James D. Benson, Ph. D.
Assistant Professor
Department of Mathematics
Northern Illinois University
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Education

Ph.D. Mathematics, University of Missouri, 2009
Thesis Title: *Mathematical Problems from Cryobiology,*
Advisors:
Carmen Chicone, Department of Mathematics
John Critser (deceased), Department of Veterinary Pathobiology

B.S. Mathematics, Purdue University, 2001

Research Interests

Mathematical Biology, Computational Biology, Cryobiology, Optimization, Optimal Control, Medical Device Design, Dead Reckoning (Path Integration)

Appointments

Assistant Professor, Department of Mathematics,

Northern Illinois University, 2011- present

National Research Council/NIST Postdoctoral Associate, Mathematical and Computational Sciences Division,
National Institute of Standards and Technology, 2009-2011

Research Assistant, Departments of Mathematics and Veterinary Pathobiology,
University of Missouri, 2002- 2009

Graduate Teaching Assistant, Department of Mathematics,

University of Missouri, 2002-2009

Summer Research Student, Cryobiology Research Institute, Indiana University School of Medicine. Dr. John Critser, Advisor. Summers of 1994-1998, 1997 excluded.

Summer Research Assistant, David Benson, Mentor. Research focused on collection of field samples from Ptarmigan in Glacier National Park,
Washington University. 1997

Awards and Honors

Excellence in Innovation Award, Division of Research and Innovation Partnerships, Northern Illinois University. Spring 2016

Recognizing Distinction in Living Learning Communities: Promoting Academic Success Award. Division of Housing and Dining, Northern Illinois University. Spring 2016

National Research Council Postdoctoral Research Associateship, NIST Mathematical and Computational Sciences Division, Gaithersburg, MD. 2009-2011

Peter L. Steponkus Crystal Award, awarded yearly for best student research and presentation at the annual Society for Cryobiology meeting, 2008

Donald K. Anderson Graduate Research Award, University of Missouri campus wide award for the best graduate student research, 2007

Student Travel Award, 41st Annual Meeting of the Society for Cryobiology, 2004

Grants

Major Grants Funded:

11/01/15-present

NIU Division of Research and Innovation Partnerships Patent Support Grant. Funding for development and testing of patented device ($10,000)

4/01/16-3/30/2021 (PI-Subcontract, 2 months/17% effort)

Assessment of ovarian tissue cryopreservation methods in non-human primates (PI Mary Zelinski, Oregon Health Sciences University)

NIH/NICHD R01

Annual funding at NIU: $47,395

Total funding at NIU: $265,615

Status: Funded

11/01/16-4/31/2017 (Consultant, 10% effort)

DOD SBIR "Organ Cryopreservation"

PI: XTherma, Inc, Palo Alto, CA

Status: Funded.

Minor Grants Funded:

NIU Office of Undergraduate Research URAP summer support. Funding for an undergraduate researcher for 15 weeks. ($1,000), Summer 2012

Society for Mathematical Biology Travel Grant. Funding to attend the 2013 Society for Mathematical Biology Annual Meeting in Tempe, Arizona ($500).

NIU College of Liberal Arts and Sciences URAP support. Funding for an undergraduate researcher for two semesters. ($1,500), Fall 2012-Spring 2013.

Organ Preservation Alliance Travel Grant. Funding to attend the ORGANS ON-DEMAND Vision-Setting DARPA Workshop ($700) Summer 2015

Society for Cryobiology Travel Grant. Funding to attend the 2015 Society for Cryobiology Annual Meeting in Ostrava, Czech Republic ($2,500).

Organ Preservation Alliance Travel Grant. Funding to attend the first World Tissue Banking Summit ($700) Spring 2015

Submitted:

9/01/16-8/31/2020 (Co-PI with Mahmoud Almasri, 2 months/17% effort)

NIH/NHLBI R01—*MEMS based diagnostics for individual red blood cells with applications in transfusion and medicine*

Annual Funding at NIU: $72,632

Total Funding at NIU: $292,712

Status: Submitted March, 2016, Scores expected June, 2016

9/01/16-8/31/2021 (PI-Subcontract, 2 months/17% effort)

NIH/NIGMS R01—*Development of a Versatile Vitrification Technique for Viable Banking of Human Tissues*

