

# Carter L. Johnson

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## Objective

Ph.D. in applied mathematics that develops and analyzes mathematical models and uses the tools of dynamical systems to understand scientific problems in biology. Currently studying the neural and mechanical mechanisms of swimming behavior in the nematode *C. elegans*. Committed to the inclusion and encouragement of underprivileged or otherwise underrepresented peoples in STEM studies.

**Research interests** dynamical systems, mathematical modeling, mathematical biology, neurolocomotion

## Education

- 2020 **Ph.D. in Applied Mathematics**, *University of California, Davis*, Davis, CA.  
Dissertation: *Neuromechanical Mechanisms of Locomotion in C. elegans*
- 2017 **M.S. in Applied Mathematics**, *University of California, Davis*, Davis, CA.
- 2015 **B.S. in Applied Mathematics**, *University of California, Davis*, Davis, CA.

## Service and Outreach

- Nov 2015- **Student Chapter Secretary**, *Association for Women in Mathematics*, Davis, CA.
- Mar 2020 Mentored undergraduate math majors, ran information sessions on applying to graduate school in math, helped to host talks by women speakers in the math department, provided online resources for women in math. Student chapter Secretary March 2018-2020, duties include: keeping official records, planning and coordinating events, maintaining the website.
- Jan 2018 - **Volunteer**, *M-PACT UC Davis*, Smythe Academy Middle School, Sacramento, CA.
- Mar 2020 Designed and taught logic problem sessions designed to encourage creative and critical thinking, helped bring non-standard mathematics education to underprivileged middle-school students in the Sacramento area through this unique afterschool program.
- May 2019 **STEM for Girls Workshop Organizer**, *STEM for Girls*, Women's Resources and Research Center, Davis, CA.  
Organized and led a math workshop at STEM for Girls, an annual program which brings local middle-school girls to the university for a day to share with them the joys of STEM. Our workshop, "Maths, Maps, and Mind-Swapping Paths" had the girls using permutations to get their "mind-swapped brains" back in their own bodies and coloring maps to discover the four-color theorem.
- Sept 2017 - **Volunteer**, *Horseplay Therapeutic Riding Center*, Dixon, CA.
- July 2019 Assisted in horse riding lessons for students with disabilities, worked one-on-one with riders to overcome individual challenges and advance towards the students' riding goals, trained horses to better serve their disabled riders.

Sept 2015 - **Volunteer Math Tutor**, *Women's Resources and Research Center STEM Cafe*,  
Mar 2018 Davis, CA.  
Provided free math tutoring in a safe space for all undergraduate minorities.

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## Publications

**Johnson, C.L.**, "*Neuromechanical Mechanisms of Locomotion in C. elegans*", Ph.D. Dissertation (2020).

**Johnson, C.L.**, Lewis, T.J., and Guy, R.D., "*Neuromechanical Mechanisms of Gait Adaptation in C. elegans: Relative Roles of Neural and Mechanical Coupling*", Submitted to SIAM DS (2020), Preprint.

**Johnson, C.L.** and Hastings, A., "*Resilience in a Two-Population System: Interactions between Allee effects and connectivity*", *Theoretical Ecology* (2018) 11:281-289, <https://doi.org/10.1007/s12080-018-0365-4>

**Carter Johnson**, "*Coupling in Networks of Neuronal Oscillators*", Mathematics Dept. Undergraduate Honors Thesis, June 2015.

**Carter Johnson**, "*Phase Response Properties and Phase-Locking in Neural Systems with Delayed Negative-Feedback*", *UC Davis Explorations*, June 2015.

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## Research Experience

2017-2020 **Graduate Student Researcher**, *University of California, Davis*, Davis, CA, Advisors: Timothy Lewis and Robert Guy.

Studied the neural underpinnings of swimming behavior in the *C. elegans* nematode. Methods included: differential equations to model the coupled neuromechanical system of the body, nervous system, and behavior, coupled oscillators theory to understand the pattern of rhythm generation and coordination, and numerical PDE simulations to determine the closed-loop effects of the fluid environment and body.

