

contact information

Dept of Integrative Biology (formerly Zoology)
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education

- 1992 Ph.D., Indiana University
Fields of Study: Animal Behavior, Neuroscience
Dissertation Title: Anatomy of the Peripheral Olfactory and Vomeronasal Systems in Aquatic Salamanders and its Implications for the Evolution of Vertebrate Chemosensory Systems
- 1985 B.A., University of Pennsylvania
Major: Psychology

research interests

The goal of my research is to understand the mechanisms and functional consequences of evolutionary changes in the nervous system. For most of my career, I have focused on examining changes in vertebrate olfactory systems over evolutionary time and the impact of these changes on behavior and physiology. In this research, I have worked extensively with salamanders, but have also conducted studies with lampreys and teleost fishes. As part of this work, I have studied the production of chemical signals as well as their detection, topics that have taken me into the realm of chemical ecology. Recently, these studies have expanded into amphibian toxins and their consequences for nervous systems and behavior, along with studies of the symbiotic bacteria that produce these toxins.

professional experience

- 2022 - Faculty Advocate, College of Natural Science, Michigan State University
2018 - Professor, Department of Integrative Biology, Michigan State University
2011- Member, Cognitive Science Program, Michigan State University
2010- Member, BEACON Center for the Study of Evolution in Action
1997- Member, Neuroscience Program, Michigan State University
1997- Member, Ecology, Evolution, and Behavior Program, Michigan State University
2003-18 Associate Professor, Department of Zoology, Michigan State University
1997-2003 Assistant Professor, Department of Zoology, Michigan State University
1993-97 Research Associate, Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA
1992-93 Postdoctoral Fellow, Neuroscience Dept, University of California at San Diego
1992 Grass Foundation Fellow in Neurophysiology, Marine Biological Laboratory, Woods Hole, MA
1989-92 Associate Instructor, Departments of Psychology and Biology, Indiana University
1985-89 Teaching and Research Assistant, Indiana University, Department of Psychology
1984-85 Research Assistant, Monell Chemical Senses Center, Philadelphia, PA

extramural support

- 2017-22 National Science Foundation, “Nervous System Adaptations in a Highly Neurotoxic Organism”, PI Heather Eisthen, co-PI Emma Coddington (\$404,823)
- 2014-18 National Science Foundation, “Evolution of a Pheromonal Communication System in Amphibians”, PI Heather Eisthen, co-PI Barry Williams (\$510,000)
- 2014-15 National Science Foundation, “Conference: ICN, Sapporo, Japan, July 28 - Aug 1, 2014” PI Heather Eisthen, co-PI Masashi Kawasaki (\$27,200)
- 2012-15 National Science Foundation “REU site: Integrative Biology of Social Behaviors”, PI Heather Eisthen, co-PI Joseph Lonstein (\$336,000)
- 2008-12 National Science Foundation, “Centrifugal Modulation in the Vertebrate Olfactory Epithelium” (\$477,887, including REU and ROA supplements)
- 2006-09 National Institute of Physiological Sciences (Japan), Joint Group Study Proposal, PI: Yoshitaka Oka, University of Tokyo (approx. US \$30,000)
- 2005-07 National Institutes of Health, US-Japan Brain Research Cooperation Program, “Modulation of Olfactory Epithelial Activity by Terminal Nerve Peptides” (\$15,100)
- 2002-08 National Institutes of Health, R01 award, “Modulatory Peptides and Olfactory Receptor Cell Function” (\$1,073,653)
- 2000-05 National Science Foundation, “Organization and Function of the Extra-Bulbar Olfactory Pathway” (\$301,300, including REU supplements)
- 1996-98 National Institutes of Health, R03 award, “Function of Vomeronasal Receptor Neurons” (\$79,565)
- 1993-95 National Institutes of Health, National Research Service Award, “Nasal Placode Ontogeny and its Phylogenetic Implications”

intramural support

- 2021-22 Ecology, Evolution, and Behavior Program seed grant, “Mechanisms to Prevent Cheating in a Newt-Microbe Symbiosis”, Heather Eisthen and Elizabeth Heath-Heckman (\$15,901)
- 2014-15 BEACON Center for the Study of Evolution in Action, “Mechanisms of Adaptation: Voltage-Gated Sodium Channel Evolution in a Neurotoxic Amphibian”, Patric Vaelli and Heather Eisthen (\$70,452)
- 2013-15 BEACON Center for the Study of Evolution in Action, “IBSB REU Mentoring Program”, Heather Eisthen and Judi Brown Clarke (\$30,400)
- 2013-14 BEACON Center for the Study of Evolution in Action, “Evolution of Mechanisms Enabling the Use of a Neurotoxin as a Pheromone”, Heather Eisthen, Harold Zakon, Luke Harmon, and Ben Liebeskind, (\$118,797)
- 2013-14 BEACON Center for the Study of Evolution in Action, “The Role of Symbiotic Bacteria in a Predator-Prey Coevolutionary Arms Race”, Heather Eisthen, Patric Vaelli, Kevin Theis, James Foster, Katherine Hunt, and Luke Harmon (\$114,308)
- 2012-14 MSU Discretionary Funding Initiative, “Olfactory Detection of Tetrodotoxin in Rough-Skinned Newts” (\$60,000)
- 2012-13 BEACON Center for the Study of Evolution in Action, “Pinpointing the Genetic Origins and Functional Co-option of a Peptide Pheromone”, Heather Eisthen and Barry Williams (\$85,048)

teaching experience

- 2016-2014-17 Neural Basis of Animal Behavior; undergraduate course, Michigan State University
- 2014-17 Design Principles of Nervous Systems; graduate course (co-taught with Arend Hintze), Michigan State University
- 2011-16 Evolution of Nervous Systems; graduate seminar, Michigan State University