Annual Funding at NIU: $77,069

Total Funding at NIU: $412,429

Status: Submitted February, 2016, Scores expected June, 2016

11/01/16-4/31/2017 (Consultant, 20% effort) DOD SBIR "Tissue Cryopreservation"

PI: Tissue Testing Technologies, LLC, North Charlston, SC

Status: Submitted March, 2016, Scores expected July, 2016

Professional Affiliations and Service

Faculty Advisor NIU-STEM Living Learning Community 2014-present

Organized and facilitated a community of 120 Science, Technology, Engineering and Mathematics (STEM) majors living in a dormitory on campus. Planned and budgeted for enrichment events, guest speakers, and field trips. Directed and collaborated with other faculty advisors along with student leadership. Worked with housing and dining staff. Mentored and counseled individual students on personal, student, and career decisions. (see http://www.niu.edu/housing/llc/stem/index.shtml)

Governor-at-Large *Society for Cryobiology* 2012-present

(Elected for two terms)

Chair, Student Awards Committee 2012-present

Revamped awards program to highlight top-tier students. Annually Evaluate 20-40 student abstract submissions for a number of different Society for Cryobiology Student awards.

Editorial Board, *CryoLetters* (Journal), 2008-present

Member, *Society for Cryobiology* 2003-present

Member, *Society for Mathematical Biology* 2008-present

Reviewer, *Cryobiology, Journal of Mathematical Biology, CryoLetters, Journal of Porous Media, Annales Polonici Mathematici, PeerJ, Rejuvination Research, Tissue Engineering, Clinica Chimica Acta,*

Peer-Reviewed Full Papers: In Review

1. DM Anderson, JD Benson, and AJ Kearsley. Foundations of modeling in cryobiology—II: Heat and mass transport with free interfacial and membrane boundary conditions*.
2. PA Blankenship, SL Stuebing; SS Winter; JL Cheatwood, JD Benson, IQ Whishaw, and DG Wallace. The medial prefrontal cortex contributes to but does not organize rat exploratory behavior.

Peer-Reviewed Full Papers*

*Reprints available at http://www.math.niu.edu/~benson or by request.

1. PA Blankenship, AA Blackwell, N Ebrahimi, JD Benson, and DG Wallace. A History of adolescent binge drinking is associated with impaired self-movement cue processing on manipulatory scale navigation tasks. In press. Pysiology and Behavior.
2. AF Davidson, C Glasscock, DR McClanahan, JD Benson, AZ Higgins. Toxicity-Minimized Cryoprotectant Addition and Removal Procedures for Adherent Endothelial Cells. *PLOS One* **10**(11): e0142828, 2015. doi:10.1371/journal.pone.0142828
3. JD Benson. Global stability and exact solution of an arbitrary-solute nonlinear cellular mass transport system. *Mathematical Biosciences* **258**,176–181, 2014 doi:10.1016/j.mbs.2014.09.014
4. DM Anderson, JD Benson, and AJ Kearsley. Foundations of modeling in cryobiology—I: Concentration, Gibbs energy, and chemical potential relationships *Cryobiology,* **69** *349–360,* 2014. doi:10.1016/j.cryobiol.2014.09.004
5. JD Benson, CT Benson, and JK Critser. Mathematical model formulation and validation of water and cryoprotective agent transport in whole hamster pancreatic islets. *Mathematical Biosciences.* **254**, 64–75, 2014 doi:10.1016/j.mbs.2014.06.003
6. AF Davidson, JD Benson, and AZ Higgins. Mathematically Optimized Cryoprotectant Equilibration Procedures for Cryopreservation of Human Oocytes. *Theoretical Biology and Mathematical Modeling,* **11** (13) 2014. doi: 10.1186/1742-4682-11-13
7. CM Kashuba, JD Benson, and JK Critser. Rationally optimized cryopreservation of multiple mouse embryonic stem cell lines: I—Comparative fundamental cryobiology of and implications for embryonic stem cell cryopreservation protocols. *Cryobiology* **68** (2) 166-175, 2014. doi:10.1016/j.cryobiol.2013.12.007
8. CM Kashuba, JD Benson, and JK Critser. Rationally optimized cryopreservation of multiple mouse embryonic stem cell lines: II— Mathematical prediction and experimental validation of optimal cryopreservation protocols. *Cryobiology* **68** (2) 176-184, 2014. doi:10.1016/j.cryobiol.2013.12.003
9. RE Lusianti, JD Benson, JP Acker, AZ Higgins. Rapid removal of glycerol from frozen-thawed red blood cells. *Biotechnology Progress*, **29** 609-620, 2013. onlinelibrary.wiley.com/doi/10.1002/btpr.1710
10. JD Benson, EM Walters, EJ Woods and JK Critser. The cryobiology of spermatozoa. *Theriogenology*, **78** 1682-1699, 2012. doi:10.1016/j.theriogenology.2012.06.007
11. JD Benson, CC Chicone, and JK Critser. Analytical optimal controls for the state constrained addition and removal of cryoprotective agents. *Bulletin of Mathematical Biology* **74** (7) 1516-1530, 2012. link.springer.com/article/10.1007/s11538-012-9724-2
12. JD Benson. Some comments on recent discussion of the Boyle van't Hoff relationship. *Cryobiology* **64** (2) 118-120, 2012. doi:10.1016/j.cryobiol.2011.12.001

