Dean for Research (https://engineering.osu.edu/news/2024/01/weinberg-named-associate-dean-research)
- **Dan Siegal-Gaskins, Ph.D.** Spring ′09–11. OSU Mathematical Biosciences Institute post-doc jointly supervised w/ Erich Grotewold (Dept. Plant Molecular and Cellular Biology).
- **Drew LaMar, Ph.D.** Spring ′07–Summer ′11. Supported by the W&M Biomath Initiative and the W&M's HHMI undergraduate biological sciences education program (PI: Saha). Now Associate Professor, Dept. of Biology at W&M.
- **Marco Huertas, Ph.D.** Summer ′03–09. Research Assistant Professor beginning 2007. Lead Data Scientist, Nielsen (2018–2022). Sr. Research Investigator, QSP, Bristol Myers Squibb (2022–present).
- **Bori Mazzag, Ph.D.** Summer ′03–05. Supported by NSF funding. Now in the Department of Mathematics at Humboldt State University. She has served as both department chair and associate dean of academic affairs.
- **Yinshui Fan, Ph.D.** Fall ′01–Spring ′02. Supported by NSF funding.

Graduate Students Supported and Supervised[4]

- **Emily S. G. Simmons** (Fall ′19–Summer ′25). Emily was jointly supervised and funded (w/ Josh Puzey).

  Dissertation: *Genetic analysis and multigenerational spatial modeling of petal patterns and transgressive phenotypes in hybrid Mimulus.* Conradi Smith*, Puzey*, Cooley, Shaw.

- **Spenser E. Wood, M.S.** (Spring ′20–Summer ′23).
- **Cameron Grover, Ph.D.** (Fall ′20–22). Cam was jointly supervised and funded w/ Del Negro beginning Fall ′20. Currently at Delaware Institute of Science & Technology, Delaware State University.

  Dissertation: *The origins of inspiratory and sigh breathing rhythms: ion channels, burst-generating mechanisms, and synaptic topologies studied in vitro and in silico.* Del Negro*, Conradi Smith*, Shaw, Ly.

- **Daniel Borrus, Ph.D.** (Fall ′17–21). Jointly supervised and funded (w/ Del Negro). Currently a post-doc with Albert Higgins-Chen, Department of Psychiatry, Yale University School of Medicine.

  Dissertation: *Cellular and synaptic mechanisms that underlie eupnea and sigh rhythms for breathing behavior in mice.* Del Negro*, Conradi Smith*, Saha, Bestman.

- **Jonathan Newman, M.S.** (Fall ′19–Spring ′21).
- **Ronald D. Smith, Ph.D.** (Fall ′14–Spring ′19). Jointly supervised w/ Puzey. Now Lecturer in W&M's Data Science program.

  Dissertation: *Evolution of the genome-wide distribution of genes and transposons.* Conradi Smith*, Puzey*, Shaw, LaMar.

- **Lauren Shriver, M.S.** (Spring ′16–17).
- **Wenchong He, M.S.** (Spring ′18–Fall ′19).
- **Daniel Hancock, M.S.** (Fall ′14–Spring ′16).
- **Futa Ikeda, M.S.** (Fall ′13–Spring ′14).
- **Xiao Wang, Ph.D.** (Fall ′10–Spring ′15). Associate Quantitative Analytst at Citigroup Global Markets, Inc., New York, NY (Spring ′16–present).

  Dissertation: *Langevin, population density and moment-based modeling of local and global aspects of intercellular calcium signaling.* GD Smith*, Shaw, Shi, Sobie.

[4]Chair or co-chairs of dissertation committees is indicated with an asterisk (*).

- **Yan (Amy) Hao, Ph.D.** (Fall ′06–Spring ′11). Now Associate Professor, Dept. of Mathematics and Computer Science, The Hobart and William Smith Colleges in Geneva NY.

  Dissertation: *Automated reduction of Markov chain models of calcium release sites.* GD Smith*, Kemper, Leemis, Shaw.

