Inga A. Johnson

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(2019-2024, in blue)

Education

Ph.D. **University of Oregon, Eugene.** Ph.D. in Mathematics, June, 2001. Dissertation "The Effect of Multiplication by 2^k on the Root Invariant."

M.S. **University of Oregon, Eugene.** Mathematics, June, 1997.

B.A. **Richard Stockton College of New Jersey, Pomona, New Jersey.** Mathematics, June, 1995.

Academic Positions

Willamette University, Professor Fall 2015 – present.
Willamette University, Associate Professor. Fall 2009 – Spring 2015.
Willamette University, Assistant Professor. Fall 2004 – Spring 2009.
University of Rochester, Visiting Assistant Professor. Fall 2001 – Spring 2004.
University of Oregon, Graduate Teaching Fellow. Fall, 1995 – Spring, 2001.

Research Interests

Knot theory: knot games, pseudo knots, virtual knots. Algebraic and Applied Topology: persistence homology and applications.

Book

I. Johnson, A. Henrich. An Interactive Introduction to Knot Theory, Dover (2017).

Book Chapters & Reviews

[1] I. Johnson, E. McNicholas. Group Examinations in Introduction-to-Proof Courses. Beyond Lecture: Techniques to Improve Student Proof-Writing Across the Curriculum, MAA Notes Series (2015).

[2] I. Johnson, Pseudoknots and Singular Knots. Encyclopedia of Knot Theory, Adams, C. et al Encyclopedia of Knot Theory. First ed. Boca Raton: Chapman & Hall, CRC, 2021.

[3] I. Johnson, Gauss Diagrams. Encyclopedia of Knot Theory, Adams, C et al. First ed. Boca Raton: Chapman & Hall, CRC, 2021.

- Book Review for the MAA: *Knots, Links and Their Invariants: An Elementary Course in Contemporary Knot Theory*, by A. B. Sossinsky. (accepted: soon to appear)

Publications

- I. Johnson, É. Roldán Roa. Solution Numbers to Eight Blocks to Madness Puzzle. (preprint on Arxiv)

[9] A. Henrich, I. Johnson, J. Ostroff. The Region Smoothing Swap Game. Osaka Journal of Mathematics Vol. 58, (1) (2021), 171-187.

[8] C. Cericola, I. Johnson, J. Kiers, M. Krock, J. Purdy, J. Torrence. Extending Hypothesis Testing with Persistence Homology to Three or More Groups. *Involve* 11 (1), 27-51, (2018).

[7] A. Henrich, S. Jablan, I. Johnson. The signed weighted resolution set is not a complete pseudoknot invariant. *Journal of Knot Theory and Its Ramifications* 25 (09) 1641007 (2016).

[6] F. Dorais, A. Henrich, S. Jablan, I. Johnson. Isotopy and Homotopy Invariants of Classical and Virtual Pseudoknots. *Osaka Journal of Mathematics* 52 (2), 409-423 (2015).

[5] A. Henrich, I. Johnson. The Link Smoothing Game, *AKCE Int. J. Graphs Comb.*, 9, No. 2 (2012), pp. 145-159.

[4] I. Johnson, S. Powers, C. Starr, C. Trevelyan, C. Webster. Characterizing an infinite family of Frobenius semigroups by filtration. *Journal of Integer Sequences*, vol. **12** (1), 2009, Article 09.1.2.

[3] I. Johnson, J. L. Merzel. A class of left ideals of the Steenrod algebra. *Homology, Homotopy and Applications*, vol. **9** (1), 2007, pp.185–191.

[2] F. R. Cohen, I. Johnson. On the degree two map of a sphere. *Recent Developments in Algebraic Topology*. 83–99 Contemp. Math., **407**, Amer. Math. Soc., Providence, RI, 2006.

[1] I. Johnson. The effect of multiplication by 2^k on the root invariant. *Topology and Its Applications*, **141** (2004) 21–57.

