



JAMES S. WATERS

appointments

Associate Professor of Biology, Providence College, 2018 – present.
Assistant Professor of Biology, Providence College, 2014 – 2018.
Visiting Scientist, Field Museum of Natural History, 2014.
Postdoctoral Research Associate, Princeton University, 2012 –2014.

education

Ph.D., Biology, Arizona State University, 2012.
A.B., Mathematics, The University of Chicago, 2005.

publications

(* indicates
undergraduate
student mentee)

- Varoudis, T., Swenson, A.*[†], Kirkton, S. D., and Waters, J. S. (2018). Exploring nest structures of acorn dwelling ants with x-ray microtomography and surface based 3D visibility graph analysis. *Philosophical Transactions of the Royal Society B*, in press.
- Waters, J. S. and McGlynn, T. P. (2018). Natural history observations and kinematics of strobing in Australian strobe ants, *Opisthopsis haddoni* (Hymenoptera: Formicidae). *Myrmecological News* 27, 7-11.
- Neville, K.*[†] E., Bosse, T.*[†] L., Klekos, M.*[†], Mills, J. F.*[†], Weicksel, S. E., Waters, J. S. and Tipping, M. (2018). A novel *ex vivo* method for measuring whole brain metabolism in model systems. *Journal of Neuroscience Methods* 296, 32–43.
- Harrison, J. F., Waters, J. S., Biddulph, T. A.*[†], Kovacevic, A.*[†], Klok, C. J. and Socha, J. J. (2017). Developmental plasticity and stability in the tracheal networks supplying *Drosophila* flight muscle in response to rearing oxygen level. *Journal of Insect Physiology* in press.
- Waters, J. S., Ochs, A.*[†], Fewell, J. H. and Harrison, J. F. (2017). Differentiating causality and correlation in allometric scaling: ant colony size drives metabolic hypometry. *Proceedings of the Royal Society B: Biological Sciences* 284, 20162582.
- Harrison, J. F., Klok, C. J. and Waters, J. S. (2014). Critical PO₂ is size-independent in insects: implications for the metabolic theory of ecology. *Current Opinion in Insect Science* 4, 54–59.
- Waters, J. S. (2014). Theoretical and empirical perspectives on the scaling of supply and demand in social insect colonies. *Entomologia Experimentalis Et Applicata* 150, 99–112.
- Pinter-Wollman, N., Hobson, E., Smith, J., Edelman, A., Shizuka, D., de Silva, S., Waters, J. S., Prager, S., Sasaki, T., Wittemyer, G., Fewell, J., and McDonald, D. (2014). Response to comments on the dynamics of network dynamics. *Behavioral Ecology* 25(2), 260-261.
- Pinter-Wollman, N., Hobson, E. A., Smith, J. E., Edelman, A. J., Shizuka, D., de Silva, S., Waters, J. S., Prager, S. D., Sasaki, T., Wittemyer, G., et al. (2013). The dynamics of animal social networks: analytical, conceptual, and theoretical advances. *Behavioral Ecology* 25, 242–255.
- Waters, J. S., Lee, W. K., Westneat, M. W., and Socha, J. J. (2013). Dynamics of tracheal compression in the horned passalus beetle. *American Journal of Physiology – Regulatory, Integrative, and Comparative Physiology* 304, R621-R627.