2007	Neural Basis of Behavior; graduate seminar (co-taught with Petra Telgkamp), Michigan State University
2004-06	Professional Development; graduate seminar, Michigan State University
2000-02	Integrative Animal Behavior; graduate course (co-taught with Kay Holekamp), Michigan State University
1999-2004	Systems Neuroscience; team-taught graduate course, Michigan State University
1999	Molecular Principles of Nervous System Adaptation and Evolution; team-taught short course, Kristineberg Marine Research Station, Fiskebäckskil, Sweden
1998	Development and Evolution; graduate seminar, Michigan State University
1997-2015	Neurobiology; undergraduate course, Michigan State University
1991-92	Developmental Vertebrate Anatomy; undergraduate lab course, Indiana University
1990	Experimental Methods; undergraduate lecture/lab course, Indiana University

honors and awards

2021	College of Natural Science Junior Faculty Mentoring Award, Michigan State University
2010	Ann E. Kammer Memorial Research Award, Marine Biological Laboratory
2010	Laura and Arthur Colwin Summer Research Fellowship, Marine Biological Laboratory
2009	Stephen W. Kuffler Fellow in Neurobiology, Marine Biological Laboratory
2007	Edmund A. Arbas Memorial Lecturer, University of Arizona
1999-2000	Lilly Foundation Teaching Fellow, Michigan State University
1996-97	German and American Young Scholars' Institute Fellowship, "Organization of Behavior in Lower and Higher Animals"
1993	Irving J. Saltzman Dissertation Award, Dept of Psychology, Indiana University
1991-92	Research Fellowship, Program in Animal Behavior, Indiana University
1991	Doctoral Dissertation Grant-In-Aid, College of Arts and Sciences, Indiana University
1991	Research Support Grant, Program in Animal Behavior, Indiana University
1990-91	Dissertation Year Research Fellowship, College of Arts and Sciences, Indiana University
1990	Sears Crowell Fellowship in Marine Biology, Indiana University

professional activities

2019-pres	Member, Inclusion and Diversity Committee, International Society for Neuroethology
2017, 2020	External Advisor, New Faculty Search Group, Stowers Institute, Kansas City, MO
2015-pres	Advisory Committee, Ambystoma Genetic Stock Center, University of Kentucky
2015-16	Program Committee, International Congress of Neuroethology, Montevideo, Uruguay
2014	Program Co-Chair (with Masashi Kawasaki, U Virginia), International Congress of Neuroethology, Sapporo, Japan
2013	Co-Chair (with Hans Hofmann, U Texas), Gordon Research Conference, "Neuroethology: Behavior, Evolution, & Neurobiology"
2013-14	Member, Executive Committee, International Society for Neuroethology
2013-16	Co-director (with Joseph Lonstein), REU Site in the Integrative Biology of Social Behavior, Michigan State University
2012	Organizer, Amphibian Neuroethology, a satellite of the International Congress of Neuroethology
2011	Participant (on behalf of the International Society for Neuroethology), Broadening Participation workshop, National Science Foundation
2011	Vice-Chair, Gordon Research Conference, "Neuroethology: Behavior, Evolution, & Neurobiology"
2011-12	Awards Committee, International Society for Neuroethology
2009-2019	Editorial Advisory Board, Journal of Experimental Biology

2010	Chair, Developing Neuroethology fellowship committee, International Society for Neuroethology
2008-10	Emerging Countries Committee, International Society for Neuroethology
2006-13	Editorial Board, Journal of Experimental Zoology A
2006-09	Election Committee, Association for the Chemoreception Sciences
2004-05	Advisory Committee, Indiana University Axolotl Colony
2003-07	Admissions Committee, Neural Systems and Behavior Course, Marine Biological Laboratory, Woods Hole, MA
2003-04	Organizing Committee, International Congress of Neuroethology
2002-04	Writer, "Outside JEB", Journal of Experimental Biology
2001	Co-organizer (with Kiisa Nishikawa, Northern Arizona U), Karger Workshop, "Evolutionary Convergence as a Tool in Neuroscience"
1995-97	Co-coordinator, Women in Science Group, Marine Biological Laboratory, Woods Hole, MA
1993	Co-organizer (with Richard Vogt, U South Carolina), symposium on "Evolution of Olfaction", Association for the Chemoreception Sciences
1989-92	Reviewer, "A Moment of Science", WFIU, Bloomington, IN

grant reviews

ad hoc reviewer, Agence Nationale de la Recherche (France)
ad hoc reviewer, Great Lakes Fishery Commission
ad hoc reviewer, National Institutes of Health
ad hoc reviewer, National Science Foundation (Animal Behavior; Animal Sensation and Movement; Behavioral Neuroscience and Neuroendocrinology; Ecological and Evolutionary Physiology; Evolutionary Genetics; Integrative Animal Biology; Neural Systems; Physiological and Structural Systems; Sensory Systems)
ad hoc reviewer, Natural Sciences and Engineering Research Council of Canada
ad hoc reviewer, Research Foundation – Flanders (Belgium)
ad hoc reviewer, US Army Engineer Research and Development Center
panel member, National Science Foundation (Animal Behavior, Animal Sensation and Movement, Modulation, Neurobiology, Sensory Systems)