- I. Johnson, É. Roldán Roa. Solution Numbers for Eight Blocks to Madness Puzzle with 5-colored cubes. (in preparation)
- I. Johnson, É. Roldán Roa. More Solution Numbers for 3- &4-color Eight Blocks to Madness Puzzle. (in preparation)

Grants & Awards

2024 Summer, Learning Circle Data ethics with Hank Ibser. $1000.

2023 Summer, Learning Circle Internal Retention Assessment for CS, DS and Math with Kristen Gore. $1000.

2019, Spring Teaching Triangle. With K. Nyman and Y. Liang $300.

2013, Finalist for Pacific Northwest MAA Distinguished Teaching Award. Nominated by Willamette colleagues and students.

2013, June, R. L. Moore Conference Travel Award. Award $440.

2012 United Methodist Award for Exemplary Teaching and Service. Award $1200.

2012 Willamette Valley Mathematics Research Consortium for Undergraduates and Teachers, REU-RET site grant renewal with Co-PI Colin Starr. Award $ 514,268.

2011-2013 Keck iScience Grant Participant. Award $1500.

2011 Academy for Inquiry-Based Learning Grant. Award $3500.

2011 Atkinson Faculty Development Award. Award $1200.

2011 Hewlett Grant Co-recipient. Award $3,000 for *Examining 100-Level Mathematics Course Offerings: Incorporating High Impact Pedagogy and Experiential Learning.*

2010 Willamette Valley Mathematics Research Consortium for Undergraduates and Teachers, NSF REU-RET site grant with Co-PI Colin Starr. Recommended for funding February 2011, but grant not awarded due to delayed National Science Foundation budgetary decisions by United States Congress.

2008-2009 Diversity Grant: Women in Math, Physics, and Computer Science

2007 Willamette Valley Consortium for Undergraduate Mathematics Research, NSF REU-RET site grant with Co-PI Colin Starr. Award $491,400.

2006 Hewlett Grant Recipient. Bridge Funding for the Summer Mathematics Undergraduate Research Program.

2007 Willamette University Junior Faculty Leave. Award one semester release from teaching.

2005 Willamette University Merit Award.

2002 National Project NExT Fellow. American Mathematics Society sponsored National NExT Fellow.

2001 University of Oregon Harrison Award Recipient. Awarded for outstanding potential in research.

Undergraduate Research & Scholarship Projects

Senior Seminar, Theses Advised 2022-2023:

- August Bergquist, 'The Power of Homology.'
- Tyler Przybylski, 'The Power of Homology.'
- River Bell, 'Stability and Persistence Modules.'
- Charlie Neufeldt, 'Model Comparison using Persistent Homology.'

Junior Seminar Mentor, Spring 2022. Charlie Neufeldt, Seth Bell, Tyler Przybylski an Introduction to Topological Data Analysis.

Mentor to four College Colloquium Students for SSRD 2010 Presentation. I mentored four freshman, Richard Leibing, Candace Hamar, Victoria Smith & Heidi Wolfe, on the presentation of their game *Root-a-bega: An Introduction to Combinatorial Game Theory* that they developed and analyzed as part of my College Colloquium class on games.

Willamette Valley Consortium for Undergraduate Mathematics Research, NSF funded REU-RET site grant. Willamette University 2007 & 2009 & 2014.

- In 2007, I worked with Professor Colin Starr, 3 undergraduates (Jette Petersen, Meghan Flink, and Phan Le), and one teacher (Greg Houser) on an 8-week research project in Number Theory.
- In 2009, I worked with Professor Erin McNicholas, 4 undergraduates (Leo Maloney, Tom Brounstein, Robert Zyskowski, and Aaron Mosher) and a teacher (Cary Takara) on a 8-week research project in Graph Theory.
- In 2014, I worked with Professor Jordan Purdy and 4 undergraduates (Johanna Torrence, Mitchell Krock, Joshua Kiers, and Christopher Cericola) on a 8-week applied mathematics research project on Topological and Statistical Data Analysis.

Summer Mathematics Undergraduate Research Program. Willamette University 2005 & 2006.

- with Professor Colin Starr. Mentored Charles Trevelyan, Sean Powers, Craig Webster, in 2005 for a six week research project on Frobenius semigroups.
- with Professor Colin Starr. Mentored Paige Cudworth, Travis Dailey, Brad Kehr, in 2006 on a six-week research project on Frobenius Semigroups.