13. Y Wu, JD Benson, M Almasri. Micromachined Coulter counter for dynamic impedence study of time sensitive cells. *Biomed Microdevices* **14** 739-750, 2012. link.springer.com/article/10.1007/s10544-012-9655-6

14. JD Benson, AJ Kearsley, and AZ Higgins. Mathematical optimization of procedures for cryoprotectant equilibration using a toxicity cost function *Cryobiology* **64** (3) 144-151, 2012. doi:10.1016/j.cryobiol.2012.01.001

15. JD Benson. Stability analysis of several non-dilute multiple solute transport equations. *Journal of Mathematical Chemistry* **49** (4) 859-869, 2011. link.springer.com/article/10.1007/s10910-010-9783-2

16. JD Benson, CC Chicone, and JK Critser. A general model for the dynamics of cell volume, global stability, and optimal control.*Journal of Mathematical Biology* **63** (2) 339-359*,* 2010. ink.springer.com/article/10.1007/s00285-010-0374-4

17. JD Benson, A Bagchi, X Han, JK Critser, EJ Woods. Melting point equations for the ternary system water-sodium chloride-ethylene glycol revisited. *Cryobiology* **61** (3) 352-356, 2010. doi:10.1016/j.cryobiol.2010.10.001

18. Y Wu, JD Benson, JK Critser, M Almasri. MEMS-based Coulter counter for cell counting and sizing using multiple electrodes. *J. Micromech. Microeng.* **20***, 085035.* 2010. doi:10.1088/0960-1317/20/8/085035

19. Y Wu, JD Benson, JK Critser, M Almasri. Note: Microelectromechanical systems Coulter counter for cell monitoring and counting. *Review of Scientific Instruments.* **81**, 076103. 2010. dx.doi.org/10.1063/1.3462327

20. X Han, L Ma, JD Benson, A Brown, JK Critser Measurement of the apparent diffusivity of ethylene glycol in mouse ovaries through rapid MRI and theoretical investigation of cryoprotectant perfusion procedures. *Cryobiology.* **58** (3), 2009. doi:10.1016/j.cryobiol.2009.02.005

21. AI Glazar, SF Mullen, J Liu, JD Benson, JK Critser, EL Squires, JK Graham Osmotic Tolerance Limits and Membrane Permeability Characteristics of Stallion Spermatozoa Treated with Cholesterol. *Cryobiology.* **59** (2), 2009. doi:10.1016/j.cryobiol.2009.07.009

22. S Wei, H Men, JD Benson, JK Critser Osmotic characteristics and fertility of murine spermatozoa collected in different solutions. *Reproduction,* **137**, 215-223, 2009. www.reproduction-online.org/content/137/2/215

23. CM Kashuba Benson, JD Benson, JK Critser Improved cryopreservation methods for a mouse embryonic stem cell line. *Cryobiology.* **56** (2) 2008. doi:10.1016/j.cryobiol.2007.12.002

24. S Wei, JD Benson, H Men, JK Critser. Osmotic tolerance limits and effects of cryoprotectants on the motility, plasma membrane integrity and acrosomal integrity of rat sperm. *Cryobiology.* **53** (3), 336-348. 2006. doi:10.1016/j.cryobiol.2006.09.001

25. JD Benson, MA Haidekker, CM Kashuba Benson, JK Critser. Mercury free operation of a Coulter Counter Multisizer II sampling stand. *Cryobiology.* **51** (3), 344-7. 2005. doi:10.1016/j.cryobiol.2005.08.004