ad hoc reviewer: journals

American Naturalist	Evolution
American Zoologist	Frontiers in Neuroanatomy
Anatomia, Histologia, Embryologia	Herpetologica
Anatomical Record	Integrative and Comparative Biology
Anatomy and Embryology	Journal of Anatomy
Animal Behaviour	Journal of Chemical Neuroanatomy
Applied and Environmental Microbiology	Journal of Comparative Neurology
Behaviour	Journal of Comparative Physiology A
Behavioral and Brain Sciences	Journal of Experimental Biology
Behavioral Neuroscience	Journal of Experimental Zoology A
Biological Bulletin	Journal of Experimental Zoology B
Brain, Behavior and Evolution	Journal of General Physiology
Brain Research	Journal of Herpetology
Cell and Tissue Research	Journal of Morphology
Chemical Senses	Journal of Neurocytology
Current Biology	Journal of Neurophysiology
Current Ornithology	Journal of Neuroscience
Environmental Biology of Fishes	Lab Animal

Molecular Biology and Evolution
Molecular Ecology
Naturwissenschaften
Neuron
Neuroscience Letters
PeerJ: Life and Environment
Philosophical Transactions of the Royal Society B

Physiological and Biochemical Zoology
Proceedings of the National Academy of Sciences
Science
Scientific Reports
Toxicon
Veterinary Medicine: Research and Reports
Zoological Science
Zoologischer Anzeiger

edited volume

Eisthen HL and Nishikawa KC (2002) Evolutionary Convergence as a Tool in Neuroscience. *Brain, Behavior and Evolution*, 59(3), Karger Publishing, Basel, Switzerland.

research publications

Bucciarelli GM, Lechner M, Fontes A, Kats LB, **Eisthen** HL, Shaffer HB. (2021) From poison to promise: the evolution of tetrodotoxin and its potential as a therapeutic. *Toxins* 13:517. doi: 10.3390/toxins13080517.

Cesario J, Johnson DJ, **Eisthen** HL. (2020) Your brain is not an onion with a tiny reptile inside. *Curr Dir Psychol Sci* 29:255-260. doi: 10.1177/0963721420917687.

Vaelli PM, Theis KR, Williams JE, O'Connell LA, Foster JA, **Eisthen** HL. (2020) The skin microbiome facilitates adaptive tetrodotoxin production in poisonous newts. *eLife* 9:e53898. doi: 10.7554/eLife.53898.

Del Valle JM, **Eisthen** HL (2019) Treatment of chytridiomycosis in laboratory axolotls (*Ambystoma mexicanum*) and rough-skinned newts (*Taricha granulosa*). *Comp Med* 69:204-211. doi: 10.30802/AALAS-CM-18-000090.

Hall KW, **Eisthen** HL, Williams BL (2016) Proteinaceous pheromone homologs identified from the cloacal gland transcriptome of a male axolotl, *Ambystoma mexicanum*. *PLOS ONE*. doi: 10.1371/journal.pone.0146851.

Eisthen HL, Theis KR (2016) Animal-microbe interactions and the evolution of nervous systems. *Phil Trans Roy Soc B (London)* 371: 20150052. doi:10.1098/rstb.2015.0052.

Kvam P, Cesario J, Schossau J, **Eisthen** H, Hintze A (2015) Computational evolution of decision-making strategies. In *Proceedings of the 37th Annual Conference of the Cognitive Science Society (DC Noelle, R Dale, AS Warlaumont, J Yoshimi, T Matlock, CD Jennings, PP Maglio, eds), Cognitive Science Society, Austin TX*, pp 1225-1230. arXiv:1509.05646.

Ma M, Fleischer J, Breer H, and **Eisthen** H (2015) The septal organ, Grüneberg ganglion, and terminal nerve. In *Handbook of Olfaction and Gustation, 3rd Edition (RL Doty, ed), Wiley-Blackwell, New York*, pp 1133-1150.

Corfield JR, **Eisthen** HL, Iwaniuk AN, Parsons S (2014) Anatomical specialisations for enhanced olfactory sensitivities in kiwi, *Apteryx mantelli*. *Brain Behav Evol* 84:214-226. doi:10.1159/000365564.

Williams BL, Akazome Y, Oka Y, **Eisthen** HL (2014) Dynamic evolution of the GnRH receptor gene family in vertebrates. *BMC Evol Biol* 14:215. doi:10.1186/s12862-014-0215-y.

Eisthen HL, Krause BC (2012) Ambiguities in the relationship between gonadal steroids and reproduction in axolotls (*Ambystoma mexicanum*). *Gen Comp Endocrinol* 176:472-480. doi:10.1016/j.ygcen.2011.12.034.

Eisthen HL, Polese G (2009) Vertebrate olfactory subsystems and their evolution. In *Evolutionary Neuroscience (JH Kaas, ed), Academic Press, San Diego CA*, pp 407-458.

Kawai T, Oka Y, **Eisthen** HL (2009) The role of the terminal nerve and GnRH in olfactory system neuromodulation. *Zool Sci* 26:669-680. doi:10.2108/zsj.26.669.

Eisthen HL, Schwenk K (2008) Chemical senses: The stimulus and its detection. In *Sensory Evolution on the Threshold: Adaptations in Secondary Aquatic Vertebrates* (JGM Thewissen and S Nummela, eds), Univ California Press, Berkeley CA, pp 35-41.