June 2017 - **Applied Machine Learning Summer Research Internship**, Los Alamos, NM,  
Aug 2017 Supervisors: Dr. Kipton Barros and Dr. Nicholas Lubbers.

Performed machine learning analysis of large-scale experimental data. Applied random forests, gradient-boosted decision trees, and convolutional neural networks in Python for regression and classification problems.

2015 - 2017 **Graduate Student Researcher**, *University of California, Davis*, Davis, CA, Advisor: Alan Hastings.

Studied the effects of migration on the resilience of connected ecosystems in a differential equations model. Investigated the qualitative changes in the dynamical system behavior induced by parameter changes. Concluded research with a publication in *Theoretical Ecology*.

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## Teaching Experience

July 2020 - **Associate Instructor**, *University of Utah*, Salt Lake City, UT.

Present Teaching Calculus for Biologists 1, converting course to an online format due to COVID-19 campus closures.

Aug 2019 - **Associate Instructor**, *University of California, Davis*, Davis, CA.

Sept 2019 Taught Calculus for Biology and Medicine in a six-week summer session, designed and taught lectures, constructed educational supplements, and evaluated student performances.

Jan 2017 - **Course Developer**, *University of California, Davis*, Davis, CA, Supervisors: Prof. Mark Goldman, Dr. Korana Burke.

Developed laboratory sections and MATLAB computing exercises for a new differential equations course for quantitative biology majors. The class was first offered in Spring 2019, and we further adjusted the laboratory sections before and after each session.

2015 - 2020 **Teaching Assistant**, *University of California, Davis*, Davis, CA.

Held weekly discussion sections, constructed educational supplements, and evaluated student performances for courses in: differential calculus, multivariate calculus, ordinary differential equations, partial differential equations, numerical analysis, and graduate methods in applied mathematics (dynamical systems and asymptotics).

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## Presentations

SIAM Life Sciences, June 2020, *Neuromechanical Mechanisms of Swimming Gait Transitions in C. Elegans*, Talk.

UC Davis Mathematical Biology Seminar, June 2020, *GGAM PhD Exit Seminar: Neuromechanical Mechanisms of Gait Adaptation in C. Elegans*, Talk.

University of Pennsylvania Mathematical Biology Seminar, Jan. 2020, *Neuromechanical Mechanisms of Locomotion in C. Elegans*, Talk.

UC Davis Mathematics Student-Run Research Seminar, Nov. 2019, *Neuromechanical Mechanisms of Locomotion in C. Elegans*, Talk.

SIAM Pacific Northwest Conference, Oct. 2019, *Neuromechanical Mechanisms of Locomotion in C. Elegans: relative roles of mechanical and neural coupling*, Talk.

SIAM Dynamical Systems, May 2019, *Analysis of the Relative Roles of Neural and Mechanical Coupling in C. Elegans Gait Modulation*, Talk.

Computational Neuroscience Seattle 2018, July 2018, "*Neuromechanical Mechanism of Locomotion in C. Elegans: relative roles of mechanical and neural coupling*", Poster, Co-authors: Tim Lewis and Robert D. Guy.

UC Davis Mathematics Student-Run Math and Applied Math Seminar, May 2018, *Neuromechanical Mechanisms of Locomotion in C. Elegans*, Talk.

UC Davis Undergraduate Research Conference, April 2014. "*Phase Response Properties and Phase-Locking in Neural Systems with Delayed Negative Feedback*", Poster.

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## Awards

Dec 2019 SIAM Student Travel Award

Oct 2019 SIAM-PNW Student Travel Award

May 2019 SIAM Student Travel Award

June 2015 Yueh-Jing Lin Scholarship in Mathematics

June 2015 UC Davis Dept. of Mathematics - Citation for Outstanding Performance

2011-2015 University of California Regents Scholarship