

ELIZABETH S. HASWELL

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RESEARCH INTERESTS

I am interested in how molecules and cellular structures perceive force. Little is known about signaling in response to stimuli that are mechanical in nature, such as touch, osmotic pressure, or gravity—signals that are crucial for the normal growth and development of plants. My group is currently studying the structure, function, regulation, and evolution of a family of mechanosensitive ion channels related to the bacterial channel MscS, using live-imaging, single-channel patch clamp electrophysiology, and complementary biochemical and molecular genetic approaches. We are also engaged in functional and genetic screens designed to identify novel mechanosensory proteins, and in the development of new tools for the non-invasive analysis of membrane forces in plants and select pathogens. These studies promise novel insight into the strategies used by both prokaryotic and eukaryotic cells to sense mechanical stimuli.

APPOINTMENTS

Washington University in St. Louis

Assistant Professor, Department of Biology
Associate Professor, Department of Biology

2007-2014
2014-

EDUCATION

University of Washington, Seattle

B.S., Biochemistry, College Honors, *magna cum laude*

1989-1993

University of California-San Francisco

Ph.D., Biochemistry

1994-2000

California Institute of Technology

Postdoctoral Training

2000-2007

FELLOWSHIPS AND AWARDS

HHMI-Simons Faculty Scholar	2016
Visiting Professor, Sainsbury Lab, Cambridge University	2016
Visiting Fellow, Clare Hall, Cambridge, UK	2016
NSF Early Faculty Career Development Award	2013
Colvin Fund for Research Initiatives in Biomedical Sciences	2001
DOE Fellow of the Life Sciences Research Foundation	2000
UCSF Chancellor's Award for the Advancement of Women	1999
National Science Foundation Graduate Fellowship	1994
Merck Index Award for Excellence in Chemistry	1993
University of Washington Honors Scholarship	1990
National Merit Foundation Scholarship	1989
Seafirst Scholar Excellence Award	1989
University of Washington President's Scholarship	1989