Reiss JO, **Eisthen** HL (2008) Chemical senses: Comparative anatomy and physiology in amphibians. In *Sensory Evolution on the Threshold: Adaptations in Secondary Aquatic Vertebrates* (JGM Thewissen and S Nummela, eds), Univ California Press, Berkeley CA, pp 43-63.

Mousley A, Polese G, Marks NJ, **Eisthen** HL (2006) Terminal nerve-derived neuropeptide Y modulates physiological responses in the olfactory epithelium of hungry axolotls (*Ambystoma mexicanum*). *J Neurosci* 26:7707-7717. doi:10.1523/JNEUROSCI.1977-06.2006.

Eisthen HL, Polese G (2006) Evolution of vertebrate olfactory subsystems. In *Evolution of Nervous Systems, Vol 2: Non-mammalian Vertebrates* (JH Kaas, ed), Academic Press, Oxford UK, pp. 355-406.

Baxi KN, Dorries KM, **Eisthen** HL (2006) Is the vomeronasal system really specialized for detecting pheromones? *Trends Neurosci* 29:1-7. doi:10.1016/j.tins.2005.10.002.

Eisthen HL, Wyatt TD (2006) The vomeronasal system and pheromones. *Curr Biol* 16:R73-74. doi: 10.1016/j.cub.2006.01.038.

Eisthen HL, Park D (2005) Chemical signals and vomeronasal system function in axolotls (*Ambystoma mexicanum*). In *Chemical Signals in Vertebrates 10* (R Mason, M LeMaster, and D Müller-Schwarze, eds), Springer Verlag, New York, pp 216-227. doi: 10.1007/0-387-25160-X_26.

Park D, Propper CR, **Eisthen** HL (2005) The pheromonal repelling response in red-spotted newts (*Notophthalmus viridescens*). In *Chemical Signals in Vertebrates 10* (R Mason, M LeMaster, and D Müller-Schwarze, eds), Springer Verlag, New York, pp 42-48. doi: 10.1007/0-387-25160-X_6.

Park D, McGuire JM, Majchrzak AL, Ziobro JM, **Eisthen** HL (2004) Discrimination of conspecific sex and reproductive condition using chemical cues in axolotls (*Ambystoma mexicanum*). *J Comp Physiol A* 190:415-427. doi: 10.1007/s00359-004-0510-y.

Park D, McGuire JM, **Eisthen** HL (2004) Differential responses of large and small male red-spotted newts, *Notophthalmus viridescens*, to conspecific chemical cues. *Kor J Biol Sci* 8:81-87.

Park D, **Eisthen** HL (2003) Gonadotropin releasing hormone (GnRH) modulates odorant responses in the peripheral olfactory system of axolotls. *J Neurophysiol* 90:731-738. doi: 10.1152/jn.01162.2002.

Park D, Zawacki SR, **Eisthen** HL (2003) Olfactory signal modulation by molluscan cardioexcitatory tetrapeptide (FMRFamide) in axolotls (*Ambystoma mexicanum*). *Chem Senses* 28:339-348. doi: 10.1093/chemse/28.4.339.

Eisthen HL (2002) Why are olfactory systems of different animals so similar? *Brain Behav Evol* 59:273-293.

Eisthen HL, Nishikawa KC (2002) Convergence: Obstacle or opportunity? *Brain Behav Evol* 59:235-239. doi: 10.1159/000063560.

Wirsig-Wiechmann CR, Wiechmann AF, **Eisthen** HL (2002) What defines the nervus terminalis? Neurochemical, developmental and anatomical criteria. *Prog Brain Res* 141:45-58.

Eisthen HL (2000) Presence of the vomeronasal system in aquatic salamanders. *Phil Trans Roy Soc B (London)* 355:1209-1213. doi: 10.1098/rstb.2000.0669.

Eisthen HL, Delay RJ, Wirsig-Wiechmann CR, Dionne VE (2000) Neuromodulatory effects of gonadotropin releasing hormone on olfactory receptor neurons. *J Neurosci* 20:3947-3955.

Eisthen HL (1997) Evolution of vertebrate olfactory systems. *Brain Behav Evol* 50:222-233. doi: 10.1159/000113336.

Eisthen HL, Northcutt RG (1996) Silver lampreys (*Ichthyomyzon unicuspis*) lack a gonadotropin-releasing hormone- and FMRFamide-immunoreactive terminal nerve. *J Comp Neurol* 370:159-172. doi: 10.1002/(SICI)1096-9861(19960624)370:2<159::AID-CNE3>3.0.CO;2-1.

Eisthen HL, Sengelaub DR, Schroeder DM, Alberts JR (1994) Anatomy and forebrain projections of the olfactory and vomeronasal organs in axolotls (*Ambystoma mexicanum*). *Brain Behav Evol* 44:108-124. doi: 10.1159/000113574.

Eisthen HL (1992) Phylogeny of the vomeronasal system and of receptor cell types in the olfactory and vomeronasal epithelia of vertebrates. *Microsc Res Tech* 23:1-21. doi: 10.1002/jemt.1070230102.

Farley J, Grover LM, Sun L, Huang SS, **Eisthen** HL, Girolami C, Wu R (1990) Chemosensory conditioning of *Hermisenda crassicornis*. *Behav Neurosci* 104:583-596. doi: 10.1037/0735-7044.104.4.583.

Eisthen HL (1989) Courtship and mating behavior in the axolotl. *Axolotl News* 18:18-19.