- **Ryan Carpenter, M.S.** (Spring ′07–11). Now Instructor, Dept. of Mathematics, Christopher Newport University.
- **Hilary DeRemigio (Fletcher), Ph.D.** (Fall ′03–Spring ′08). Assistant Professor in the Dept. of Mathematical Sciences, United States Military Academy (2008–14).

  Dissertation: *Markov chain models of instantaneously coupled intracellular calcium channels.* GD Smith*, Shaw, Kemper, Sobie.

- **George Stuart Blair Williams, Ph.D.** (Fall ′03–Spring ′08).

  Dissertation: *Probability density methods for modeling local and global aspects of intracellular calcium signaling.* GD Smith*, Bagdassarian, Bradley, Sobie.

- **Jeff Groff, Ph.D.** (Spring ′03–Fall ′07). Chair of Shepherd University's Dept. of Environmental and Physical Sciences.

  Dissertation: *Markov chain models of calcium puffs and sparks.* GD Smith*, Hinders, Del Negro, Sobie.

- **Vivian Zhang, M.S.** (Fall ′02–Spring ′04). Vivian transfered to the applied mathematics Ph.D. program at UC Davis.
- **John Hayes, M.S.** (Fall ′02–Spring ′04). Subsequently a Ph.D. candidate in the Del Negro lab.
- **Chuan Wei, M.S.** (Fall ′02–Spring ′03).

Ph.D. Dissertation and M.S. Thesis Committee Service at W&M (reader)

- Eva Joy Kalajian, *Cellular and ion channel mechanisms of $\boldsymbol{\mu}$-opioid receptor modulation of respiratory interneurons of the preBötzinger complex in mice.* (w/ Del Negro*, Barnet, Montandon). 5/26.
- James N. K. Giroux, *Towards modular foundation models for detector readout systems in accelerator-based physics experiments* (w/ Fanelli*, ...). 4/26.
- Kathryn Anne Gour, *Neural resonance profiling: Examining the internal consistency of neural entrainment in healthy young adults* (w/ Kieffaber*, Burk). 4/26.
- Jacob Silliman, *Exfoliation, characterization, and nanomechanical testing of biosourced nanofibrils* (w/ Schniepp*, Mitra, Williamson). 4/26.
- Carlos Aparecido da Silva Junior, *Contributions of the persistent sodium and M-type potassium currents in the preBötzinger Complex for breathing rhythm generation* (w/ Del Negro*, Saha, Mitchell). 6/24.
- Avishi Abeywickrama, *Direct measurements of interfacial interactions of 2D materials* (w/ Schniepp*, Hinders, Abelt). 4/23.
- Dinidu Perera, *Structure, function, and mechanics of nanofibrillar spider silk* (w/ Schniepp*, Hinders, Saha). 11/22.
- Sudip Paudel, *Analysis of calcium activity during early neural development.* (w/ Saha*, Del Negro, Bestman). 9/22.
- Seth Goodman, *Filling in the gaps: Applications of deep learning, satellite imagery, and high-performance computing for the estimation and distribution of geospatial data.* (w/ Runfola*, Kemper, Walter). 11/20.
- Adrienna Bingham, *Controlling infectious disease: Prevention and intervention through multiscale models.* (w/ Shaw*, Murphy, Bianco). 6/19.
- Yan Wang, *Persistence and extinction dynamics in reaction-diffusion-advection stream population model with Allee effect growth.* (w/ Shi*, Patel, Shaw). 4/19.
- Victoria Tonita Akins, *Neuroanatomical and morphological properties of neurons that generate inspiratory related breathing rhythm and influence respiratory motor pattern in mice* (w/ Del Negro*, Bradley, Looft-Wilson). 12/17.
- Nikolas Vann, *Role of Dbx1-derived pre-Bötzinger complex interneurons in breathing behaviors in adult mice* (w/ Del Negro*, Burk, Pagliardini). 10/17.
- Diane Christine P. Pelejo, *Matrix results and techniques in quantum information science and related topics* (w/ Li*, Shaw, Shi, Poon). 11/16.
- Mary A. Mohr, *Quantitative analysis of periodic breathing and very long apnea in preterm infants* (w/ Delos*, Cooke, Manos, Kincaid, Fairchild). 7/15.
- Shadrack A. Antwi, *Dynamic social networks with beneficial and detrimental interactions* (w/ Shaw*, Kincaid, Collins). 3/15.
- Yunhan Long, *Spread and interaction of epidemics and information on adaptive social networks* (w/ Shaw*, Leemis, Del Negro, Schwartz). 9/14.
- Wei Xu, *Studies of molecular dynamics of FMOC amino acids using solid state deuteron nuclear magnetic resonance spectroscopy* (w/ Vold*, Hoatson, Luepke). 9/14.
- Krishanthi Weragalaarachchi, *Morphological study of Dbx1+ respiratory rhythm-generating neurons in preBotzinger complex in neonatal mice* (w/ Del Negro*, Shaw, Burk). M.S. Thesis. 4/12.