PUBLICATIONS

Peer-Reviewed Journals

1. C. P. Lee, G. Maksaev, G. Jensen, M. Murcha, M. E. Wilson, M. Fricker, R. Hell, E. S. Haswell, A. H. Millar and L. Sweetlove. (2016). MSL1 is a mitochondrial mechanosensitive ion channel that dissipates membrane potential and maintains redox homeostasis in mitochondria during abiotic stress. *Plant Journal*, in press.
2. M. E. Wilson, Matt Mixdorf, R. H. Berg and E. S. Haswell. (2016). Plastid Osmotic Shock Influences Dedifferentiation at the Plant Shoot Apex. *Development*, in press.
3. D. R. Luesse, M. E. Wilson and E. S. Haswell. (2015). RNA-Sequencing Analysis of the *msl2msl3*, *crl*, and *ggps1* Mutants Indicates that Diverse Sources of Plastid Dysfunction do not Alter Leaf Morphology Through a Common Signaling Pathway. *Frontiers in Plant Science* 6:1148.
4. E. S. Hamilton², G. S. Jensen, G. Maksaev, A. Katims¹, A.M. Sherp² and E. S. Haswell. (2015). Mechanosensitive Ion Channel MSL8 Regulates Osmotic Forces During Pollen Hydration and Germination. *Science* 350:438-441.
5. S. M. Brady, M. Burow, W. Busch, O. Carlborg, K. J. Denby, J. Glazebrook, E. S. Hamilton², S. Harmer, E. S. Haswell, J. N. Maloof, D. Kliebenstein. (2015). Reassess the t-test: Interact With All Your Data Via ANOVA. *Plant Cell* 27:2088-94.
6. E. S. Haswell and P. E. Verslues. (2015). The Ongoing Search for the Molecular Basis of Plant Mechanosensing. *Journal of General Physiology* 145:398-394. Featured on the cover of the May 2015 issue.
7. E. S. Hamilton², A. Schlegel², and E. S. Haswell. (2015). United in Diversity: Plant Mechanosensitive Channels. *Annual Review of Plant Biology* 66:113-137.
8. K. M. Veley, G. Maksaev, S. M. Kloepper¹, E. M. Frick², E. January and E. S. Haswell. (2014). MSL10 has a Regulated Cell Death Signaling Activity that is Separable from its Mechanosensitive Ion Channel Activity. *Plant Cell* 26:3115-31.
9. S. Bell, J. Blumstein, K. Brose, A. Carroll, J. Chang, J. Charles, E. S. Haswell, M. Michelitsch, J. Owens, C. K. Patil, R. Smith, J. Tupy, E. Walsh, T. Ware. (2014). Defining Success in Graduate School. *Molecular Biology of the Cell* 25:1942-1944.
10. M. E. Wilson², M. R. Basu¹, G. B. Bhaskara, P. E. Verslues, and E. S. Haswell. (2014). Plastid Osmotic Stress Activates Cellular Osmotic Stress Responses. *Plant Physiology* 165:119-128.
11. M.E. Wilson², G. Maksaev, and E. S. Haswell. (2013). MscS-like Mechanosensitive Ion Channels in Plants and Microbes. *Biochemistry* 52 (34): 5708–5722.
12. G. E. Monschausen & E. S. Haswell. (2013). A Force of Nature: Molecular Mechanisms of Mechanoperception. *J. Experimental Botany* 64(15):4663-80.
13. G. Maksaev and E. S. Haswell. (2013). Recent Characterizations of MscS and its Homologs Provide Insights into the Basis of Ion Selectivity. *Channels* 7(3):215-220. Featured on the cover of the May/June 2013 issue.
14. G. Maksaev and E. S. Haswell. (2012). MscS-Like10 is a Stretch-Activated Ion Channel from *Arabidopsis thaliana* with a Preference for Anions. *Proceedings of the National Academy of Sciences* 109:19015-19020.
15. G. S. Jensen and E. S. Haswell. (2012). Functional Analysis of Conserved Motifs in the Mechanosensitive Channel Homolog MscS-Like2 from *Arabidopsis thaliana*, *PLOS ONE* 7(6):e40336.
16. K. M. Veley, S. Marshburn, C. Clure¹ and E. S. Haswell. (2012). Mechanosensitive Channels Protect Plastids from Hypoosmotic Shock During Normal Plant Growth. *Current Biology* 22:408-413.
17. K. M. Veley and E. S. Haswell. (2012). Plastids and Pathogens: Mechanosensitive Channels and Survival in a Hypoosmotic World. *Plant Signaling & Behavior* 7:668-671.
18. M. E. Wilson² and E. S. Haswell. (2012). A Role for Mechanosensitive Channels in Chloroplast and Bacterial Fission. *Plant Signaling & Behavior* 7:157-60.
19. G. Maksaev and E. S. Haswell. (2011). Expression and Characterization of the Bacterial Mechanosensitive Channel MscS in *Xenopus laevis* Oocytes. *J. General Physiology* 138: 641-9.

20. M. E. Wilson², G. S. Jensen, and E. S. Haswell. (2011). Two Mechanosensitive Channel Homologs Influence FtsZ Ring Placement in Arabidopsis. *Plant Cell* 23: 2939-2949. Featured on the cover of the May/June 2013 issue.
21. E. S. Haswell, R. Phillips, and D. R. Rees. (2011). Mechanosensitive Channels: What Do They Do and How Do They Do It? *Structure* 19: 1356-1369.
22. E. S. Haswell³, R. Peyronnet³, H. Barbier-Brygoo, E. M. Meyerowitz, and J-M. Frachisse. (2008). Two MscS Homologues Required for Mechanosensitive Channel Activities in the Arabidopsis Root. *Current Biology* 18: 730-734.
23. R. Peyronnet, E. S. Haswell, H. Barbier-Brygoo, and J-M. Frachisse. (2008). AtMSL9 and AtMSL10: Sensors of Plasma Membrane Tension in the Arabidopsis Root. *Plant Signaling & Behavior* 3: 726-729.
24. E. S. Haswell and E. M. Meyerowitz. (2006). MscS-like Proteins Control Plastid Size and Shape in *Arabidopsis thaliana*. *Current Biology* 16: 1-11. Dispatch: K. Pyke. (2006). Plastid Division: the Squeezing gets Tense. *Current Biology* 16: R60-2
25. E. S. Haswell. (2003). Gravity Perception: How Plants Stand up for Themselves. *Current Biology* 13: R761-R763
26. D. J. Steger, E. S. Haswell, A. L. Miller, S. R. Went, and E. K. O'Shea. (2003). Regulation of Chromatin Remodeling by Inositol Polyphosphates. *Science* 5603: 114-116.
27. E. S. Haswell and E. K. O'Shea. (1999). An In Vitro System Recapitulates Chromatin Remodeling at the PHO5 Promoter. *Molecular and Cellular Biology* 19: 2817-2827.
28. E. S. Haswell and E. K. O'Shea. (1998). Specificity of ATP-Dependent Chromatin Remodeling at the Yeast PHO5 Promoter. *Cold Spring Harbor Symposium on Quantitative Biology* 63: 563-567.