Eisthen HL, Wysocki CJ, Beauchamp GK (1987) Behavioral responses of male guinea pigs to conspecific chemical signals following neonatal vomeronasal organ removal. *Physiol Behav* 41:445-449. doi: 10.1016/0031-9384(87)90079-5.

manuscripts in preparation _____

Eisthen HL, Erives A, Ferris R. Communication across biological scales. To be submitted to TREE.

Bellono NW, Eisthen HL. Complex modulation of odorant responses in the vertebrate olfactory epithelium. To be submitted to the Proceedings of the Royal Society B.

commentaries and general-interest articles _____

Eisthen HL, Del Valle JM (2018) Axolotls infected with chytrid? A how-to for successful treatment and facility decontamination. *Axolotl: The Newsletter of the Ambystoma Genetic Stock Center*, 2018(2), 13-18.

Eisthen HL, Halanych KM, Kelley DB, White SA, Phelps SM, and 66 additional authors (2018) New NSF policy will stifle innovation. *Science* 362 (6412), 297-298. DOI: 10.1126/science.aav4793.

Eisthen HL (2009) The vomeronasal system. In *Encyclopedia of Perception*. Thousand Oaks, CA: SAGE Publishing.

Eisthen HL (2009) Evolution of olfaction. In *Encyclopedia of Perception*. Thousand Oaks, CA: SAGE Publishing.

Eisthen HL, Isaacs R (2005) Chemical ecology: A delicious distraction. *Curr Biol* 15:R194-196.

Eisthen HL (2004) The goldfish knows: Olfactory receptor cell morphology predicts receptor gene expression. *J Comp Neurol* 477:341-346.

Eisthen HL, Coddington E (2004) A new player in synaptic plasticity. *J Exp Biol* 207 (17):vi.

Eisthen HL (2004) The cost of color. *J Exp Biol* 207 (11):v.

Eisthen HL, Wei CA (2004) More than meets the eye. *J Exp Biol* 207:713.

- Wei CA, Eisthen HL (2003) Resonating whiskers tell a touchy tale. *J Exp Biol* 206:4185.
- Eisthen HL (2003) Getting to the point. *J Exp Biol* 206:2906.
- Eisthen HL, Wei CA (2003) In defense of a burrow. *J Exp Biol* 206:1771.
- de Lame F, Eisthen HL (2003) Like that new perfume you're wearing! *J Exp Biol* 206:789.
- Eisthen HL, Braun CB (2001) Sensors of external conditions in vertebrates. In *Encyclopedia of Life Sciences*. London: Nature Publishing Group.
- Braun CB, Eisthen HL (2001) Sensory systems in vertebrates: An overview. In *Encyclopedia of Life Sciences*. London: Nature Publishing Group.
- Eisthen HL (2000) Book review: *Amphibian Biology*. Volume 3, Sensory Perception. *Copeia* 100:317-318.

invited conference talks

- 2019 *Tainted love: Olfactory detection of tetrodotoxin in rough-skinned newts*. International Congress of Comparative Physiology and Biochemistry, Ottawa, Canada.
- 2017 *Tetrodotoxin: Beyond Survival to Sex and Symbiosis*. Gordon Research Conference in Neuroethology, Les Diablerets, Switzerland.
- 2016 *Amphibian senses and scents: salamanders as model systems for understanding evolution of vertebrate olfaction*. Keynote Talk, Amphibian Neuroethology, Montevideo, Uruguay.
- 2015 *Have microbes influenced the evolution of nervous system and behaviour?* Homology and Convergence in Nervous System Evolution, Royal Society, Buckinghamshire, UK.
- 2013 *Evolution and tinkering in olfactory systems*. Barcelona Cognition, Brain, and Technology Summer School, Barcelona, Spain.
- 2012 *Tainted love: Olfactory detection of tetrodotoxin in rough-skinned newts*. Plenary talk, annual meeting of the German Zoological Society, Konstanz, Germany.
- Neuromodulatory effects in the olfactory epithelium depend on odorant and physiological state*. Plenary talk, International Symposium on Olfaction and Taste, Stockholm, Sweden.
- Neuromodulatory effects in the olfactory epithelium vary with odorant and physiological state*. Association for the Chemoreception Sciences, Huntington Beach, CA.
- 2011 *Odorant responses depend on physiological state in axolotls (Ambystoma mexicanum)*. North American Society for Comparative Endocrinology, Ann Arbor, MI.
- 2010 *Start making sense: Evolutionary origins of the major sensory systems*. Keynote talk, Evolution of Olfaction MMX, Christmas Island, Australia.
- Neural mechanisms of species-typical odorant responses in salamanders*. Plenary talk, Bicentennial Meeting of the Sociedad Chilena de Neurociencia, Valdivia, Chile.
- Why do aquatic animals have a vomeronasal system?* Symposium talk, Bicentennial Meeting of the Sociedad Chilena de Neurociencia, Valdivia, Chile.
- Tainted love: Olfactory detection of tetrodotoxin in rough-skinned newts*. International Society for Neuroethology, Salamanca, Spain.