- Shahla Nasserasr, *The logarithmic method and the solution to the TP_2-completion problem* (w/ Johnson*, Luepke, Spitkovsky). 4/10.
- William H. Kaczynski, *Computational applications in stochastic operations research* (w/ Leemis*, Drew, Del Negro, Kincaid). 6/09.
- John A. Hayes, *Phenotypic properties and intrinsic currents of neurons involved in the neuronal generation of mammalian breathing* (w/ Del Negro*, Saha, Guyenet). 6/07.
- Yuemei Zhang, *UV cure kinetics of dimethacrylate thin and thick samples* (w/ Kranbuehl*, Del Negro, Starnes, Abelt). 10/06.
- Wen Gao. *Sonar sensor interpretation for ectogeneous robots* (w/ Hinders*, Rahman, Mao). 5/05.
- Kevin Leonard. *Ultrasonic guided wave tomography of pipes* (w/ Hinders*, Rahman, Welsh). 5/04.
- Jidong Hou. *Ultrasonic signal detection and recognition using dynamic wavelet fingerprint* (w/ Hinders*, Tracy, Rahman). 4/04.
- John Hayes. *A framework for implementing bioinformatics knowledge-exploration systems.* (w/ Miller, Sasinowski, Trosset, Manos). 04/04.
- Thomas Milligan. *On certain sets of matrices: distance matrices, ray nonsingular matrices and matrices generated by reflections* (w/ Li*, Mathias, Tsatsomeros). 4/04.
- George A. Andrews, Jr. *Spontaneous pulse formation in bistable systems* (w/ Tracy*, Manos, Cooke, and Champion). 12/03.
- Brian Killough. *A semi-empirical cellular automata model for wildfire monitoring from a geosynchronous space platform* (w/ Hinders*, Levine, Rahman). 1/03.
- John E. Lynch. *Ultrasonographic measurement of periodontal attachment levels* (w/ Hinders*, Madaras, Rogers). 6/01.

External Dissertation Committee Service (reader)

- Shawn Means, Mathematics, University of Auckland, *Spatio-temporal calcium dynamics of the interstitial cells of Cajal.* (advisor James Sneyd). 9/10.
- Michael Sheller, Bioengineering, Arizona State University (advisors Jiping He and James Ryaby). 11/08.
- Greg Lemon, School of Mathematics and Statistics, University of Sydney, *Mathematical Modeling of Some Aspects of Intracellular Second Messenger Signaling* (advisors: Bill Gibson and Max Bennett). 10/03.
- Dritan Zela, Mathematics, Arizona State University, *A two-dimensional model for the horizontal-cell-to-cone feedback in the cat outer retina* (advisor: Steve Baer). 12/01.