Book Chapters

1. G. Maksaev and E. S. Haswell. (2015). Expression and Characterization of Mechanosensitive Ion Channels in *Xenopus* Oocytes. *Plant Gravitropism: Methods and Protocols*. 1309:151-69.
2. E. S. Haswell (2007). MscS-like Proteins in Plants. *Current Topics in Membranes* 58: 329-359.

¹Undergraduate Author, ²PhD student Author, ³Equal Contribution

VIDEOS, SOCIAL MEDIA, and SCIENCE COMMUNICATION

Lab website: <http://pages.wustl.edu/haswell>

Haswell Lab Blog, A Force of Nature: <http://pages.wustl.edu/haswell/blog>

Haswell Lab YouTube Channel: https://www.youtube.com/channel/UCSfXeijJESvUq0Dzve0R_Sg

Twitter handle: [@ehaswell](https://twitter.com/ehaswell)

PROFILES in the POPULAR PRESS

"Researchers identify proteins making up mechanosensitive ion channels," Julia Strait. WUSTL Record, June 3, 2008

"Plants feel the force," Diana Lutz. WUSTL Record, October 21, 2011

"Como hacen las plantas para "sentir," Alejandra Martin. BBC Mundo, October 31, 2011

"Leaf Me Alone! Plants Are More Sensitive Than We Realize," Jeannette Cooperman. STL Magazine, April, 2012.

"Mechanically gated channels play a role in plant sex," Alexandra Taylor. Wild Types, a blog for ASBMB Today, October 22, 2015

"Question together: What are you Curious About?" A promotional video for Merck KGaA featuring commentary by Liz Haswell. October 27, 2016

"Scientists discover ancient safety valve linking pollen to bacteria" Eric Hamilton and Diana Lutz. WUSTL Record, October 28, 2015

"Sharing Science: Mechanosensitive Channel MSL8 Regulates Osmotic Forces During Pollen Hydration and Germination" Stacey Kelley and Reyda González-Nieves, NSF MCB Blog, Dec 18, 2015

"Hydropowered Pollen" by Karen Zusi, Editor's Choice, The Scientist, February 1, 2016

"I'm Plant Scientist Elizabeth Haswell and This is How I Work, by Ian Street, ASPB Blog, March 14, 2016

RECENT (LAST 5 YEARS) INVITED TALKS

Scientific Meetings

1. Southern Section ASPB Keynote Address, Myrtle Beach, SC (March 2012)
2. Interdisciplinary Plant Biology Symposium, U of Missouri (May 2012)
3. Donald Danforth Annual Retreat Keynote Speaker (May 2012)
4. Woods Hole Physiology Course, Marine Biological Labs (June 2014)
5. Gordon Conference on Mitochondria and Chloroplasts, Smithfield, RI (July 2012)
6. Plant Biomechanics Conference, Auvergne, France (August 2012)
7. ASPB "Mechanosensation" Minisymposium, Providence, RI (July 2013)
8. Midwest Society for Developmental Biology, St. Louis, MO (September 2013)
9. American Society for Space and Gravitational Research Meeting, Orlando FL (Nov 2013)
10. Midstates Consortium for Math and Science Meeting Keynote Speaker, St. Louis, MO (Nov 2013)
11. Biophysical Society Annual Meeting, San Francisco, CA (Feb 2014)
12. Northwest Regional Developmental Biology Meeting, Friday Harbor, WA (March 2014)
13. Pollen Research Coordination Network Meeting, Charlotte, NC (May 2014)
14. Plant Protein Phosphorylation Symposium, Columbia, MO (May 2014)
15. Physiology Course, Marine Biological Labs, Woods Hole, MA (June 2014)
16. International Congress of Arabidopsis Research, Vancouver, BC (July 2014)
17. Gordon and Betty Moore Imaging Conference, Sausalito, CA (Dec 2014)
18. Janelia Conference on Force-Gated Ion Channels, Ashburn, VA (March, 2015)
19. Gordon Research Conference on Organellar Channels & Transporters, Waltham, MA (June 2015)
20. Woods Hole Physiology Course, Marine Biological Labs (July 2015)
21. ASCB, Lightning Talk in Motility and Cytoskeleton of Microbes Minisymposium (Dec 2015)
22. NorPlant Biology 2016, Trondheim, Norway (June 2016)
23. ASPB "Reproductive Biology" Minisymposium, Austin, TX (July 2016)
24. HHMI Faculty Scholars Meeting, Chevy Chase, MD (Nov 2016)

