

## Nathan Thomas Moore

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### Education

Ph.D. Physics, University of Minnesota 2006.  
PhD Thesis: “Knot Entropy,” thesis advisor A.Y. Grosberg.  
B.S. Applied Physics, Grove City College 2000

### Timeline

Professor of Physics	2015-present
Physics Chairperson	2012-13, 2019-2022
Associate Professor of Physics	2010-2015
Assistant Professor of Physics	2005-2010
Winona State University	Winona, Minnesota
Blue Gene Science Application Analysis	2005
IBM	Rochester, Minnesota
Research and Teaching Assistant	2000-2005
Physics Department and Army HPCRC	University of Minnesota, Minneapolis

### Teaching

Physics 115	Conceptual Physics
Physics 141	Physics for Future Presidents
Physics 150	Engineering for the Modern World
Physics 180	Investigative Science (aka Science Education 201)
Physics 201-2	Algebra-based Introductory Physics with labs
Physics 221-2	Calculus-based Introductory Physics with labs
Physics 320	Computational Physics
Physics 321	Computerized Data Acquisition and Analysis
Physics 330	Electronics with labs
Physics 332	Computer Organization (Digital Circuits) with labs
Physics 333	Microprocessor Electronics with labs
Physics 340	Modern Physics
Physics 345	Thermodynamics and Statistical Mechanics
Physics 350	Classical Mechanics
Physics 370	Optics
Physics 451	Quantum Mechanics

### Publications

“Don’t throw that video away! Reference Frames can fix Video Analysis with a Moving Camera,” Nathan T. Moore. Submitted.  
<https://arxiv.org/abs/2301.00013>

“Inexpensive Student-fabricated Solar Panels and Some Related Classroom Measurements,” Nathan T. Moore and Carl D. Ferkinhoff. Submitted.  
<https://arxiv.org/abs/1712.04029>

“A model for including Arduino microcontroller programming in the introductory physics lab,” Andrew J. Haugen and Nathan T. Moore.

Submitted. <http://arxiv.org/abs/1407.7613>

“Small Oscillations via Conservation of Energy,” Tia Troy, Megan Reiner, Andrew J. Haugen, and Nathan T. Moore.  
(IOP) Physics Education, vol. 52, no. 6, 2017. <http://arxiv.org/abs/1407.5243>

“Using Cognitive Acceleration Materials to Develop Pre-Service Teachers’ Reasoning and Pedagogical Expertise,” Nathan Moore, Jacqueline O’Donnell, and Dennis Poirier. 2012 ASQ Advancing the STEM Agenda in Education, the Workplace and Society. (peer reviewed) <http://asq.org/qic/display-item/index.html?item=34852>

“Computational Physics and Reality: Looking for Some Overlap at the Blacksmith Shop”, Nathan Moore and Nicole Schoolmeesters, submitted.  
<http://arxiv.org/abs/0904.3960>

“Using Garlic As A Far-Transfer Problem of Proportional And Probabilistic Reasoning”, Nathan Moore and John Deming, Mathematics Teacher, August 2010.  
<http://arxiv.org/abs/0811.2133>

“Measuring the 2D Vector Aspect of Momentum Using Only One Dimension”, Andrew Ferstl and Nathan Moore, submitted.  
<http://arxiv.org/abs/0803.4142/>

“Abundance of unknots in various models of polymer loops”, N.T. Moore and A.Y. Grosberg, J. Phys. A: Math. Gen. 39, 9081, (2006).  
<http://arxiv.org/abs/cond-mat/0604225/>

“On the Limits of Analogy Between Self-Avoidance and Topology-Driven Swelling of Polymer Loops”, N.T Moore and A.Y. Grosberg, Phys. Rev. E 72, 061803 (2005).  
<http://arxiv.org/abs/cond-mat/0506786>

“Topologically Driven Swelling of a Polymer Loop”, N.T. Moore, R.C. Lua, A.Y. Grosberg. Proc. Natl. Acad. Sci. USA 101(37), 13431-13435, (2004).  
<http://arxiv.org/abs/cond-mat/0403419/>