UNDERGRADUATE RESEARCH EXPERIENCES

International Genetically Engineered Machine (iGEM) Competition

- Summer and Fall ′15: Mentored John Marken's mathematical modeling contribution to W&M's iGEM project "Measurement of Promoter-Based Transcriptional Noise..." (lead faculty advisor, Margaret Saha). The W&M team won the Grand Prize in the undergraduate division of the *iGEM Jamboree* held September 24–28, 2015 in Boston.
- Summer and Fall ′16: Co-advisor of W&M's iGEM team (w/ Saha, lead faculty advisor). I was the team's faculty resource for quantitative and theoretical aspects of the iGEM project.
- Summer and Fall ′17: Co-advisor of W&M's iGEM team (w/ Saha, lead faculty advisor). I advised Wukun (John) Liu and Cedar Ren on mathematical modeling. In the 2017 iGEM competition, W&M's iGEM team was named First Runner-Up and also won two special awards, one for Best Innovation in Measurement and a second for Best Model.
- Summer and Fall ′25: Co-advisor of W&M's iGEM team (w/ Saha, lead faculty advisor, and Bradley). I advised Sean Emmett on continuum mathematical modeling related to fluid flow.

Undergraduate research students associated with the Computational Biology Laboratory

- Hannah Willett (′26, Neuroscience & Mathematics). Fall ′23–Spring ′26.

  Thesis: *Nucleotide exchange kinetics in a minimal model of a GPCR dimer.*
  ⇒ Mathematics Ph.D. program at University of Pittsburgh.

- Izzy Ralph (′25, CAMS Mathematical Biology & Neuroscience). Spring ′24–Summer ′25. Followed by post-baccalaureate studies (w/ Kieffaber). AY ′25–26.

  ⇒ Cognitive & Brain Sciences Ph.D. program at Binghamton University SUNY (advisor: Sung-Joo Lim).

- Sarah Sakly (Neuroscience, ′25). Spring ′24–Summer ′25.

  Thesis: *Phase separation dynamics of SynGAP & PSD-95 in post-synaptic densities.*
  ⇒ Applied Science Ph.D. program at William & Mary (advisor: Conradi Smith).

- Yulee Kang (′27, CAMS Mathematical Biology). Spring ′25–present.
- Weifeng Liu (′27, Mathematics). Fall ′24–Spring ′25.
- Olivia Webster (′27, CAMS Mathematical Biology). Spring ′25 (w/ Jen Bestman)
- Lauren McCluskey (′27, CAMS Mathematical Biology). Spring ′25
- Olabisi Bashorun (′27, Computer Science). Fall ′24–Spring ′25.
- Diego Morandi Zerpa (′24, Neuroscience). Fall ′23–Spring ′24.
- Sarah Sakly (′25, Neuroscience & Psychology). Spring ′24–Summer ′24.
- Vivian Brown (′27, CAMS Mathematical Biology. Spring ′24.
- Clara Rinker (′26, CAMS Mathematical Biology & Hispanic Studies). Spring ′23—-Summer ′24.
- Ryno Chen (′24, Neuroscience & Mathematics). Spring ′23–Spring ′24.

  Thesis: *Spike timing-dependent plasticity and synaptic scaling invoke episodic bursting in an excitatory recurrent neuronal population* (w/ Del Negro). ⇒ Mathematics Ph.D. program at the University of Utah.
- Jingzhi (Jane) Zhao (′24, Neuroscience). Spring ′24.

  Thesis: *Assessing pre- and post-synaptic effects of opioid drugs on breathing rhythmogenesis via population activity mathematical modeling* (w/ Del Negro).
  ⇒ Applied Science Ph.D. program at William & Mary (advisor: Del Negro).
- Nicholas Park (′23, Neuroscience). Fall ′22–Spring ′23 (w/ Del Negro).
- Judah Engel. Spring ′20. Now at Carnegie Mellon University.
- Lindsay Stolting (′22, Neuroscience w/ CAMS minor): Spring ′20–22.
- Xinyun (Stacey) Li: Summer ′19–Fall ′20 (w/ Josh Puzey).
- Sung Joon Won: Fall ′19–20 (w/ Josh Puzey).
- Shirley Kwok: Summer–Fall ′19.
- Emma Glass (′21, CAMS Mathematical Biology): Fall ′18–19. Now a Bioengineering Ph.D. candidate at UVA.
- CiCi Zheng (′21, CAMS Mathematical Biology): Fall ′18–Spring ′20 (w/ Josh Puzey). Now a doctoral candidate at the Watson School of Biological Science at Cold Spring Harbor Laboratory.