- Harrison, J. F., Waters, J. S., Cease, A. J., Vandenbrooks, J. M., Callier, V., Klok, C. J., Shaffer, K. and Socha, J. J. (2013). [How locusts breathe](#). *Physiology* 28, 18–27.
- Fewell, J. H., Armbruster, D., Ingraham, J., Petersen, A. and Waters, J. S. (2012). [Basketball teams as strategic networks](#). *PLoS ONE* 7, e47445.
- Waters, J. S. and Fewell, J. H. (2012). [Information Processing in Social Insect Networks](#). *PLoS ONE* 7, e40337.
- Waters, J. S. and Harrison, J. F. (2012). [Insect Metabolic Rates](#). In *Metabolic Ecology: A Scaling Approach*, R.M. Sibly, J.H. Brown, and A. Kodric-Brown, eds. Wiley-Blackwell, pp. 198-211.
- Schilman, P. E., Waters, J. S., Harrison, J. F. and Lighton, J. R. B. (2011). [Effects of temperature on responses to anoxia and oxygen reperfusion in *Drosophila melanogaster*](#). *Journal of Experimental Biology* 214, 1271–1275.
- Waters, J. S., Holbrook, C. T., Fewell, J. H. and Harrison, J.F. (2010). [Allometric scaling of metabolism, growth, and activity in whole colonies of the seed harvester ant, *Pogonomyrmex californicus*](#). *The American Naturalist* 176(4), 501-510.
- Socha, J. J., Lee, W.-K., Harrison, J. F., Waters, J. S. Fezzaa, K., and Westneat, M. W. (2008). [Correlated patterns of tracheal compression and convective gas exchange in a carabid beetle](#). *The Journal of Experimental Biology* 211, 3409-3420.
- Socha, J. J., Westneat, M. W., Harrison, J. F., Waters, J. S. and Lee, W. K. (2007). [Real-time phase-contrast x-ray imaging: a new technique for the study of animal form and function](#). *BMC Biology* 5 (6).

intellectual
property

Tipping, M. and Waters, J. S. (2017). Method and device for restraining contents of a cell plate. U. S. Patent 62/491,431.

guest lectures
and invited
research
seminars

The physiological ecology of the ants: metabolic scaling, collective behavior, and natural history. Ecology and Evolutionary Biology, Brown University, Fall 2017.

The physiological ecology of the ants: metabolic scaling, collective behavior, and natural history. Department of Biology, The University of Vermont, Fall 2017.

The Ants of Rhode Island. Rhode Island Natural History Survey, University of Rhode Island, Spring 2017.

Insect respiratory physiology: from tracheal systems to brain metabolism. Traniello Lab, Boston University, Fall 2016.

Cardiovascular system: Blood & Hematology. Physiology (BIO 405), Providence College, Spring 2016.

Interaction networks and the emergence of complexity. Graph Theory (MTH 331), Providence College, Spring 2015.

Emergence of complexity in the respiratory physiology of ant colonies. Social Insects in the Northeast Regions, Boston University, Fall 2015.

Collective behavior in social insect colonies. Animal Behavior (BIO 350), Providence College, Fall 2014.

Social behavior in the ants: power, identity, and resistance. Animal Behavior (56-1420), Columbia College, Spring 2014.

The fire of life: metabolic allometry in social insect colonies. The Field Museum of Natural History, A. Watson Armour III Research Seminar Series, Spring 2014.

The fire of life, metabolic scaling, and the search for universal laws in biology. Sarah Lawrence College Science Seminar Series, Fall 2013.

Complexity in ant colonies: Emergence of energetic scaling, respiratory synchrony, and dynamic living structures. NSF Physics of Living Systems Research Network Symposium, Princeton, NJ, Fall 2013.

Ant colony metabolic networks: insights from respiratory physiology and collective behavior. Harvard University, Concord Field Station Seminar, Fall 2013.

Metabolic and behavioral integration in social insect colonies. The University of Würzburg, Behavioral Physiology & Sociobiology Seminar, Summer 2013.

The metabolic ecology of social insect colonies. Princeton University, Theoretical Ecology Lab Tea, Spring 2013.

Comparative biomechanics: the biology of structure and function. Biologically Inspired Design (DSC 598), Arizona State University, Spring 2012.

grants and fellowships

Arts & Sciences Summer Scholars Award, Providence College, 2016.

Grant Improvement Fund, Providence College, 2016.

Walsh Fund Travel Support, Providence College, 2014.

The James S. McDonnell Foundation Postdoctoral Fellowship Award in Complex Systems, 2012-2014.

Graduate and Professional Students Association Travel Grant, 2012.

NSF Doctoral Dissertation Improvement Grant, 2012.

Society for Integrative and Comparative Biology Grant in Aid of Research, 2011.

American Physiological Society Research Travel Award, 2010.

Graduate and Professional Students Association Research Grant, 2010.

National Science Foundation Graduate Research Fellowship, 2008-2011.

Graduate and Professional Students Association Travel Grant, 2009.