- 2009 *Context-dependent modulation of activity in the vertebrate olfactory epithelium.* European Chemoreception Research Organization, Villasimius-Cagliari, Italy
- How many vertebrates does it take to change a bulb? Functional implications of olfactory system evolution.* Neural Systems and Behavior course, Marine Biological Laboratory, Woods Hole, MA
- 2008 Discussion Leader, Gordon Research Conference in Neuroethology, Oxford UK
- 2007 *Why do tetrapods have two olfactory systems? Origins and Evolution of Chemoreception,* National Evolutionary Synthesis Center, Durham, NC
- 2006 *Olfaction and social behavior: A comparative approach.* Social Cognition and the Olfactory Brain, Nancy Lurie Marks Family Foundation, Wellesley, MA
- 2005 *Evolutionary changes in the vertebrate olfactory system: How do they affect behavior?* Gordon Research Conference on Neuroethology, Oxford, UK
- Evolution of the vomeronasal system in aquatic vertebrates.* Evolution of Aquatic Tetrapods, Akron, OH
- Why are olfactory systems in different animals so similar? What evolution can teach us about nervous system function.* Winter Conference on Brain Research, Breckenridge, CO
- The terminal nerve modulates activity in the olfactory epithelium.* Modulation of Chemosensory Signaling, Jackson Hole, WY
- 2004 *Accessories after the fact: The vomeronasal system and terminal nerve in vertebrate olfaction.* Plenary Talk, International Congress of Neuroethology, Nyborg, Denmark
- Why are olfactory systems similar across phyla? Hennig XXIII: Phylogenetics and Evolutionary Biology,* Paris, France
- Accessories after the fact: The vomeronasal system and terminal nerve in vertebrate olfaction.* Neural Systems and Behavior course, Marine Biological Laboratory, Woods Hole, MA
- 2001 *Terminal nerve-derived peptides modulate excitability of olfactory receptor neurons.* Second International Symposium on Gonadotropin-Releasing Hormone, Penang, Malaysia
- 1999 Discussion Leader, Gordon Research Conference in Neuroethology, Oxford UK
- Origin of the vomeronasal system in early aquatic tetrapods.* Sensory Processing of the Aquatic Environment, Heron Island, Australia
- 1996 *Evolution of the vertebrate olfactory system.* Karger Symposium, Evolution of Vertebrate Sensory Systems, Washington DC

departmental seminars

- 2022 Comparative Physiology Group, University of California, Irvine
- 2021 Institute of Ecology and Evolution, University of Oregon
Department of Ecology and Evolutionary Biology, University of California, Los Angeles
- 2019 Department of Biology, Central Michigan University
Department of Biology, University of Toronto, Mississauga
- 2018 Neurobiology Graduate Program, University of Chicago
Biology Department, Vrije Universiteit Brussel, Belgium
Monell Chemical Senses Center, Philadelphia
- 2016 NeuroNET Research Center, University of Tennessee

Department of Biology, University of Oklahoma
 2015 Department of Biology, Washington University in St. Louis
 2014 Department of Biology, University of Washington
 Darwin Day speaker, Minot State University
 2013 Department of Integrative Biology, University of Texas
 Brain, Behavior, and Evolution group, University of Texas
 Department of Biology, University of California at Santa Barbara
 Department of Biology, Humboldt State University
 Darwin Day speaker, Eastern Illinois University
 2012 Department of Biology, Western Michigan University
 Department of Biomedical Sciences, Grand Valley State University
 Department of Biology, University of Vermont
 Faculty of Science, Lund University, Sweden
 2011 BEACON Center for the Study of Evolution in Action, Michigan State University
 2010 Summer Program in Neuroscience, Ethics, and Survival, MBL, Woods Hole, MA
 Max-Planck-Institut für chemische Ökologie, Jena, Germany
 Department of Biological Sciences, University of Idaho
 Department of Biology, University of Guelph
 2009 Grass Foundation Fellowship program, Marine Biological Laboratory, Woods Hole, MA
 Summer Program in Neuroscience, Ethics, and Survival, MBL, Woods Hole, MA
 Department of Neurobiology, Physiology and Behavior, University of California, Davis
 Department of Physiology, University of Otago, Dunedin, New Zealand
 2008 Department of Biology, Swarthmore College
 Department of Biology, University of Cincinnati
 Department of Anatomy and Neurobiology, University of Puerto Rico
 Whitney Laboratory for Marine Bioscience, St. Augustine, FL
 2007 Arizona Research Labs Division of Neurobiology, University of Arizona
 Department of Biology, Oberlin College
 Department of Biology, Keio University School of Medicine, Yokohama, Japan
 Department of Ecology and Evolutionary Biology, University of Connecticut
 2006 Department of Biology, Georgia State University
 Department of Biological Sciences, University of Maryland, Baltimore County
 Department of Zoology, University of Hawai'i
 2005 Department of Neurobiology and Behavior, Cornell University
 Department of Anatomy, Nippon Medical School, Tokyo, Japan
 Department of Biology, Wayne State University
 Department of Biology, Bowling Green State University, OH
 Departments of Evolution, Ecology, and Organismal Biology and Oral Biology,
 Ohio State University
 2004 Computation and Neural Systems Program, California Institute of Technology
 Department of Biology, Case Western Reserve University
 Department of Biology, University of Akron
 2003 Department of Biology, University of Windsor
 Institute for Mind and Biology, University of Chicago
 Center for the Integrative Study of Animal Behavior, Indiana University
 2002 Department of Zoology, University of Toronto
 2001 Center for the Integrative Study of Animal Behavior, Indiana University
 2000 Department of Zoology, University of Oklahoma
 1999 Department of Biology, Western Michigan University
 1998 Neuroscience Program, Michigan State University
 Ecology and Evolutionary Biology Program, Michigan State University
 1997 APA Minority Fellowship Program in Neuroscience, Woods Hole MA
 1996 Department of Biology, Hofstra University, NY
 Department of Biology, University of Texas, San Antonio

Max-Planck-Institut für Entwicklungsbiologie, Tübingen, Germany
Monell Chemical Senses Center, Philadelphia PA
1995 Department of Biology, University of Victoria, Canada
Department of Integrative Biology, University of California, Berkeley

contributed conference presentations (last 10 years only) _____

Shafau F, Lopez-Bermejo F, Westcott SM, Heath-Heckman EA, Eisthen HL (2022) The role of amino acid precursors in the biosynthesis of tetrodotoxin. Mid-Michigan Symposium for Undergraduate Research Experiences, East Lansing, MI.