  Thesis: *Modeling hybrid novel traits: A case study in complex petal pigment patterning in hybrid Mimulus.*
- Weizheng (Kevin) Yuan (′21, Neuroscience): Fall ′18–20 (w/ Puzey).
- Belle Salas (′21, Neuroscience & Mathematics): Spring ′18–Fall ′19.
- Rishi Gupta (′18, Neuroscience): Spring ′18.
- Chloe How (′20, CAMS Mathematical Biology): Spring ′18–19.
- Erin Lottes (′18, Neuroscience / Art & Art History): Fall ′17–Spring ′18. Now a Ph.D. student in Neuroscience at Georgia State University.
- Margaret Sullivan (′18, Neuroscience, minor in Art): Fall ′17–Spring ′18.
- Daniel Borrus (′17, Neuroscience): Fall ′15–Spring ′17. Dan entered the Applied Science Ph.D. program.

  Thesis: *Plateau potential fluctuations and intrinsic membrane noise.*
- John Marken (′17, Mathematics): Fall ′13–Spring ′17. John became a Bioengineering Ph.D. student at The California Institute of Technology.

  Thesis: *Absolute fluctuation robustness in chemical reaction networks.*
- Levi Keatts (′17, Biophysics): Spring ′16–Fall ′16.
- Fabiana Arrazola (′17, Neuroscience & Music): Spring ′16.
- Prashant Saini (′18, Biology w/ Computer Science minor): Spring ′16.
- Lulu Xu (′16, Mathematics): Summer ′14.
- Jeffrey Liu (′15, Biophysics): Spring ′14–15. → Medical student at Keck School of Medicine of USC, Los Angeles.

  Thesis: *Modeling the effect of cooperative binding on ligand-driven fluctuations in metabotropic glutamate receptors.*
- Andrew Smith (′16, Neuroscience): Fall ′13.
- Eric Dove (′16, Neuroscience & Mathematics): Spring ′13.
- Kiah Hardcastle (′14, Neuroscience & Mathematics): Spring ′10–Fall ′11. Kiah received W&M's Excellence in Neuroscience Award. Subsequently a Ph.D. student in the Dept. of Neurobiology, Stanford University, co-advised by Lisa Giocomo and Surya Ganguli. Subsequently a post-doc in the Ölveczky Lab at Harvard University.

  Thesis: *A population density model of domain calcium-mediated inactivation of L-type calcium channels.*
- Sarah McKinstry (′12, Neuroscience): Summer ′11–Spring ′12. Subsequently enrolled in Emory's Masters of Public Health program.

- James Janopaul-Naylor (14, Neuroscience and Mathematics): Summer ′11–Fall ′12. Supervised by Del Negro beginning Spring ′13. Subsequently a medical student at the University of Pennsylvania School of Medicine. Then Resident Physician at Emory University School of Medicine.
- Olivia Walch (′11, Mathematics & Biophysics): Fall ′09–Spring ′11. Subsequently, Olivia obtained a Ph.D. in Applied and Interdisciplinary Mathematics from The University of Michigan.

  Thesis: *Modeling synaptic facilitation and depression in thalamocortical relay cells.*
- George Cortina: Fall ′10.
- Joel Frohlich: Fall ′10.
- Rachel Gray (′12, Biology): Fall ′09.
- Christian Sciacca (′11, Biology): Spring ′09.
- McKenzie Jump (′11, Neuroscience): Spring ′09–Fall11. Funded in part by HHMI.
- Sarah Kim (′12, Neuroscience): Spring ′09–10.
- Matt Peppe (′11, Mathematics & Chemistry): Spring ′09–Summer ′10.
- Claire Kaplan (′09, Neuroscience): Fall ′08–Summer ′10. Subsequently a Clinical Psychology doctoral student at University of Maryland College Park.
- Jana Hartman (′09, Physics): Summer ′08–Fall ′10.