Sigma Xi Grant In Aid of Research, 2008.

grants awarded to research students

Ants of Rhode Island: *Myrmica rubra*. Providence College Veritas Summer Undergraduate Research Grant awarded to Jonathan Eckel ('21), 2018.

Seed-harvesting ant colony effects on soil chemistry and plant growth rates. PC Undergraduate Research Grant awarded to Molly Andrus ('18), 2017.

Acorn ant colony collective respiratory physiology. Walsh Student Research Fellowship awarded to Nicole Korzeniecki ('18), 2016.

Natural history and urban ecology of the ants on campus at Providence College. PC Undergraduate Research Grant awarded to Joey Burt ('17), 2015.

published conference abstracts

*Swenson, A. S., Kirkton, S. D., and Waters, J. S. (2018). [Using X-ray Microtomography to Visualize and Quantify the Nest Architecture of Acorn Ant Colonies](#). *Integrative and Comparative Biology* 58.

(* indicates undergraduate student mentee)

Waters, J. S. (2017). Insights on the fluid transport, geometric scaling, and living architecture of insect physiological systems revealed by x-ray imaging. *Proceedings of the 2nd International Symposium on Image Based Metrology (ISIMet)*.

*Korzeniecki, N. W., *Cassidy, D. P., and Waters, J. S. (2017). [Metabolic Dynamics: From Individuals to Whole Colonies](#). *Integrative and Comparative Biology* 57.

*Campbell, A. M., *Korzeniecki, N. W., and Waters, J. S. (2017). [The Ants of Rhode Island: Species Richness and Spatiotemporal Abundance of Ants Across an Urban College Campus](#). *Integrative and Comparative Biology* 57.

- *Higgins, D. J., Kirkton, S. D., and Waters, J. S. (2017). [The Secret Societies Living Within an Acorn: Temnothorax Ant Colonies Visualized with X-ray Microtomography](#). *Integrative and Comparative Biology* 57.
- Waters, J. S., *Toth, J., Harrison, J. F., and Fewell, J. H. (2017). [Metabolic Allometry and the Scaling of Interaction Patterns with Ant Colony Size](#). *Integrative and Comparative Biology* 57.
- *Fabiano, J. N., *Higgins, D., *Ortega, J., *Precoio, L., and Waters, J. S. (2017). [The pressure is on: modeling, design, and performance of circulatory pumps in physiology](#). *Integrative and Comparative Biology* 57.
- Waters, J. S., *Ochs, A., *Toth, J., Fewell, J. H., and Harrison, J. F. (2016). Experimental manipulation demonstrates causality of colony size effects on metabolic rates of ant colonies. *The FASEB Journal*, 30.
- Waters, J. S. (2015). Collective behavior and the respiratory physiology of social insect colonies. *The FASEB Journal*, 29, LB643.
- Harrison, J.F., Waters, J. S., Holbrook, C. T., and Fewell, J. H. (2014). Scaling of energetics and division of labor in harvester ants. 17th Congress of the International Union for the Study of Social Insects (IUSI), Cairns, Australia, 13-18 July 2014.
- Waters, J. S. (2014). Modeling the collective dynamics of metabolic allometry. *Integrative and Comparative Biology* 54.
- Waters, J. S., and Harrison, J. F. (2013). Metabolic and behavioral variation with colony size and age: a manipulative test of the size-dependence theory of metabolic allometry. *Integrative and Comparative Biology* 53, e223.
- *Kovacevic, A., *Biddulph, T., Waters, J. S., and Harrison, J. F. (2013). Effects of the larval oxygen environment on the three-dimensional branching structure of insect flight muscle tracheae. *Integrative and Comparative Biology* 53, e312.
- *Biddulph, T. A., *Kovacevic, S., Waters, J. S., and Harrison, J. F. (2013). Trachea and flight muscle volumes of adult *Drosophila melanogaster* reared in hypoxia, normoxia, and hyperoxia using synchrotron x-ray phase contrast microtomography. *Integrative and Comparative Biology* 53, e247.
- Harrison, J.F., Waters, J. S., Cease, A. C., VandenBrooks, J. M., Callier, V., Klok, C. J., *Shaffer, K., and Socha, J. J. (2013). How hoppers breathe. *Integrative and Comparative Biology* 53, e294.
- Miller, L., Waters, J. S., Harrison, J.F., Vandenbrooks, J.M., Yager, D.D., Xiao, X., DeCarlo, F., and Socha, J.J. (2012). The use of SR- μ CT for 3D visualization of insect tracheal systems. *Integrative and Comparative Biology* 52, e295.
- Harrison, J.F., Waters, J. S., *Heinrich, S.M., and Socha, J.J. (2012). Effects of rearing oxygen level on the anatomy of the adult tracheal system in *Drosophila*. *Integrative and Comparative Biology* 51 (6).
- Waters, J. S., *Heinrich, S. M., and Harrison, J. F. (2011). Anatomy of the tracheole system supplying *Drosophila* flight muscle. *Integrative and Comparative Biology* 51, e264.
- *Bespalova, I. and J. S. Waters. (2011). Variable success of two colony founding strategies: A case study using the California seed-harvester ant. *Integrative and Comparative Biology* 51, e165.