“Under-knotted and over-knotted polymers: 1. Unrestricted loops”, N.T. Moore, R.C. Lua, A.Y. Grosberg, in Physical and Numerical Models in Knot Theory, Including Applications to the Life Sciences, Series on Knots and Everything 36 363-384 (World Scientific)  
<http://arxiv.org/abs/cond-mat/0403457/>

“Under-knotted and over-knotted polymers: 2. Compact self-avoiding loops”, R.C. Lua, N.T. Moore, A.Y. Grosberg, in Physical and Numerical Models in Knot Theory, Including Applications to the Life Sciences, Series on Knots and Everything 36 385-398 (World Scientific)  
<http://arxiv.org/abs/cond-mat/0403413/>

## Talks and Commentary

“**Fun with incomplete data**”, University of Minnesota College in the Schools instructors, August 2019.

“**Chronic Wasting Disease: Please shoot all the deer so we can eat Cheerios in peace!**” Winona Nerd Nite, June 2018, Winona, MN.

**SEPCI Workshop**, organized by Lee Schmitt, Hamline University. Forces and Bridges workshop leader. June 2016, Anoka, MN.

**“Cognitive Acceleration in the Physics Classroom,”** a talk for College in the Schools teachers at the University of Minnesota. 27 February 2015 at the East Bank of UMN.

**“Is School-Lunch More Effective than School?”** The relevance of Proportional Reasoning in Physics (and other science classes)” Physics Strand Speaker at MnSTA’s MnCOSE15 meeting. 20 February 2015, Mankato, MN. Also given at a Winona Nerd Nite, May 2019.

**“Tree Rings, Thyroid Disorders, and the Distribution of Problem-Solving Ability in Children.”** 16 February 2015, Rochester Century High School, Rochester MN.

**“Adapting Modeling Instruction to DIY Arduino (microcontroller) Lab Equipment Development,”** and **“Student-built lab equipment via an Arduino and Modeling Instruction,”** and **“Arduino in an Undergraduate Lab Curriculum and Applications ”**, with Tia Troy, Megan Reiner, and Andrew J. Haugen. National AAPT meeting, Minneapolis, July 2014.

**“Modeling, Making, DIY, and Arduino,”** Minnesota Science Teachers’ Association MnCOSE14 meeting, 21 February, 2014.

**“When Will We Make Potions?” A Description of Elementary Science Clubs in Winona,”** WSU’s Consortium for Liberal Arts and Science Promotion (CLASP), 30 October, 2013.

**“Strategies for Reasoning Ability Growth in Pre-service Teacher Preparation: Cognitive Acceleration, Science Clubs, and STEM Elementary Schools”** Thomas Edison High School, 7 May, 2013.

**“Designing Curriculums for STEM Elementary Schools”**, University of Minnesota Physics Education Seminar, 8 March 2013.

*Abstract: Suppose you accept a request to help design a “STEM” elementary school. What would you include in the curriculum? What outcomes would you value? Is it possible to make such a school better than the average institution through specific curricular choices? In the talk, I will talk about my experience in such a situation and the way it has altered my perception/practice of education. Specific topics touched on include measures of (Piagetian) reasoning ability, a detailed and useful taxonomy of reasoning ability, Shayer and Adey’s program of “Cognitive Acceleration through Science Education,” and after-school elementary science clubs (Zvonkin’s math circles).*

**“Strategies for Reasoning Ability Growth in Pre-service Teacher Preparation: Cognitive Acceleration, Science Clubs, and STEM Elementary Schools”** Minnesota Science Teachers’ Association Meeting, 22 February, 2013.

**“Exploring our Common Questions: Inquiry about Teaching and Learning at MN’s Public Colleges and Universities”**, Panelist, University of Minnesota Postsecondary Teaching and Learning Research Series, 8 November, 2012.

**“Using Cognitive Acceleration Materials to Develop Pre-service Teachers’ Reasoning and Pedagogical Expertise”**, Education Division of the American Society for Quality (ASQ) meeting, Summer 2012, University of Wisconsin-Stout.