Teaching Interests

Pedagogy: Inquiry-Based Course Design & the Moore method, collaborative teaching, collaborative and student-centered learning techniques such as using Group Examinations, flipped classrooms.

EDI Activities & Workshops

Data Ethics Learning Circle. Willamette, Summer 2024

JED Campus Faculty Workshop. Willamette, June 2022

TLC: PDE Workshop with Dr. Osei-Kofi. Willamette, June 2022

The Grading Conference. Online June 2021

TLC: Accessible Documents. Willamette, May 2021

Math Department Reading Group. Asked and Answered: Dialogues On Advocating For Students of Color in Mathematics

TLC: Diversifying the Curriculum. Willamette, March 2021

Introduction to Online Inquiry-Based Learning. Online Workshop, July 2020

Experiences of Black Stem in the Ivory: A Call to Disruptive Action. Online Workshop, July 2020

TLC Workshop: Trauma Informed Teaching. Willamette, December 2020

AMS Advocating for Students of Color: There's More You Can Do Virtual professional development webinar promoting EDI in mathematical sciences. Nov & Dec 2020

Courses Taught

Senior Research Seminar I Theses Advised: Charlie Neufeldt, River Bell, Tyler Przybylski, August Bergquist

Senior Research Seminar I Topological Data Analysis research and thesis planning (C. Neufeldt, S. Bell, T. Przybylski, A. Bergquist)

Junior Research Seminar Introduction to Topological Data Analysis. (C. Neufeldt, S. Bell, T. Przybylski)

Statistics with Applications. ISI simulations-based curriculum by Tintle et al., with self-authored theory-based Labs in R.

Calculus with Precalculus. Flipped calculus class for students without prior calculus course work.

Senior Seminar on Cryptology. Inquiry-based cryptology course with individual projects.

The Mathematics of Secret Codes. Inquiry-based advanced cryptology course with Python programming.

Senior Seminar on Knot Theory. Students completed, presented, and LaTeX'ed all proofs and exercises in an inquiry-based knot theory textbook.

Topology. Inquiry-based course on compactness, classification of surfaces, Euler characteristic, map coloring, the five-color theorem for S^2, the fundamental group, and Seifert-van Kampen Theorem.

Real Analysis I & II. Sequences & series, limits, continuous functions, completeness, compactness, connectedness, differentiation, Riemann integral, uniform convergence, power series, Newton's method, the implicit function theorem, spaces of continuous functions, measure theory.

Foundations of Advanced Mathematics. A course on set theory, functions, equivalence relations, and cardinality with main focus on proof reading and writing.

Linear Algebra. A course in linear algebra emphasizing the connections between matrix algebra, linear systems, and linear transformations with emphasis on theory through proofs reading and writing.

Accelerated Calculus II. Integral calculus, taught as a half semester course.

Sequences and Series. Taylor Series, Fourier Series and applications, taught as a half semester course.

Modeling with Calculus. Modeling and application based modeling course. Topics include Fermi problems, applications of the Buckingham Pi theorem, linear algebra applications to find curves of best fit, and the differential and integral applications of calculus.

College Colloquium: What's in a Game? The Mathematics of Games and Puzzles. A discussion and inquiry-based course with emphasis on writing and problem solving.

College Colloquium: Math in America. An analysis of the history and controversies of current mathematics education with emphasis on writing and critical thinking.

Discrete Math. Logic, proof techniques, elementary number theory, algorithms, and recursion.

Contemporary Mathematics. A survey of mathematical topics for liberal arts students. Sections of the course on cryptology and knot theory.

Chaos and Fractals. A discovery of chaos theory and fractals through theory, WinFract, and Mathematica.

Multivariable Calculus and Quest Calculus. Quest Calculus includes proofs and more challenging Calculus problems. Taught from both the Harvard calculus reform textbook and from Stewart.

Calculus for Biology I, II, & Business Calculus I, II. Differential and integral calculus taught from a modeling viewpoint and an economics/finance viewpoint respectively.