- Waters, J. S., Fewell, J. H., and Harrison, J. F. (2011). Metabolic and behavioral integration in social insect colonies. *Integrative and Comparative Biology* 51, e146.
- Fewell, J. H. and Waters, J. S. (2010). Social insect networks are not “social networks.” Annual meeting of the Animal Behavior Society, Williamsburg, VA.
- Waters, J. S. and Harrison, J. F. (2010). Geometric characterization and phenotypic plasticity in tracheal networks supplying insect flight muscle. *Integrative and Comparative Biology* 50, e186.
- Waters, J. S., Holbrook, C. T., Fewell, J. H., and Harrison, J. F. (2009). Allometric scaling of whole colony metabolic rate in *Pogonomyrmex californicus*. *Integrative and Comparative Biology* 49, e179.
- Lee, W. K., Socha, J. J., Westneat, M. W., Harrison, J. F., and Waters, J. S. (2007). Direct visualization of internal respiratory and food transport dynamics in insects. *Bulletin of the American Physical Society* (52).
- Westneat, M. W., Socha, J. J., Waters, J. S., Hale, M. E., and Lee, W-K. (2006). The expiration data is today: Diversity of convective insect respiratory behavior visualized by synchrotron x-ray imaging. *Integrative and Comparative Biology* 46, e265.
- Socha, J. J., Waters, J.S., Westneat, M. W., LaBarbera, M., Cook, S., Fezzaa, K., and Lee, W-K. (2006). The Poise that refreshes: dynamics of internal food transport in a butterfly. *Integrative and Comparative Biology* 46, e133.
- Hale, M. E., Waters, J. S., Lee, W-K, Socha, J. J., Fezzaa, K., and Westneat, M. W. (2006). Drawing inspiration from insect breathing and heaving conventional wisdom: Convective tracheal and air sac mechanisms in *Drosophila* visualized with x-ray imaging. *Integrative and Comparative Biology* 46, e53.
- Waters, J. S. and Socha, J. J. (2005). Mechanics of tracheal compression in the bessbug, *Popilius disjunctus*. *Integrative and Comparative Biology* 45(6): 1209.
- Socha, J. J., Fezzaa, K., Lee, W-K., Waters, J. S., and Westneat, M. W. (2004). Tracheal compression patterns involved in gas exchange in the ground beetle, *Platynus decentis*. *Integrative and Comparative Biology* 44(6): 748.

media & press

- College Professor Documenting R.I.’s Ant Biodiversity, *Eco RI News* (2017).
<https://www.ecori.org/natural-resources/2017/5/18/providence-college-professor-documenting-rhode-islands-ant-biodiversity>
- Student researchers discover the secrets of ant colony behavior (2017).
<https://news.providence.edu/student-researchers-discover-secrets-ant-colony-behavior>
- Stranger than fiction: These ants look like the dragons in 'Game of Thrones' (2016).
<https://www.csmonitor.com/Science/2016/0727/Stranger-than-fiction-These-ants-look-like-the-dragons-in-Game-of-Thrones>
- A view from Providence: Synagogue is a mirror of Jewish history, *Providence Journal* (2015). <http://www.providencejournal.com/article/20150725/NEWS/150729492>
- Scott Turner: Wasps summer under sandy sidewalk, *Providence Journal* (2015).
<http://www.providencejournal.com/article/20150801/OPINION/150809894>
- Research featured in BBC’s “Insect Dissection: How Insects Work” (2013).
<http://www.bbc.co.uk/programmes/p00zst23>
- Featured in “Local Research, Global Impact” video produced by ASU (2012).
<http://vimeo.com/user1763763/videos>