26. JD Benson, CC Chicone and JK Critser Exact solutions of a two parameter flux model and cryobiological applications. *Cryobiology* **50** (3), 308-316. 2005. doi:10.1016/j.cryobiol.2005.03.003

27. EJ Woods, JD Benson, Y Agca, JK Critser. Fundamental cryobiology of reproductive cells and tissues. *Cryobiology*. Apr; **48** (2), 146-56. 2004. doi:10.1016/j.cryobiol.2004.03.002

28. MJ Phelps, JD Benson, J Liu, CE Willoughby, JA Gilmore, JK Critser. Effects of Percoll separation, cryoprotective agents, and temperature on plasma membrane permeabil- ity characteristics of murine spermatozoa and their relevance to cryopreservation. *Biol Reprod.* **61** (4), 1031-41. 1999. www.biolreprod.org/content/61/4/1031

29. CT Benson, C Liu, DY Gao, ES Critser, JD Benson, JK Critser. Hydraulic conductivity (Lp) and its activation energy (Ea), cryoprotectant agent permeability (Ps) and its Ea, and reflection coefficients (sigma) for golden hamster individual pancreatic islet cell membranes. *Cryobiology.* **37** (4) 290-9. 1998. http://europepmc.org/abstract/MED/9917345

Patents

1. International Patent Application No.: PCT/US2015/023014
(Claiming priority to U.S. Provisional Application No. 61/971,979)
Title: Ultra-Rapid Tissue Cryopreservation Method and Apparatus
Application Date: March 27, 2015
Inventor(s): Benson, James D.

Book Chapters

1. JD Benson. Modeling and Optimization in Cryobiology. In: *Cryopreservation and Freeze-Drying Protocols, Third Edition*. Willem F. Wolkers and Harriette Oldenhof, Editors. Springer:Berlin, Methods in Molecular Biology Volume 1257, 2015, pp 83-120. (http://link.springer.com/protocol/10.1007/978-1-4939-2193-5_3)

Conference Publications

1. Y. Wu, JD Benson, M Almasri. MEMS Coulter Counter for Dynamic Impedance Measurement of Cells. *15th International Conference on Miniaturized Systems for Chemistry and Life Sciences*. October 2-6, 2011, Seattle Washington, USA.

2. X Han, Y Liu, JD Benson, H Ma, JK Critser. Measurement of Water-Cryoprotectant Mutual Diffusivity in Micro-Scale Biological Tissues at Subzero Temperatures. *In: ASME 2009 Second International Conference on Micro/Nanoscale Heat and Mass Transfer.* 495–499, 2009.
3. WG Zhao, GL Solbrekken, SF Mullen, JD Benson, X Han, JK Critser. Development of a micro-scale differential scanning calorimeter for single cell measurements. *In: Proceedings of HT2007: 2007 ASME-JSME Thermal Engineering Summer Heat Transfer Conference.* July 8-12, 2007, Vancouver, British Columbia, Canada. Paper number HT2007-321555.
4. M Korampally, JD Benson, Y Wu, JK Critser, M Almasri. MEMS based Coulter counter for cell sizing. *In: Proceedings of SPIE: Microfluidics, BioMEMS, and Medical Microsystems VI*. 22 January 2008, San Jose, CA, Vol. 6886, p 68860A
5. JD Benson and JK Critser. Fundamental Cryobiology. In: *Proceedings of a Workshop on Transporting Gametes and Embryos*. (2004) Havermeyer Monograph Series No. 12. Suffolk, UK.

Conference Presentations and Abstracts

1. JD Benson. Hybrid agent based model of transport in ovarian follicles (Invited Speaker). To be presented at *the 52nd Annual Meeting of the Society for Cryobiology*, July 24-27, 2016 in Ottawa, Canada
2. JD Benson. Cryopreservation modeling enables rational protocol design and develops informed hypotheses: the past, present, and future of modeling cryopreservation in Drosophila (Invited Speaker). To be presented at *the first NIH Workshop on Drosophila Cryopreservation*, July 13, 2016 in Orlando, Florida
3. JM Lahmann, C Cruz-Sanchez, C Huntley, JD Benson, AZ Higgins. Rapid Processing to Prepare Cryopreserved Blood for Transfusions. Presented at *BMES 2015 Annual Meeting*, October 7-10, 2015 in Tampa, Florida
4. *IH Jasim, Y Agca, M Almasri, JD Benson. A Microfluidic Coulter Counter for Dynamic Sizing and Cell Volume Control. (Invited Speaker). Presented at *the 51st Annual Meeting of the Society for Cryobiology*, July 26-29, 2015 in Ostrava, Czech Republic.
5. *JD Benson. Computational tools enable cryobiological understanding and rapid prototyping: historical successes,future potential, and a cutting edge cell-based tissue model. (Invited Speaker). Presented at the *Controlling Biological Time for Organs on Demand - A Vision-setting Workshop*, sponsored by DARPA and Organ Preservation Alliance, West Point, NY, 2015.