Elementary Functions. A pre-calculus class with emphasis on trigonometric functions.

College Algebra. An algebra course in preparation for calculus.

Pre-College Education Development

2002-2004 Mathematician and Teacher in Participation with Warner School NSF Grant to Deepen Content Knowledge of K-12 math teachers. I have developed and taught courses for K-12 teachers to deepen their content knowledge in mathematics. University of Rochester.

Academic Services

Associate Editor Math Magazine, 2024-
Faculty Pool for University Relationships, 2022-2023
Mathematics Department Chair, Spring 2020 - Spring 2023
Math Department Commencement Speaker, May 2021. Small departmental gathering due to Covid
Math Department Representative for Admissions Bearcat Day Events and Phone calls. 2021-2023
Computer Science Hiring Committee Member January 2021
Calculus Placement Advising. August 2020, August 2021, August 2022
Lab Taskforce Committee. Spring 2020. Work delayed due to pandemic.
Faculty Admissions Committee, 2018-2019.
General Education Proposal Writing Group Explore, Engage, Empower and Quest. Spring-Fall 2018.
Governance Council Member. Willamette University, 2017-2018.
Asian Studies Thesis Advisor. Second reader for Taylor Matsumura, 2017.
STEM Grants Group Member. Grant planning and strategy, 2016-2017.
Budget Advisory Committee Member. Willamette University, 2014-2016.
Department of Mathematics Hiring Committee. 2015-2016, search for Statistician cancelled Aug 2016.
Faculty Council Member. Willamette University, 2012-2014.
VP Admission and Communications Search Committee Member. Fall 2012-Spring 2013.
Math Department Visiting Instructor Search Committee Member. Spring 2013.
Pi Day Convocation Speaker. March 14, 2013.
NW5C Workshop Attendee. Skamania Lodge, Fall 2012.
Budget Advisory Committee Member. Willamette University 2010-2011.
Math Department Webwork Administrator. Willamette University 2009-present. Manage and create Webwork course sites for faculty at Willamette and Linfield College.
Presenter in Expanding Your Horizons. A career exploration day for middle school girls. Willamette University, January 2011.
Faculty Resource Committee Chair. Willamette University 2008-2009 & 2009-2010.
Organized Math Department Thursday lunch talks. Seminar for Math Faculty. Each week talks alternated between research presentations and pedagogy discussions. Co-organized with C. Giusti and N. Seaders 2010-2011 & 2011-2012.
Director of Residence Life Search Committee, Faculty Representative. Willamette University 2009-2010.
Department of Mathematics Hiring Committee Member. Willamette University 2005-2006 & 2006-2007 & 2008-2009 & 2009-2010.
Faculty Resources Committee Member. Willamette University 2007-2008.
Math Department Colloquium Organizer. Willamette University, Spring 2009.
Ford Hall Art Committee. Willamette University 2008-2009.
Willamette Committee for Undergraduate Grants and Awards. Willamette University 2005-2007.
Department of Computer Science Hiring Committee Member. Willamette University 2008-2009.
Assistant for Webwork Mini-course at MAA-AMS Joint Meetings. January, 2003.

Talks & Presentations

Games with Knots: Oregon State University, Knot Theory Class. June 2024.

Games with Knots: Max Plank Institute for Mathematics in the Sciences. Outreach talk to students. May 2024.

Solution Numbers for the Eight Blocks to Madness Puzzle: Max Plank Institute for Mathematics in the Sciences. May 2024.

Topological Data Analysis: Hypothesis Testing with Persistence Homology. Jim Albaugh Math Colloquium, March 2024.

Topological Data Analysis: An Introduction to the Mapper Algorithm. Jim Albaugh Math Colloquium, March 2021.

The Region Smoothing Swap Game. The UnKnot Conference, Invited Speaker. July 2019.

An Interactive Introduction to Knot Theory. Willamette University Faculty Colloquium. February 2017.

An Introduction to Topological Data Analysis. Liberal Arts Mathematics Colloquium, Invited Speaker. October 2016.

Another Knotty Game: The Link Smoothing Game. The UnKnot Conference, Invited Speaker. July 2016.