*Abstract: The talk outlines two approaches taken at Winona State University (WSU) to increase the reasoning ability of pre-service elementary education majors through exposure to the Cognitive Acceleration materials produced by Shayer, Adey, and collaborators in the UK.*

**Global Physics Department, Cognitive Acceleration** Summary: last night we spoke with Nathan about what he and collaborators are doing to study the effects of increasing students cognitive ability. We talked about the Lawson test, UK education, middle schools, and lots of other ideas. 5 October 2011.

**The Arduino, a cheap micro-controller with multiple uses in the physics curriculum** , Joint Wisconsin and Minnesota American Association of Physics Teachers Meeting, University of Wisconsin at River Falls, 30 October 2010.

**“The Physics of Cold-Weather Gardening”**, WSU’s Consortium for Liberal Arts and Science Promotion (CLASP), 2 December, 2009.

**“Underprepared is underserved: a first-year math and science cohort class”**, Inaugural meeting of the Prairie Section of the American Physical Society. The University of Iowa, 12-14 November 2009. Session Q2.00004.

**“A reminder that meat comes wrapped in fur and feathers”**, Guest Opinion, Winona Daily News, 29 August, 2009.

**“Blacksmithing and your GeForce Video Card”**, WSU Physics Department Occasional Seminar, September 2009.

**“Blacksmithing, introductory physics, and computer programming”** , Minnesota American Association of Physics Teachers meeting at the University of St. Thomas, April 25, 2009.

**“A Different Sort of Homework: Student-Created Simulations using VPython”** , MNSCU iTeach Conference, Minneapolis Community and Technical College, February 27, 2009.

**“Underprepared is Underserved: A Freshman Math and Science Cohort Class”**, MNSCU iTeach Conference, Minneapolis Community and Technical College, February 27, 2009. Given with John Deming, WSU Chemistry. We gave a similar talk at a meeting of the 2-year College Chemistry Consortium at Rochester Community and Technical College, September 25, 2009.

**“A Molecular Cartoon of Heat Transfer”** , Minnesota American Association of Physics Teachers meeting at Gustavus Adolphus College, October 25, 2008.

**“Better than Sliced Bread: Using a wiki to reduce intellectual clutter”** , Faculty Development Workshop, 21 August, 2008.

**“Without bridge, Winona commuter trades car for canoe”**, All Things Considered, Minnesota Public Radio, 4 June, 2008.

**“Im-peck-able logic: The case for keeping chickens in Winona”**, Guest Opinion, Winona Daily News, 23 March, 2008.

**“Knot Populations in DNA”** , WSU Physics Department Occasional Seminar, January 2008

**“Using Wikis in Physics Courses,”** WSU Library Athenaeum, 21 February, 2007

**“The Science of Shopping.”** WSU’s Consortium for Liberal Arts and Science Promotion, 25 October, 2006.

**“The presence of knots in DNA: How our bodies untangle fishing line.”** Minnesota Science Teachers Association Regional Meeting, WSU, April 2006.

#### Student Research Projects and Internships

**Ryan Morgans**, coil gun testing and analysis, 2020-21.

**Robert Zlock**, MIT coffee can radar 2019-20.

**Adam Muschler**, photovoltaic-powered water pumping, 2018-19.

**Noah Finn**, construction and initial data from a “Radio Jove” phased dipole radio telescope, 2015-16.

**Sam Robinson**, construction and initial data from a Stanford “SuperSID” space weather monitor, Spring 2016.

**Keegan Christensen** Zigbee/Xbee antenna field strength and pattern analysis. Presented at WSU Physics Occasional Seminar, January 2014.

**Jodi Misar** Increases in pedagogical sophistication as the result of Science Club Facilitation, Fall 2012-Spring 2013. Presented at the WSU Research Celebration, Spring 2013.

**Megan Reiner** Arduino and Labview programming to implement an acoustical and kinesthetic baby monitor, Spring 2013, presented at MN-AAPT meeting, April 2013.

**Megan Reiner, Tia Troy, and Tucker Besel** Labview and Arduino programming as an alternate lab curriculum in Physics 221, with Andrew J. Haugen. Presented at MN-AAPT meeting, April 2013.

**Anthony Martino** Parallel and Graphics Card Programing, and Knot Invariant implementation (with Dr. Eric Errthum), Fall 2012.