6. JM Lahmann, C Cruz-Sanchez, C Huntley, JD Benson, AZ Higgins. Rapid Processing to Prepare Cryopreserved Blood for Transfusions. To be presented at *the 51st Annual Meeting of the Society for Cryobiology*, scheduled for October 7-10, 2015 in Ostrava, Czech Republic.
7. *P Macklin, AF Ghaffarizadeh, JD Benson. Cell-based modeling of mechanical and chemical stress in tissues during cryoprotocols (Invited Speaker). Presented at the *Global Organ Banking Summit*, Palo Alto, CA, 2015.
8. *JD Benson[1], Y Wu, M Almasri. MEMS Coulter Counters for Dynamic Impedance Measurement of Time Sensitive Cells. (Invited Speaker) Presented at the *2014 World Forum on Biology. Joint Meeting of the Society for In Vitro Biology and the Society for Cryobiology.* Savannah, GA, 2014.
9. *JD Benson. Cost functional dependence of optimal CPA equilibration trajectories. (Invited Speaker) Presented at the *50th International Meeting of the Society for Cryobiology.* Bethesda, MD, 2013
10. JD Benson. Regular synthesis of optimal controls of a class of state constrained mass transport problems with applications to cryopreservation. Presented at The Society for Mathematical Biology Annual Meeting and Conference, Tempe, AZ, 2013
11. Dan Sindelar and JD Benson. Modeling Mass Transport During Cell Cryopreservation and Determining Parameters for Cellular Lysis Upon Thawing. (Undergraduate Poster Session). Presented at The Society for Mathematical Biology Annual Meeting and Conference, Knoxville, TN, 2012.
12. JD Benson. Optimal control of a class of PDE and state constrained bio mass transport problems. Presented at The Society for Mathematical Biology Annual Meeting and Conference, Knoxville, TN, 2012
13. RE Lusianti, JD Benson, AZ Higgins. Rapid Removal of Glycerol from Frozen-Thawed Red Blood Cells. Presented at the *49th International Meeting of the Society for Cryobiology.* Rosario, Argentina, 2012.
14. D Anderson and JD Benson. A coupled heat and mass transport model with applications in cryobiology. Presented at the *48th International Meeting of the Society for Cryobiology.* Corvallis, Oregon, 2011. *Cryobiology*, **63** (3) 329, 2011.
15. AK Fry, JD Benson, AZ Higgins. Toxicity-minimized cryoprotectant addition and removal procedures for human oocytes. Presented at the *48th International Meeting of the Society for Cryobiology.* Corvallis, Oregon, 2011. *Cryobiology*, **63** (3) 330, 2011.
16. D Anderson and JD Benson. A coupled heat and mass transport model with applications in cryobiology. Presented at the 2011 *ICIAM meeting.* Vancouver Canada.
17. JD Benson and AJ Kearsley. Mini-Symposium: Mathematical Modeling and Optimization in Cryobiology. 2011 *ICIAM meeting.* Vancouver Canada.

[1] Underlined authors indicate presenter.
* Invited Speaker

18. JD Benson and AJ Kearsley. Time-Optimal Boundary Control of a State Constrained Bio-Mass Transport System. Presented at the 2011 *ICIAM meeting.* Vancouver Canada.

19. JD Benson and AJ Kearsley. Exact and numerical boundary control of the diffusion equation in cryobiology. Presented at the *47th International Meeting of the Society for Cryobiology.* Bristol, United Kingdom, 2010. *Cryobiology*, **61** (3) 372, 2010.

20. JD Benson, CC Chicone, JK Critser. Optimal control of cryoprotective agent addition and removal protocols. Presented at the *46th International Meeting of the Society for Cryobiology.* Sapporo, Japan, 2009. *Cryobiology,* **59** (3) 382, 2009.