Westcott SM, Sullivan LF, Shafau FO, Bucciarelli GM, Frey A, Green DB, Heath-Heckman EA, Eisthen HL (2022) Newt-associated bacteria synthesize a protective neurotoxin. 8th Conference on Beneficial Microbes, Madison WI.

Sullivan L, Eisthen HL, and Heath-Heckman EA (2022) Metagenomic comparison of the skin microbiome of toxic and non-toxic populations of the rough-skinned newt. University Undergraduate Research and Arts Forum, East Lansing, MI. <https://youtu.be/fjUL8kZDTwzc>

Rochell R, Westcott SM, Eisthen HL (2021) The effect of arginine on tetrodotoxin production and bacterial growth in rough skinned newts (*Taricha granulosa*). University Undergraduate Research and Arts Forum, East Lansing, MI. <https://www.youtube.com/watch?v=SYgZftDtrPM>

Al-Tameemi Z, Westcott SM, Eisthen HL (2020) When and why do symbiotic bacteria produce tetrodotoxin? University Undergraduate Research and Arts Forum, East Lansing, MI.

Al-Tameemi Z, Westcott SM, Eisthen HL (2019) When and why do symbiotic bacteria produce tetrodotoxin? Mid-Michigan Symposium for Undergraduate Research Experiences, East Lansing, MI.

Dueñas HA, Westcott SM, Eisthen HL (2019) Investigation of structural differences and storage capabilities of skin glands in rough-skinned newts, *Taricha granulosa*. Mid-Michigan Symposium for Undergraduate Research Experiences, East Lansing, MI.

Smoll EL, Westcott SM, Eisthen HL (2019) Biosynthetic pathway of tetrodotoxin production in skin-associated microbes on *Taricha granulosa*. Mid-Michigan Symposium for Undergraduate Research Experiences, East Lansing, MI.

Westcott SM, Vaelli PM, Eisthen HL (2019) Exploring variation in toxicity of chemically defended amphibians. Purdue Applied Microbiome Symposium, Lafayette, IN.

Del Valle JM, HL Eisthen HL, Hankenson FC (2018) What's your diagnosis? Multifocal dermatitis and bloating in laboratory-maintained axolotls (*Ambystoma mexicanum*) and wild-caught rough skinned newts (*Taricha granulosa*). American Association for Laboratory Animal Science National Meeting, Baltimore, MD.

Vaelli PM, Theis KR, Foster JA, Eisthen HL (2018). Animal-microbial symbiosis in neuroethology: a hologenomic approach to understanding tetrodotoxin toxicity in rough-skinned newts (*Taricha granulosa*). International Congress of Neuroethology, Brisbane, Australia.

Rupp TM, Eisthen HL (2018) Sensory mechanisms for localizing spermatophores in the axolotl (*Ambystoma mexicanum*), an aquatic salamander. International Congress of Neuroethology, Brisbane, Australia.

Vaelli PM, Theis KR, Foster JA, Eisthen HL (2017) Symbiotic bacteria underlie neurotoxin production and evolution of toxin resistance in voltage-gated sodium channels of rough-skinned newts (*Taricha granulosa*). Society for Neuroscience, Washington DC.

Vaelli PM, Theis KR, Foster JA, Eisthen HL (2017) Symbiotic bacteria underlie toxin production and

voltage-gated sodium channel evolution in the rough-skinned newt (*Taricha granulosa*). Gordon Research Conference in Neuroethology, Les Diablerets, Switzerland.

Vaelli PM, Theis KR, Coddington EJ, Eisthen HL (2016) Origins of tetrodotoxin and molecular evolution in the voltage-gated sodium channels of poisonous newts (*Taricha granulosa*). International Congress of Neuroethology, Montevideo, Uruguay.

Kvam P, Cesario J, Schossau J, Eisthen H, Hintze A (2015) Computational evolution of decision-making strategies. CogSci 2015, Pasadena, CA.

Vaelli PM, Theis KR, Coddington EJ, Eisthen HL (2015) Tetrodotoxin production in rough-skinned newts: Metaorganismal evolution in a predator-prey arms race? University of Michigan Early Career Scientist Symposium, Ann Arbor, MI.

Vaelli PM, Theis KR, Coddington EJ, Eisthen HL (2014) Microbial origins and physiological consequences of tetrodotoxin toxicity in the rough-skinned newt (*Taricha granulosa*). Amphibian Neuroethology Workshop, Hokkaido University, Sapporo, Japan.