  Thesis: *Calcium spark frequency and ER leak in a hybrid model of local and global calcium responses.*
- Claire Zimmeck (′09, Neuroscience): Summer ′08–Fall ′08.
- Puja Parekh (′09, Neuroscience): Fall ′06.
- Andrew McGowen (′08, Physics & Religous Studies): Summer ′06–Fall ′06.
- Adam Carpenter (′08, Mathematics): Summer ′06.
- Evan Molinelli (′07, Physics): Fall ′05–Spring ′07.
- Greg Pelander (′06, Neuroscience): Summer ′05–Fall ′05.
- Jyotsna (Joey) Singh (′07, Biology): Spring ′05–Summer ′05.
- Rita Schneider (Fairfield University, ′05): Summer ′04.
- Becky Ellison (′03, Mathematics): Spring ′03.
- Chris Tignanelli (′05, Bioinformatics): Spring ′03–05.

  Thesis: *The effect of residual* Ca^{2+} *on the stochastic gating of* Ca^{2+}*-regulated* Ca^{2+} *channels.*
- Paul Brewer (′03, Physics): Summer ′02–Spring ′03.
- Coleen Loomis (′02, Mathematics): Summer ′02–Fall ′02.
- Vien Nguyen (′05, Physics): Fall ′01–05.

  Thesis: *The dynamics* Ca^{2+} *puffs: a study of instantaneously-coupled intracellular* Ca^{2+} *channels.*
- Shannon McNulty, Fall ′01.

Service as reader and committee member of undergraduate honors theses at W&M

- Caroline Cha (Neuroscience and Art & Art History ′26). Reflections from trespassing: perceptual painting and visual neuroscience. (w/ Lee*, Mead, Stevens).
- Joseph Reed (Mathematics ′26). Antennal lobe dynamics and the generation of diverse response patterns. (w/ Patel*, Day, Landino).
- Caden Sanko (CAMS, ′25). Cutting translation out of the equation: Exploring the P4 CI RNA as the basis for a novel family of translation-independent genetic parts. (w/ Saha*, Murphy).
- Marco Stettler (Neuroscience ′25). Mechanisms of opioid drug action in the respiratory rhythm-generating preBötzinger complex. (w/ Del Negro*, Saha).
- Jeffrey Gu (Neuroscience ′25). Elucidating emotional control of breathing: Monosynaptic projections from the central amygdala to the preBötzinger complex. (w/ Del Negro*, Saha).
- Marco Stettler (CAMS ′25). Transcriptomic analysis of response to AP axis rotation in *Xenopus laevis* embryos. (w/ Saha*, Patel).
- Lulu King (Psychological Sciences ′25). Measuring neural resonance profiles induced by binaural beats and their relationship with personality and autism spectrum disorder. (w/ Kieffaber*, Burk).
- Megan Fleeharty (Neuroscience ′24). Bringing synthetic biology from the flask to the soil (microcosm). (w/ Saha*, Forsyth, Willner).
- Caroline K. David (Neuroscience ′22). Nucleotide sequences and transcriptomes of inspiratory neurons of the preBötzinger complex in neonatal mice. (w/ Del Negro*, Saha, LaMar).