21. EM Walters, A Reike, JK Graham, JK Critser. Cholesterol-loaded methyl-β-cyclodextrin improves boar spermatozoa cryoprotectant addition and removal tolerance. Presented at *45th Annual Conference of the IETS.* San Diego, CA. *Reproduction, Fertility and Development*. **21** (1), 140-141, 2008.

22. JD Benson, CC Chicone, JK Critser. A coupled concentration and fluid transport model for cells, tissues and their boundary layers. *45th International Meeting of the Society for Cryobiology.* Charlotte, NC, USA, 2008. *Cryobiology,* **57** (3) 335, 2008.

23. X Han, L Ma, JD Benson, A Brown, JK Critser. Measurement of apparent cryoprotectant diffusivity through rapid MRI and theoretical development of cryoprotectant perfusion procedures. *45th International Meeting of the Society for Cryobiology.* Charlotte, NC, USA, 2008. *Cryobiology,* **57** (3) 2008.

24. EJ Woods, A Bagchi, JD Benson, X Han, JK Critser. Melting point equations for the ternary system water-sodium chloride-ethylene glycol revisited. *45th International Meeting of the Society for Cryobiology.* Charlotte, NC, USA, 2008. *Cryobiology,* **57** (3) 336, 2008

25. CMK Benson, JD Benson, and JK Critser An improved cryopreservation method for the R1 embryonic stem cell line. *44th International Meeting of the Society for Cryobiology.* Banff, Canada, 2007. *Cryobiology,* **55** (3) 370, 2007

26. JD Benson, JM Gallia, CC Chicone, JK Critser. Coulter Counter data reduction and parameter estimation. *43rd International Meeting of the Society for Cryobiology.* Hamburg, Germany, 2006. *Cryobiology,* **53** (3) 441, 2006.

27. CMK Benson, JD Benson, and JK Critser. Improved cryopreservation methods for mouse embryonic stem cell lines. *43rd International Meeting of the Society for Cryobiology.* Hamburg, Germany, 2006. *Cryobiology,* **53** (3) 413, 2006.

28. CK Benson, JD Benson, and JK Critser. Comparison of membrane permeability characteristics of multiple mouse embryonic stem cell lines. *42nd International Meeting of the Society for Cryobiology*. Minneapolis, MN, 2005. *Cryobiology*, **51** (3) 2005.

29. JD Benson, CC Chicone, JK Critser. Theoretical Optimization of CPA addition and removal strategies. *42nd International Meeting of the Society for Cryobiology*. Minneapolis, MN, 2005. *Cryobiology,* **51** (3) 2005.

30. JD Benson, CC Chicone, JK Critser. Implicit and Exact solutions of a two parameter solute solvent flux model. *41st International Meeting of the Society for Cryobiology.* Beijing, China, 2004. *Cryobiology,* **49** (3) 2004.

31. CK Benson, JD Benson, Y Agca, JK Critser Comparison of membrane permeability characteristics for mouse embryonic stem cell lines. *41st International Meeting of the Society for Cryobiology.* Beijing, China, 2004. *Cryobiology,* **49** (3) 2004.

32. E.J. Woods, JD Benson, L. Mead, D. Ingram, M. Yoder, J.K. Critser. Water and solute permeability of human cord blood endothelial progenitor cells. *41st International Meeting of the Society for Cryobiology.* Beijing, China, 2004. *Cryobiology,* **49** (3) 2004.

33. JD Benson, C. Chicone, J. A. W. Elliott and J. K. Critser. Solvent and solute chemical potential and theoretical constraints on the osmotic virial equation, *First Annual Meeting Extreme Cryobiology*, Edmonton, AB, January 30-31, 2004 *Cell Preservation Technology* **2** (3), 236 (2004).

34. Woods EJ, Liu J, Agca Y, Gilmore J, JD Benson, Critser JK. Murine Spermatozoa Cryopreservation: Development of a Defined Cryoprotectant Medium. *36th International Meeting of the Society for Cryobiology*. Marseille, France, 1999. *Cryobiology,* **39** (6), 284-285, 1999.

35. Benson CT, Liu C, Gao DY, Critser ES, Benson JD, Critser JK. Water Permeability (Lp) and its activation energy (Ea), cryoprotectant permeability (Ps) and its Ea, and re- flection coefficients (sigma) for golden hamster individual pancreatic islet cell membranes (with). *33rd International Meeting of the Society for Cryobiology*. Indianapolis, IN, 1996. *Cryobiology,* **33** (6) 1996.