Compound Eye (Scientific American Blog): "James Waters' iPhone Ants" (2011).
<http://blogs.scientificamerican.com/compound-eye/>

Outside JEB: "Ant colonies obey 3/4 power 'law' of metabolic scaling" (2010).
<http://jeb.biologists.org/cgi/content/full/214/1/v-a>

ASU News: "Social evolution regulates the fire of life" (2010).
http://asunews.asu.edu/20100825_energyants

Myrmecos.net: "More support for the superorganism concept" (2010).
<http://myrmecos.net/2010/08/27/more-support-for-the-superorganism-concept/>

American Physiological Society: "Ant colonies shed light on metabolism" (2010).
<http://www.the-aps.org/press/releases/10/25.htm>

Life Lines: "Ant colonies & metabolic scaling, Parts I & II (2010).
http://scienceblogs.com/lifelines/2010/12/ant_colonies_metabolic_scaling.php

scientific
photography

Two photographs on exhibit at the New York Hall of Science (NYSCI), 2017.
Three photographs selected for Art of Science exhibit, Princeton University, 2014.
Photograph of *Temnothorax rugatulus* colony featured in TED talk, 2017.
Pogonomyrmex californicus photo featured on the cover of *Geology*, 2014.
Temnothorax photograph published in *Nature* 500(7461): p. 125, 2013.
American Microscopical Society Photomicrography contest, 3rd place, 2013.
Temnothorax rugatulus photos for *Current Biology*, 2012.
Drosophila photomontage cover for *The Royal Society*, 2010.
Insectes magazine article on recent developments in *Drosophila* research, 2010.
Drosophila illustration in the *Encyclopedia of Behavioral Neuroscience*, 2009.
Drosophila photo for *Neurotoxicology and Teratology* 32(1): p. 75, 2009.
Brochure for the *Max Planck Institute for Biophysical Chemistry*, 2009.
Pheidole micrograph for *School of Life Sciences Magazine* (4)1: p.30, 2008.

open-access data

Waters, J. S. (2013). Horned Passalus Tracheal Compression (first leg). figshare.
<http://dx.doi.org/10.6084/m9.figshare.693019>

Waters, J. S. (2013). Collapse and reinflation of a main thoracic tracheal tube. figshare.
<http://dx.doi.org/10.6084/m9.figshare.693020>

Waters, J. S. (2013). Horned Passalus Tracheal Compression (prothorax). figshare.
<http://dx.doi.org/10.6084/m9.figshare.693018>

Waters J. S., Holbrook C. T., Fewell J. H., Harrison J. F. (2010) Data from: Allometric scaling of metabolism, growth, and activity in whole colonies of the seed harvester ant, *Pogonomyrmex californicus*. Dryad Digital Repository. doi:10.5061/dryad.1594

honors and
awards

Award for Best Presentation, Second Prize, 2nd International Symposium on Image Based Metrology (ISIMet), 2017.
George C. Eickwort Student Research Award Honorary Mention, 2012.
First Place Presentation, Arizona Imaging and Microanalysis Society, 2007.
Nominated for GPSA Teaching Excellence Award, 2006.
Sigma Xi Science Prize, The University of Chicago, 2005.
President's Award, Chicago Area Undergraduate Research Symposium, 2005.
University of Chicago Merit Scholarship, 2001.