Department Seminars

1. Department of Plant Biology/PRL, Michigan State University (January 2011)
2. Department of Biochemistry, University of Kansas (April 2011)
3. Department of Microbiology, WUSTL School of Medicine, St. Louis, MO (Sept 2011)
4. Plant Molecular and Cell Biology, University of Florida, FL (February 2012)
5. Vanzant Biochemistry and Cell Biology Seminar Series, Rice University, TX (May 2012)
6. CBMG Program, University of Maryland, College Park, MD (Oct 2013)
7. Department of Biology, Indiana University, Bloomington, IN (Dec 2013)
8. Carnegie Institution for Science, Palo Alto, CA (April 2104)
9. Basic Sciences Division, Fred Hutchinson Cancer Research Center, Seattle, WA (June 2014)
10. Department of Biology, Penn State University, State College, PA (Oct 2014)
11. Department of Biology, MCSB Program, University of Massachusetts, Amherst, MA (Nov 2014)
12. Department of Biology, University of Washington (Jan 2015)
13. Molecular Biology Institute, UCLA (Feb 2015)
14. Plant Molecular and Physiological Biology Seminar Series, University of Illinois Champaign-Urbana (April 2015)
15. Section of Plant Biology, Cornell University (May 2015)
16. Biotechnology/Life Sciences Seminar Series, University of Nebraska, Lincoln, NE (Nov 2015)
17. University of Adelaide, Plant Research Lab, Australia (Feb 2016)
18. University of Western Australia, Plant Energy Biology Centre, Perth, Australia (Feb 2016)
19. Sainsbury Labs, Cambridge University, Cambridge, England (May, 2016)
20. Department Plant Sciences, Oxford University, Oxford, England (June 2016)
21. Donald Danforth Plant Sciences, Saint Louis, MO (August 2016)

CURRENT RESEARCH SUPPORT

NSF Workshop. “Finding your Inner Modeler—How Computational Biology can Advance your Research and How to get Started”

David Stone (UI Chicago), PI. Mentewab Ayalew, Suzanne Barbour, Elizabeth Haswell, Hong Qin, Elizabeth Sztul coPIs

July 2017-19

HHMI Faculty Scholar Grant. “Opening Ancient Doors: Mechanotransduction and Bioelectricity in Plants”

Elizabeth Haswell, PI

November 2016-2021

NSF MCB-1253103. “CAREER: The Function, Regulation, and Molecular Identity of Mechanosensitive Channels in *Arabidopsis thaliana*.”

Elizabeth Haswell, PI.

Jan 2013-Dec 2017

Gordon and Betty Moore Foundation. “Membrane Forces in Bacteria and Plants: from Basic Biophysics to Designer Organisms.”

Adam Cohen (Harvard), PI and Elizabeth Haswell, co-PI.

July 2013-June 2016

NASA NNX13AM55G. “Mechanosensitive Channels in Plants: Genetic, Computational, and Systems-Levels Approaches to Understanding their Proposed Role in Gravity Perception.”

Elizabeth Haswell, PI, Edgar Spalding (U. Wisconsin, Madison) co-PI.

NIH 2R01GM084211-5A1. “Biophysical, Structural, and Functional Analysis of Mechanosensitive Channels.”

Doug Rees (Caltech), PI; Rob Phillips (Caltech), and Elizabeth Haswell, co-PIs.