36. JD Benson, Willoughby CE, Mazur P, Critser JK. Effects of Percoll Preparation on the Hydraulic Conductivity of Murine Spermatozoa. *33rd International Meeting of the Society for Cryobiology*. Indianapolis, IN, 1996. *Cryobiology,* **33** (6) 1996.

Invited Non Conference Presentations

1. Cryobiology: Cool Biophysics. (2012) *Northern Illinois University* Center for Biochemical and Biophysical Studies Colloquium.

2. The cool mathematics of freezing cells and tissues. (2012) *Illinois Council of Teachers of Mathematics.* Annual math contest awards ceremony keynote speaker.

3. Modeling and optimization of freezing cells and tissues. (2011) *Northern Illinois University.* Department of Biology Colloquium.

4. The mathematics of freezing cells and tissues. (2011) *Illinois Math and Science Academy.* Mu Alpha Theta honors and induction dinner.

5. Modeling and optimization in cryobiology. (2010) *Northwestern University.* Applied Mathematics Colloquium.

6. Modeling and optimization in cryobiology. (2010) *Shippensburg University.* Mathematics Colloquium.
7. Basic principles of sperm cryopreservation. (2010) *ESHRE Sperm and testicular banking* course, Grenada, Spain.
8. Mathematical problems from cryobiology. (2010) *George Mason University.* Applied and Computational Mathematics seminar series.

Local Presentations, Lectures, and Panels

1. Markov Chain and Monte Carlo methods for predicting ice propagation in tissues. *Northern Illinois University.* Department of Mathematical Sciences Applied Mathematics Seminar (3 1-hour lectures, 2015).
2. Common Errors in Statistics. *Northern Illinois University.* Guest lecture in NIU Department of Biosciences Lab Animal Medicine course BIOS 483 (Spring 2013-2015).
3. Modeling in Biology. *Northern Illinois University.* Guest lecture in NIU Department of Biosciences Lab Animal Medicine course BIOS 483 (Spring 2013-2015).
4. How to survive the trip from 310 to 77.15 and back: the applied math of bio mass transport, optimal control, and freezing cells. *Northern Illinois University.* Math Club Invited Talk.
5. A simple trick to solve an 80-year-old problem: exact solutions of mass transport modeling in cell biology and applications. *Northern Illinois University.* Mathematics Department Colloquium.
6. Cryobiology: The how and why of freezing cells. *NIST Take our Daughters and Sons to Work Day.* 4-half hour lectures to elementary school children. NIST, 2011.
7. Modeling and optimization in cryobiology. *Applied and Computational Mathematics Division Seminar Series.* NIST, 2010.
8. Cryobiology: The how and why of freezing cells. *NIST Take our Daughters and Sons to Work Day.* 4-half hour lectures to elementary school children. NIST, 2010.
9. Mathematical Problems in Cryobiology. *Department of Mathematics Graduate Student Seminar.* University of Missouri, 2008.
10. Mathematics and Cryobiology. *MU Graduate School Adventures in Education*, University of Missouri, 2008. (An event exposing children to graduate research).
11. Cryobiology is a convergence of fields in the university setting. *Keynote-MU Graduate Professional Council Missouri Legislator Awards Event.* University of Missouri, 2008.
12. What we can freeze from the body and why: a historical, physical and mathematical introduction. *MU Body Project 2008* (Interdisciplinary conference for MU Graduate students). University of Missouri, 2008.

13. *Panel Member for* "Tips on Surviving (and Succeeding in) Graduate School," University of Missouri-Columbia, 2007.
14. *Panel Member for "Surviving Graduate School: The Graduate Student Perspective,"* University of Missouri-Columbia, 2007.
15. Mathematics and Cryobiology. *MU Graduate School Adventures in Education*, University of Missouri, 2007. (An event exposing children to graduate research).
16. Mathematical Optimization of CPA Addition and Removal Strategies. *Department of Mathematics Graduate Student Seminar*. University of Missouri-Columbia, 2005.
17. FUN-damentals of Cryobiology. *Lecture for Veterinary Pathobiology Reproductive Biology Seminar Series.* University of Missouri-Columbia, 2004.