An Assortment of Knot Games. MathIly Daily Gatherings, Willamette University. July 2016.

Topology and Data Oregon State University, REU Colloquium. July 2015.

Topology, Homology & Data. Willamette Faculty Colloquium Series, Spring 2013.

Topology, Homology & Data. Invited Keynote Address at the Northwest Undergraduate Mathematics Symposium, Pacific Lutheran College, Spring 2013.

The Link Smoothing Game. Pacific Northwest Mathematical Association of America Sectional Meeting, Willamette University, Spring 2013.

The Link Smoothing Game. University of Portland Mathematics Colloquium, April 2012.

The Link Smoothing Game. Willamette University Mathematics Colloquium, September 2011.

The Magic Number that Lives on the Surface of a Doughnut. Presentations in Expanding Your Horizons, January 2011, a career exploration day for middle school girls.

Conway's Classification of Rational Tangles. Invited Speaker, Pacific Lutheran University. April 2008.

Planting Trees. Willamette University Mathematics Colloquium. September 2007.

An Introduction to Homotopy Theory. Mathematics Colloquium, Willamette University. May 2007.

Conway's Classification of Rational Tangles. Invited Speaker, University of Rochester Society of Undergraduate Math Students. February 2007.

The Nature of Mathematical Research. Joint presentation with Colin Starr. Willamette Faculty Colloquium, October 2006.

The degree 2 map for a sphere. Poster presentation. MAA-AMS Joint Meeting Conference. San Antonio, TX. January 2006.

On the degree 2 map for a sphere. University of Oregon Topology Seminar. Winter 2006.

Group exams in calculus. Pacific Northwest MAA Conference. University of Puget Sound, Tacoma, Washington. Spring 2005.

Homotopy theory and the degree 2 map on the sphere. Pacific Northwest MAA Conference. University of Puget Sound, Tacoma, Washington. Spring 2005.

An introduction to WeBWorK. Pacific Lutheran University. June 2004.

Multiplication by 2 and the H-space squaring map on $\Omega^k S^{n+k}$. AMS-MAA Joint Meeting Conference. Phoenix, Arizona, January 2004.

Loops on the degree 2 map of an odd sphere. Cornell University Topology Seminar, invited speaker, November, 2003.

On the degree 2 map for a sphere. University of Chicago Topology Seminar, invited speaker, November, 2003.

On the degree 2 map for a sphere. SUNY Binghamton AMS sectional meeting. Invited speaker in special session honoring Peter Hilton's 80th birthday, October, 2003.

Loops on the degree 2 map and the H-space squaring map on ΩS^{2n+1}. University of Rochester Topology Seminar, October, 2003.

Factorizations of Powers of 2 on Stunted Projective Spaces and the Root Invariant. Massachusetts Institute of Technology Topology Seminar, invited speaker, November, 2002.

Stunted Projective Spaces and the Root Invariant. Topology Seminar at the University of Rochester, Fall 2001.

Conferences & Workshops Attended

MAA MathFest Indianapolis, IN. August 2024.

Critical Issues in Mathematics Education (CIME) at MSRI. Initiating, Sustaining, and Researching Mathematics Department Transformation of Introductory Courses for STEM Majors, March 2022.

eCOTS: Teaching Statistics Conference. Teaching the modern student. May 2022.

Advising Workshop Willamette University, August 2020, August 2021.

An Introduction to (Online) Inquiry-Based Learning Online workshop. July 2020.

The RSA Conference Asia Pacific & Japan. Online, July 2020.

Mastery Grading Conference Online, June 2020.

Workshop on Topological Data Analysis & Clay Lectures Online, June 2020.

Department Chair Forum Online with Transforming Post-Secondary Education in Math. (TPSE) May 2020.

The UnKnot Conference University of Washington, Bothell, July 2019.

The Academy of Inquiry Based Learning, Portland, OR, June 25-28, 2019.

Liberal Arts Mathematics Colloquium October 2016.

PNW MAA Conference and Project NExT Meeting April 2016.

The UnKnot Conference Denison University, July 2016.