Sept 2013-Aug 2017

COURSES TAUGHT

2008-2009

Bio4028 Seed to Senescence: The Genetics, Cell Biology, and Development of Plants

Bio572 Plant Biology Journal Club

2009-2010

Bio4028 Seed to Senescence: The Genetics, Cell Biology, and Development of Plants

2010-2011

Bio4028 Seed to Senescence: The Genetics, Cell Biology, and Development of Plants

Bio572 Plant Biology Journal Club

2011-2012

Bio493 Original Biological Research and Methods

Bio3041 Plant Biology and Genetic Engineering

2012-2013

Bio4028 Seed to Senescence: The Genetics, Cell Biology, and Development of Plants

Bio3041 Plant Biology and Genetic Engineering

2013-2014

Bio3041 Plant Biology and Genetic Engineering

Bio4025 Current Approaches in Plant and Microbial Research

2014-2015

Bio3041 Plant Biology and Genetic Engineering

Guest Lecturer/Project Leader

SP2008, SP12, SP13 Bio572 Plant Biology Journal Club

SP2008, SP09, SP11 Bio5491 Advanced Genetics
FL2011 Be262 Physical and Synthetic Biology Bootcamp (at Caltech)
Summer 2014, 2015 MBL Physiology Course, Woods Hole
FL2014 Bio1810 Freshman Seminar in Imaging Sciences

TRAINING

Postdoctoral Scientists

Dr. Eric Schwartz (2016-present) • Dr. Yanbing Wang (2016-present) • Dr. Ivan Radin (2016-present) • Dr. Debarati Basu (2015-present) • Dr. Grigory Makshev (2010-present) • Dr. Wendy Huang-Verslues (2014-2015) • Dr. Maggie Wilson (2014-2016) • Dr. Kira Veley (2010-2015) • Dr. Ellen Martin-Tryon (2008-2009)

Graduate Students

Angela Schlegel, *Plant Biology* (2014-present) • Eric Hamilton, *Plant Biology* (2013-present) • Margaret Wilson, *Plant Biology* (2009-2013) • Silvano Ciani, *Plant Biology* (2008-2011, Masters)

Rotation Students: Elizabeth Frick, *Plant Biology* (Spring 2013) • Ashley Muehler, *Plant Biology* (Spring 2012) • Jeremy King, *Cell Biology* (Summer 2009) • Brian San Francisco, *Plant Biology* (Fall 2008) • Scott Higdon, *Developmental Biology* (Summer 2008) • Caitlin Ramsey, *Plant Biology* (Spring 2008) • Rachel Schwowe, *Molecular Genetics and Genomics* (Spring 2008)

Technicians and Salaried Employees

Ryan Richardson (2015-present) • Matthew Mixdorf (2014-present) • Emma January (2013-2015) • Gregory Jensen (2007-2010, 2012-2015) • Kelsey Kropp (2013-2014) • Katherine Shortt (2011-2012) • Sarah Marshburn (2011) • Anupama Vijayaraghavan (2009-2010) • Madalyn Fleisler (2007-2008)

Undergraduates

Research: Liam Joyce (Summer 2016) • Josephine Lee (SP14-FL15) • Sarah Kloepper (SP13-14) • Meera Basu (Summer 2012, FL12-SP14) • Hyunu Ray Kim (SP12-Summer 2012) • Andrew Katims (FL11-Summer 2012) • Cara Clure (FL07-SP10) • Kelly Meuthing, Summer Scholar (2010) • Dylan Cockson (FL09) • Vivien Goh, Summer Scholar (2009)

Lab Assistants: Rachel Eddy (FL15-SP16) • Samantha Embrick (FL13-SP15) • Brandon Eng (SP13) • Paul Micevych (FL12) • Meghan Lam (SP12) • David Xiong (FL10) • Michael Benefiel (FL08-SP11) • Chan Lee (SP08)

Visiting Scientists

Paul Verslues, Freiburg Professor (Fall 2014/Spring 2015) • Darron Luesse, Sabbatical (Summer/Fall 2014) • Kevin Hall, St. Louis high school teacher (Summer 2010) • Stephanie Johnson, Ph.D. candidate at California Institute of Technology (SP08)