Vaelli PM, Theis KR, Coddington EJ, Eisthen HL (2014) Microbial origins and physiological consequences of tetrodotoxin toxicity in the rough-skinned newt (*Taricha granulosa*). International Congress of Neuroethology / Japanese Society for Comparative Physiology and Biochemistry, Sapporo, Japan.

public outreach

- 2020- "Gotta Get 'Em All: Predators vs. Prey", Grandparents University Course, Michigan State University (*debut delayed until 2023 due to COVID-19*)
- 2008-16 "The Secret of Good Taste (and Smell)", Grandparents University Course, Michigan State University
- 2011-12 "Michigan's Most Deadly", Fenner Nature Center, Lansing MI

memberships in professional societies

International Society for Neuroethology; Society for Integrative and Comparative Biology; Society for Neuroscience

institutional service

- 2021-22 COVID impact committee, College of Natural Science
- 2019-22 faculty advisory committee, Department of Integrative Biology
- 2019-21 founder and co-organizer, Diversity, Equity, and Inclusion Journal Club, Department of Integrative Biology
- 2018-19 reappointment, promotion, and tenure committee, College of Natural Science
- 2018-20 graduate affairs committee, Neuroscience Program
- 2014-20 seminar committee, EEBB Program
- 2014-16 graduate admissions committee, Zoology/Integrative Biology Department
- 2014-15 chair, faculty search committee, Zoology Department
- 2013-14 director search committee, MSU Museum
- 2012-13 faculty search committee, EEBB Program
- 2011-12 undergraduate major steering committee, Neuroscience Program

2011-12	faculty search committee, Neuroscience Program
2011-14	curriculum committee, College of Natural Science
2007-09	personnel committee, Zoology Department
2006-07	attending veterinarian search committee, University Lab Animal Resources
2005-08	advisory committee, Neuroscience Program
2004-06	graduate admissions committee, Zoology Department
2003	committee to establish the MSU Bike Share program
2002-08	seminar committee, EEBB Program
2002, 2008	comprehensive exams committee, Neuroscience Program
2001	selection committee, Lilly Fellows program
1999-2002	chair search committee, Zoology Department
1998-2000	curriculum committee, Zoology Department
1998-2000	Women's Advisory Committee to the Dean, College of Natural Science
1998	website committee, Zoology Department

trainees mentored

undergraduate students

2022 -	Julia Walton
2022-	Mara Roiland
2021-	Fernanda Lopez-Bermejo
2021-	Faheed Shafau
2021-	Lucy Sullivan
2021-2022	Toinu Oglesby-Rodgers
2021	Zach Brooks
2020-pres	Sergio Acuna
2020-21	Roya Rochell
2020-21	Preethi Saravanan
2019-20	Cole Silva
2019	Emma Smoll (REU student from Willamette U)
2019	Hope Dueñas (REU student from Willamette U)
2018-21	Adam Petrucco
2018-20	Zahraa Al-Tameemi
2018-19	Aalayna Green
2017-18	Hannah O'Rourke
2017-18	Faith White
2016-17	Momin Samad
2016-17	Ian Zaback
2016-20	William Burke
2016-20	Ayley Shortridge
2016	Nathan Elwood
2016	Vladimir Jdanov
2015-18	Jennifer Lough
2015-17	Hannah Hipkiss
2015-17	Richard Middlebrook
2015	Alejandra Ferrer-Diaz (IBSB REU student from U Puerto Rico at Cayey)
2014-15	Ben Goheen
2014-15	Dagny Kaspar
2014	Kimberly Brummell (IBSB REU student from U North Carolina)
2013-14	Clara Lepard
2013	Alyssa Garvey (IBSB REU student from U New Haven)
2012	Aaron Neal (BEACON REU student from North Carolina A&T)
2012-14	Justin Merkel
2012-13	Rachel Emory

2011-13	Bryan Walters
2011-12	Allison Apland
2011-12	Julie Chamness
2011-13	Tiuana Toria Davis
2010	Lila Wakeman
2010-14	Jake Billhorn
2009-13	Justin Schroeder
2008-09	Paul Campbell
2008-09	Laurel Lindemann
2008-11	Nicholas Bellono
2007-10	Lianna Greene
2007-08	Tom Pietrus
2006-11	Brianne Krause
2006	Adam Bouchard
2004-06	Latrista Lane
2004-07	Katherine Leitch
2004-06	Chad Estep
2003-05	David Dimitrie
2003	Craig Carter
2002-03	Sheetal Patel
2002	Kristen Werner
2001-05	Julie Ziobro
2001-02	Sarah Zawacki
2001-02	Jennifer Schlegel
2001	Robin Roth
2001-02	Jeanette McGuire
2000-01	Jessica Fawley
2000-01	Hannah Kliewer
2000-01	Katherine Hohausser
2000	Christine Malinowski
1999-04	Shenna Washington
1999-00	Jennifer Kolasa
1998-99	David Schmitz
1997-98	Doug Woodhams

M.S. students

2013-17	Sarah Wegener (now a biology teacher at J.E.B. Stuart High School, Falls Church, VA)
2003-05	Kosha Baxi Carstens (now Senior Sales Representative at Janssen Pharmaceuticals, Chicago IL)
2002-04	Tracy Duda Walker (now a Compliance Analyst in MSU's Human Research Protection Program)
2002-06	Amy Majchrzak Lark (now an Assistant Professor at Michigan Technical U)
1998-00	Edward Siuda (now a Research Scientist at Trevena, Chesterbrook, PA)

Ph.D. students

2018-pres	Samantha Westcott
2015-pres	Taylor Rupp
2012-2019	Patric Vaelli (now a research associate at Harvard University)

Postdoctoral researchers

2004-06	Gianluca Polese (now a faculty member at University of Naples Federico II, Naples, Italy)
2001-04	Daesik Park (now a faculty member at Kangwon National University, Chuncheon, South Korea)