Training Workshop for Diversity Advisors, Willamette University, May 2015

Faculty Development for 21st Century Diversity, May 2015

MAA Mathfest Washington D.C., Aug 2015

MAA MathFest Portland, OR, August 2014. Advisor to four student presenters.

PIMS: Applied Topology - Methods, Computation and Science 6 May 2014 University of British Columbia, Vancouver, BC.

AMS Western Sectional Meeting Riverside, CA, November 2013.

R. L. Moore Legacy Conference Austin, TX, June 2013.

MAA Sectional Meeting, University of California Riverside November 2013.

NUMS Conference Pacific Lutheran University, April 2013.

MAA PNW Sectional Meeting Willamette University, April 2013.

Cascade Topology Seminar. May 2013 at Portland State University, Portland, Oregon. November 2000 at The University of Oregon, Eugene, Oregon, **Invited Speaker**. May 2000 at Portland State University, Portland, Oregon. October 1999 at The University of British Columbia, Vancouver, British Columbia. May 1999 at The University of Puget Sound, Tacoma, Washington. November 1998 at Boise State University, Boise, Idaho.

NITLE Seminar Teaching to Fail, by Ed Burger. Nov 2012.

AAC&U Institute on High Impact Practices and Student Success June 2012.

MAA-AMS Joint Meetings Conference. Boston, January 2012.

Teaching Modeling Based Calculus Workshop Boston, January 2012.

Mathematics Research Communities Program on Computational and Applied Topology. Snowbird Resort, Utah, June 2011.

Workshop on Inquiry Based Learning. University of Michigan, Ann Arbor, May 2011.

Pacific Northwest MAA Sectional Meeting. Seattle University, April 2010. I co-organized a panel on outreach to local schools and the community.

The UnKnot Conference. Denison University, July 2009.

MAA Mathfest Portland, OR, August 2009. Conference participant and mentor to four undergraduate and one high-school teacher attendee.

MAA-AMS Joint Meetings Conference. Washington D.C., January 2009.

College Colloquium Workshop on Teaching Writing, by Greg Coloumb. Willamette University, May 2009.

MAA Pacific Northwest Sectional Meeting. Linfield College, McMinnville, Oregon. April 2007.

Project NExT Pacific Northwest Sectional Meeting. Linfield College, McMinnville, Oregon. April 2007.

Learning Spaces and Technology Workshop, CIC & NITLE. University of Puget Sound, Tacoma, Washington. March 2007. Attended at the request of Dean Carol Long.

Complex Cobordism and Homotopy Theory: its impacts and prospects. Johns Hopkins University, Baltimore, Maryland. March 2007.

MAA-AMS Joint Meetings Conference. New Orleans, Louisiana. January 2007. San Antonio, Texas. January 2006.

MAA Pacific Northwest Sectional Meeting. University of Puget Sound, Tacoma, Washington. Spring 2005. Invited speaker.

AMS Eastern Sectional Meeting. Invited speaker in special session honoring Peter Hilton's 80th birthday. Binghamton, New York, October 11-12, 2003.

Fields Institute Program on Homotopy Theory and its Applications. University of Western Ontario, London, Ontario September, 2003.

Topology Conference in Honor of John Moore's 80th Birthday. University of Rochester, Rochester, New York, May, 2003.

MAA-AMS Joint Meetings Conference. Phoenix, Arizona, January 2004. Baltimore, Maryland, January 2003. New Orleans, Louisiana, January 2001.

MAA Seaway Sectional meeting. Brock University, St. Catharines, Ontario, Canada, Fall 2001. SUNY Brockport, Brockport, New York, Spring 2002. Rochester Institute of Technology, Rochester, New York, Fall 2003. I attended these conferences with undergraduates from the University of Rochester.

Northwestern University International Conference on Algebraic Topology. March 24-28, 2002.

MAA Mathfest. Burlington, Vermont, July 2002. Boulder, Colorado, July 2003.

Homotopie stable, nilpotence et périodicité. Une introduction (sous la direction scientifique de M. J. Hopkins). An introduction to stable homotopy, nilpotence and periodicity. A five day workshop/conference under the direction of Mike Hopkins. CIRM, Luminy, France, January, 2001.