- Shreyas Kumar (Neuroscience & Global Business ′21). Gene knockdown investigations to test the disinhibition hypothesis of motor program initiation by glutamatergic neurons of the pedunculopontine nucleus of the mesencephalic locomotor region. (w/ Del Negro*, Bestman, Hunt).
- Akshata Pisharody (Mathematics ′21). Quantum symmetry in graphs. (w/ Pierre*, Schwartz).
- Harrison Glen Tuckman (CAMS ′20), *Dynamics of sensory integration of olfactory and mechanical stimuli within the response of moth antennal lobe neurons.* (w/ Patel*, Saha, Day, Shi).
- Alyssa Luz-Ricca (Neuroscience ′20), *The functional role of mitochondria in neural progenitor cells.* (w/ Bestman*, Saha, Myer).
- Callan Monette (CAMS ′19), *The use of foundational mathematical modeling techniques to inform understanding and design of complex biological systems.* (w/ Saha*, Bradley, Forsyth).
- Ravikant Pattapagala (Neuroscience ′18), *A computational model of multiple sclerosis and NF-κB regulation.* (w/ Coleman*, Porter).
- Kalen Paige Clifton (CAMS ′18), *Quantitative approaches in bioengineering.* (w/ Saha*, Bradley, Patel).
- Erin Lottes (Neuroscience, Art & Art History ′18), *Lost and found in figurative painting.* (w/ Santiago*, Kreydatus, Campbell).
- Sonia Dermer (Neuroscience ′17), *The sodium channel NaV1.6 is not essential for normal breathing or gasping behavior.* (w/ Del Negro*, Burk, Hunt).
- Quinn Monette (Anthropology ′17), *Natural debts; natural dangers: an ideology of nation-state and subject in an immunology text.* Fischer*, Thompson, Smith.
- Panya Vij (Neuroscience ′17), *The role of basal forebrain orexin-2 receptors in attentional performance in* Rattus norvegicus. (w/ Burk*, Davis).
- Prajal Bishwakarma (Neuroscience ′17), *The mechanism of NMDA receptor mediated increase in gamma oscillation frequency.* (w/ Buchser, Patel*).
- Ellen Yates (Neuroscience ′17), *Frontal, amygdala, and temporal convergence in the primate ventral striatum: implications for Huntington's disease.* (w/ Burk*, Haug).
- Martín Salgado-Flores (Mathematics ′16), *Computing all isolated invariant sets at a finite resolution.* (w/ Day*, Chung, Ninh).

⇒ *I served in this capacity an additional 16 times from 2003–16 (not shown).*

REPRESENTATIVE PROFESSIONAL SERVICE

- **Reviewer** for the 2nd edition of Paul Bressloff's *Stochastic Processes in Cell Biology*, Springer, 2020.
- **Ad hoc reviewer** for Michael Stern's NIA research program, Board of Scientific Counselors' meeting, 2019.
- **External reviewer** for faculty promotions at Carnegie Doctoral/Research-Extensive Universities, 3× in 2013–2018, 1× in 2023.
- **Editorial board** for *Mathematical Medicine and Biology: Journal of the IMA*. 2010–2014.

Referee for Scientific Journals

- *American Mathematical Monthly*, 14 (2×).
- *American Journal of Physiology*, 97.
- *Biophysical Journal*, 96, 97, 01, 02, 07 (2×), 08 (4×), 11, 12, 13, 18, 19 (2×), 22 (3×).
- *Biophysical Chemistry*, 08.
- *Bulletin of Mathematical Biology*, 00.
- *European Journal of Neuroscience*, 03.
- *Journal of Computational Neuroscience*, 97, 99, 04 (2×), 07 (2×).
- *Journal of General Physiology*, 11.
- *Journal of Molecular and Cellular Cardiology*, 10.
- *Journal of Neurophysiology*, 06.
- *Journal of Neuroscience*, 02.
- *Journal of Nonlinear Science*, 05.
- *Journal of Theoretical Biology*, 00, 02 (2×), 06 (2×), 07 (2×), 08, 09, 10
- *Mathematical Medicine and Biology*, 05, 06, 12 (ed.), 14 (ed.)
- *New Journal of Physics*, 03.
- *Philosophical Transactions*, 08.
- *Physica D Nonlinear Phenomena*, 03.

Grant Proposal Review

- National Science Foundation review panels such as NSF DMS Mathematical Biology and NIH/NSF CRCNS. 2005, 07, 09, 11, 12, 14, 15, 20, 21, 23, 24, 26.
- Proposal review at request of program officers of the NSF, NIGMS, Welcome Trust, the Deutsche Forschungsgemeinschaft (German Research Foundation), the Marsden Fund of New Zealand, etc., in the areas of my expertise. 2000, 02 (6×), 03, 05, 06, 07, 22 (2×), 25, and others.
- Jeffress Trust Scientific Review Committee. 2015, 16. NIH Modeling and Analysis of Biological Systems (MABS) Study Section ad hoc reviewer. 2010.
- NIH Neurotransporters, Receptors, and Calcium Signaling Study Section temporary member. 2005.