college committee appointments	<p>Faculty Status Committee (Faculty Senate), 2018 – present. Intellectual Property Committee, 2017 – present. Strategic Web Governance Committee, 2017 – present. Jewish-Catholic Theological Exchange Committee, 2016 – present. College Archives and Special Collections Committee, 2015 – present.</p>
department service	<p>Biology department representative in the Faculty Senate, starting January 2018. Managing department social media account (@friarbiology), 2016 – present. Editing department website, 2015 – present. Neuroscience certificate program faculty, 2014 – present. Biology major and Neuroscience certificate student advising, 2014 – present. Meeting with trustee John Killian, advocating for department priorities, 2017. Meeting with Art & Science Group for assessment feedback, 2016. Biology fill-in representative for department chairs meeting, 2015. Meeting with trustee Peter Benzie, 2015. Major/minor fair department representative, 2014.</p>
college service	<p>Academic advising for undeclared students, 2016 – present. Providence College Learning Circles participant, 2015 – 2016. PC Alumni Reunion Weekend presentation on The World of The Ants, 2017. A Day in Friartown: Coffee with Professors, 2015. Freshman Common Reading Program discussion leader, 2014.</p>
discipline service	<p>Maintaining a public worldwide map of social insect research labs, 2013 - present. Organized a regional networking meeting for ant researchers in Rhode Island, 2017. Division of Invertebrate Zoology (SICB) presentation judge, 2014, 2017. Social Insects in the Northeast Regions meeting organizer, 2012 – present. Journal peer-review (see below), 2010 – present.</p>
community service and outreach	<p>Founding board member, The Rhode Island Jewish Museum, 2017 – present. Board member, The Rhode Island Jewish Historical Association, 2017 – present. Serve Rhode Island snow-shoveling volunteer, 2014 – 2016. Ant day, Charlotte Dunning Elementary School, Marlborough, MA, 2016. The University of Chicago Alumni Schools Committee, Rhode Island, 2014-2015. The University of Chicago Alumni Schools Committee, Central New Jersey, 2013. Organizing graduate student workshop on programming in R, 2013. Writing for Ask a Biologist website, http://askabiologist.asu.edu/, 2012. Bug Theater: Return of the Hexapods, Cave Creek Regional Park, 2012. Summer “Bug Theater” event at Estrella Mountain Regional Park, 2010. Physiology exhibit at Social Insect Science Expo at Desert Botanical Garden, 2010. Mentoring workshop on preparing graduate fellowship applications, 2009. Leading interdisciplinary Comparative Biomechanics reading group, 2009. Webmaster for A.S.U. Graduates in Earth, Life, and Social Sciences, 2009. Reviewing grant proposals for Graduate and Professional Students Association, 2008. Presenting a web-publishing workshop for Women in Science and Engineering, 2007. Organized the annual meeting of the Chicago Area Undergraduate Research Symposium, 2006.</p>
membership in scientific societies	<p>American Physiological Society American Society of Naturalists Arizona Imaging and Microanalysis Society Cambridge Entomological Club International Union for the Study of Social Insects Society for Integrative and Comparative Biology</p>

journals served as
manuscript
reviewer

The American Naturalist
Animal Behavior
Behavioral Ecology and Sociobiology
Biology Letters
Current Zoology
Integrative and Comparative Biology
Ecological Entomology
Entomologia Experimentalis et Applicata
Evolutionary Ecology
Functional Ecology
Integrative and Comparative Biology
Journal of Animal Ecology
Journal of Experimental Biology
Journal of Insect Physiology
Journal of Visualized Experiments
Nature Communications
PLoS One
Proceedings of the National Academy of Science USA
Proceedings of the Royal Society B: Biological Sciences
Revista Brasileira de Entomologia
Royal Society Open Science
Scientific Reports

book peer review

Sibly et al., *Metabolic Ecology: A Scaling Approach*, Wiley-Blackwell, 2012.
Harrison et al., *Ecological and Environmental Physiology of Insects*, Oxford University Press, 2012.

research profiles

Google Scholar
<http://scholar.google.com/citations?user=hKSvttMAAAAJ>
Impact Story
<https://profiles.impactstory.org/u/0000-0001-7077-9441>
ORCID
<http://orcid.org/0000-0001-7077-9441>
ResearchGate
https://www.researchgate.net/profile/James_Waters4

citation metrics

Citations: 587 (476 since 2013)
h-index: 9 (9 since 2013)