**Scott Stroh**, “On the MPEX and the effects of using the Arduino Microcontroller in Introductory Physics Classes.” Spring 2011, presented at MN-AAPT meeting.

**Physics 222 class project**, VPython models of magnetic materials, Fall 2009.

**Physics 222 class project**, VPython models of thermal transfer in a blacksmith’s forge, Fall 2008.

**Mike Thornton**, “Developing and Assessing Physics Programming Problems in VPython”, Spring-Fall 2008.

**Greg Taubel**, “Scientific Programming with the NVIDIA CUDA library”, Spring 2008-present.

**Nick Szulcweski**, “Numerical Weather Modelling with WRF-ARW”, Spring 2007 to Fall 2008.

**Physics 221 class research project**, “Applying Physics to problems in Home Arts”

**Brian From**, “Impact Craters and Pattern Recognition”, Fall 2007.

**Physics 345 class research project**, Spring 2006.

## Service

LonCapa network participant and problem author <https://loncapa.winona.edu>

(Fall 2011-Fall 2016) Coordinated after-school “Science Clubs” at Jefferson, Madison, Washington-Kosciusko, and St. Stanislaus Elementary schools via WSU students in Phys180, EFRT099, OR100, and EDUC335. Club activities are weekly practice with Cognitive Acceleration and Engineering is Elementary materials.

WSU Academic Affairs and Curriculum Committee

WSU Course Proposal and Program Committee (CPPS)

South-East Minnesota Regional Science Fair, Organizing Committee, Spring 2007 – 2015, Fair director in 2011.

Search Committees for Dean of Library, Vice-President of IT/CIO, and Physics Faculty.

## Grants and Workshops

(2019) Winona State Digital Faculty Fellow: set up, develop problems for, and share awareness of the <https://www.lon-capa.org/> open-source homework system at Winona State.

(2017) With Hannah Leverentz,  $\approx \$25K$  to publicize “Open Educational Resources,” by organizing a series of <https://software-carpentry.org/> workshops at Minnesota State institutions.

(Summers 2012, 2013, & 2015) Modeling Instruction Workshop for secondary science teachers at Winona State University.

(Spring 2011, with John Deming, WSU Chemistry) WSU “Teach21” Group award,  $\approx \$15K$  to organized a middle and elementary teacher training workshop for (among others) staff at the STEM option at Jefferson Elementary in Winona, MN. The meeting featured training on Cognitive Acceleration curricular materials, and discussion on how to convert standard science lessons to (5E) inquiry format.

(Spring 2011, with Bill Braun, Winona Senior High) WSU “Bush Education Group” award,  $\$7.5K$  to organized a Modeling Instruction Workshop for secondary science teachers at Winona State University, August 2011.

(Fall 2009, with John Deming, WSU Chemistry) MNSCU Discipline Workshop,  $\approx \$3K$  to host an on-campus workshop (held in May, 2010) to disseminate the inquiry-based approach to communicating science content that has proved effective in WSU’s first-year science cohort. In parallel, we offered a workshop for secondary science teachers.

(Fall 2008, with John Deming, WSU Chemistry) MNSCU CTL Grant,  $\approx \$29K$  (with  $\$5K$  matching from WSU) to fund a section of Chem 108, co-taught with John Deming of WSU Chemistry. The course is formulated to increase retention rates among under-prepared freshman science majors through the development of thinking skills.

(Summer-Fall 2008) MNSCU Learning Games and Simulations award.  $\approx \$20K$  to fund the creation of a suite of physics problems to be solved with VPython, an open-source programming language that produces interactive physics simulations. Funds used for faculty salary and to pay a summer research salary to a WSU Physics Education major also working on the project.

(Spring 2008) WSU IFO FDC Award,  $\$500$  for the creation of a bread oven on campus (in the context of Physics 345, WSU’s thermodynamics course).

(Fall 2006) WSU IFO PIF Travel Award. Visit to a training conference at NCAR (Colorado Boulder) with a WSU student to attend a WRF-ARW (numerical weather model) training conference.

## Professional Associations

American Association of Physics Teachers

American Modeling Teachers’ Association (AMTA, life member).

IEEE member, (2016–present).

Certified Software Carpentry Instructor, Dec 2016.

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