Representative Departmental and Programmatic Service (since 2014)

- Ad hoc Committee on Bioengineering (w/ Del Negro, Schniepp, Saha, Mitra). AY ′25–26.
- Chair of the Curriculum Committee (w/ Hinders and Saha). AY ′24–25.
- Search Committee for Visiting Teaching Faculty position in Neuroscience (w/ Bestman* and Hartjen). Spring ′26
- Chair of TTE Faculty Search in Genomic Data Science. AY ′24–25. Successful hire of Geoff Zahn.
- Departmental Retention, Promotion & Tenure Committee. AY ′24–25.
- Associate Chair, Department of Applied Science. AY ′23–24.
- Interim Chair, Department of Applied Science. 1/18–9/18.
- Search Committee for Administrator & Fiscal Coordinator. Spring ′24.
- Departmental Committee Assignments (⋆⋆ = chair). Research leave in AY ′21–22 and ′13–14.

	AY ′25–26	AY ′24–25	′23–24	′22–23	′20–21	′19–20	′18–19	′17–18	′16–17	′15–16	′14–15
Curriculum	⋆⋆	⋆⋆	⋆⋆	⋆⋆	⋆	⋆	⋆	·	·	⋆⋆	⋆⋆
Bioengineering	⋆·	·	·	·	·	·	·	·	·	·	
Academic Progress	·	·	⋆	⋆⋆	·	·	⋆	⋆	⋆	·	·
Appointments	·	·	⋆	⋆	⋆	⋆	⋆	⋆	·	·	·
DEI	·	·	⋆	·	·	·	·	·	·	·	·

- Faculty Searches and Departmental Retention, Promotion & Tenure Committee Service

	Faculty search and hiring	Mid-tenure review	Promotion to Associate Professor w/ tenure	Promotion to Full Professor
Christopher Del Negro	′02–03 ⋆⋆	·	′08–09	′14–15
Leah Shaw	′06–07 ⋆⋆	′09–10	′11–12	·
Hannes Schniepp	·	′11–12	·	·
Myriam Cotten	·	·	′18	·
Saskia Mordjick	·	′19	·	·
Indra Mitra	′23–24	·	·	·
Geoff Zahn	′24–25 ⋆⋆	·	·	·

Representative Service to the University

- ⋆ School of Computing, Data Sciences & Physics Retention, Promotion & Tenure Committee. Spring ′25–present.
- ⋆ COLL Curriculum Review Working Group. Spring ′25–Fall ′26.
- ⋆ Provost Office & Global Research Institute, Seed Funding Application Review. Fall ′2026.
- ⋆ Director of the W&M Biomath Initiative (Spring ′09–15). This Directorship involved research, teaching, and service activities that generate scientific community, foster interdisciplinary collaborations, and provide mentorship and training of graduate students and junior faculty with interests in biomathematics.
- ⋆ Faculty Affairs Committee (an elected office). Fall ′16–Spring ′19. Chair of FAC in AY ′17–18.
- ⋆ Area III Representative to the Faculty Assembly (an elected office). AY ′06–07, ′08–09.
- Wrote Vision 2026 Faculty Innovators proposal *Stage 1: Data-Intensive Biological Sciences (DIBS)* .
- Faculty Hearing Committee. AY ′14–15.
- Plumeri Award Selection Advisory Committee. AY ′14–15.
- Procedural Review & Personnel Policy Committees. Fall ′08–Spring ′12 (member), Fall ′12 (alternate)
- Search Committee A&S graduate programs Ombudsperson for (w/ Meyer*, Barnes, Martin, Sanderson). ′12.
- Biomath Faculty Search Committee (w/ Saha*, Griffin, Leu, Heidemann). AY ′10–11.
- Faculty Research Committee. AY ′05–06, ′06–07, ′08–09.