Entomology (BIO 476). This course offers students an overview of insect science with specific emphasis and training in civic engagement and scientific communication. The insects are the most abundant and species-rich animals on the planet and are important for their ecological impacts and interactions with human populations. Topics covered in lecture will include insect anatomy and physiology, sensory systems and behavior, reproduction, development and life histories, systematics and classification, biogeography and evolution, and medical and veterinary entomology. Lab field trips will offer students the opportunity to collect insects to study their behavior and develop curated collections of pinned and identified specimens. To develop the skills necessary for civic engagement, students will prepare insect-themed materials for the general public including keys to local taxa and innovative classroom lesson plans, participate in a number of external activities including collections and tours of local museums and insect collections, and host an insect fair for the community at the end of the semester. *Proposed for Fall 2018.*

Introduction to Complexity Science (BIO 479). This is an advanced topics course with a programming lab designed to introduce students to the principles of complexity theory in the life sciences and to train them in the effective and ethical communication of scientific ideas, data, and models. Students are not required to have any previous mathematical training or programming experience as these skills will be developed from scratch. Students will be introduced to methods including mathematical modeling, scaling analysis, network science, cellular automata, chaos theory, and nonlinear dynamics. Laboratory exercises will focus on learning R, a widely-used and powerful open-source platform for statistical computing. Students will complete projects that explore a topic in complexity science while developing modeling, simulation, and visualization methods to communicate these ideas in novel and effective ways. *Taught Spring 2017.*

Physiology (BIO 405). Covers the basic principles and mechanisms of animal physiology. Emphasis is placed upon nervous systems, sensory mechanisms, endocrine systems, intracellular signaling mechanisms, and muscle contractility. Homeostatic mechanisms and the systems responsible for supply of the internal environment are also discussed. The laboratory consists of experimental procedures of cellular physiology as well as instrument facilitated human and animal physiology investigations. *Taught Spring 2015, Spring 2016, Spring 2018.*

Biology of the Social Insects (BIO 475). The eusocial insects, including ants, bees, wasps, and termites, are among the most ecologically dominant species on this planet. They transform the environment, engage in warfare, cultivate symbiotic and agricultural relationships, and construct elaborate nests with complex architectural innovations. Some social insect societies demonstrate hallmark features of altruism and social cohesion while others are ruled by policing behaviors and dominance hierarchies maintained through brutal aggression. This course will explore the mechanisms responsible for the foundation and functional dynamics of social insect societies. *Taught Spring 2015.*

General Biology I (BIO 103). This course is the first-semester course of an introductory survey of the biological sciences for undergraduates majoring in biology. The sequence of material covered moves from lower to higher levels of biological organization, beginning with the cellular and organismic levels and terminating with the population and community levels. General Biology I, serves as an introduction to Cell Biology, Molecular Biology, Genetics, Biochemistry, and Evolution. The course will also cover topics in molecular physiology taken from different animal models. In addition to covering the basic vocabulary of modern molecular biology, the course will focus on critical thinking about experimental

science. This will include experimental methodologies, experimental design, and data interpretation. Conventional lecture material will be supplemented with analyses of primary scientific literature. The overall goal of this course is for students to obtain a rigorous scientific foundation that will leave them well prepared for subsequent course work. *Taught Fall 2014, Fall 2015, Fall 2016, and Fall 2017.*

General Biology Lab (BIO 103L). This hands-on laboratory course is designed to complement and amplify the themes developed in Biology 103 lectures. The course will emphasize Cell Biology, Genetics, Molecular Biology, Microscopy and other topics. Successful students will also strive to develop their analytical and scientific communication skills. *Taught Fall 2014.*

Research (BIO 395-496). In this course, students earn credit for working with faculty on scholarly projects intended to make original contributions to respective disciplines. Students in my research lab receive academic and career mentoring and hands-on training in the scholarly methods of physiological ecology, animal behavior, biomechanics, myrmecology, and natural history. In addition to doing research with the faculty member and other members of our research team, students are also prepared to engage in professional activities relevant to success in our discipline including conducting fieldwork, statistical analysis, developing scientific communication skills, presentations at local and national meetings, training in both lab and field safety, and awareness of the relevant bioethical considerations of our research. *Taught Fall 2014 – present.*