Classroom Teaching

Course	Semesters	Location
Ordinary Differential Equations (Graduate)	2	Northern Illinois University
Optimal Control in Biological Systems (Graduate)	1	Northern Illinois University
Mathematical Modeling in Applied Mathematics	2	Northern Illinois University
Advanced Calculus (Graduate/Undergraduate)	1	Northern Illinois University
Applied Mathematics for Science and Engineering	3	Northern Illinois University
Ordinary Differential Equations (Undergraduate)	5	Northern Illinois University
Calculus 2	4	Northern Illinois University
Calculus 1	1	Northern Illinois University
Calculus for Business and Life Sciences	4	Northern Illinois University
Multivariate Calculus Instructor	1	University of Missouri
Finite Mathematics Independent Study Instructor	5	University of Missouri
Finite Mathematics Instructor	2	University of Missouri
Introductory Algebra Instructor	5	University of Missouri

Mentoring

Luke Lacy—Honors Capstone Research Project. Fall 2015

Arion Huebner—PROMISE Research Assistantship project. Fall 2015, Spring 2016

Kenneth LaBuda—Funded under the NIU/CLA&S Undergraduate Research Assistantship Program (URAP) one semester project. Spring 2013

Jason Bottenburg—Funded under the NIU/CLA&S Undergraduate Research Assistantship Program (URAP) one semester project. Fall 2012

Daniel Sindelar—Funded under the NIU Undergraduate Research Assistantship Program (URAP) 15 week project. Dan presented our research at the Society for Mathematical Biology Annual Meeting 2012.

Directly mentored four students participating in an eight-week long Biosystems Research Experience for Undergraduates in Engineering.

Claire Schulkey—Was convinced by the experience to pursue a graduate degree in mathematics at Washington University at St. Louis. 2007

Sarah Rodda—Worked on numerical optimization of CPA addition and removal schemes. 2007

Jason Gallia— Was convinced by the experience to pursue a graduate degree in computer science at Binghamton University. 2006

Professional Development and Leadership:

Symposium organizer, “Transport modeling in tissues and organs” *52nd Annual Meeting of the Society for Cryobiology.* Ottawa, Canada 2016.

Symposium organizer, “Peter L. Steponkus Crystal Session” *52nd Annual Meeting of the Society for Cryobiology.* Ottawa, Canada 2016.

Symposium organizer, “Peter L. Steponkus Crystal Session” *51st Annual Meeting of the Society for Cryobiology.* Ostrava, Czech Republic 2015.

Symposium organizer, “Peter L. Steponkus Crystal Session” *50th Annual Meeting of the Society for Cryobiology.* Bethesda, Maryland 2014.

Symposium organizer, “Peter L. Steponkus Crystal Session” *49th Annual Meeting of the Society for Cryobiology.* Ottawa, Canada 2013,

Convener "*Biophysics" session. 48th Annual Meeting of the Society for Cryobiology.* Corvallis, OR, 2011.

Mini Session Organizer "*Mathematical Modelling and Optimization in Cryobiology."* 7th International Congress on Industrial and Applied Mathematics, Vancouver, Canada, 2011

Co-chair *"Biophysics of Cryobiology"* session. *47th Annual Meeting of the Society for Cryobiology.* Bristol, United Kingdom, 2010.

Organizer of Departmental Graduate Student Seminar. Fall 2008.

Entering Mentoring 8-Week Workshop on mentoring in undergraduate research, Office of Undergraduate Research, University of Missouri-Columbia, 2007

Committee Member, Society for Cryobiology Annual meeting Peter J. Steponkus Crystal Award committee, 2007,2009-2013.

Mathematical aspects of computational biology (Two Week Workshop), Mathematical Sciences Research Institute, Berkeley, CA 2006

National Science Foundation Grant Writing Workshop, Cryobiology Conference 2005, University of Minnesota.

University of Missouri Animal Care and Use Committee Laboratory Mouse Handling Workshop, 2003.

University of Missouri Animal Care and Use Committee Laboratory Rat Handling Workshop, 2003.

Teaching Workshop, 2-Week workshop on teaching mathematics to undergraduates, Department of Mathematics, University of Missouri-Columbia, 2002

Mentoring Development Course: Semester long course on mentoring. Purdue University, 2001.

University and Community Service:

Member, Board of Governors, Children's Learning Center, DeKalb, IL **Dec. 2012—present**

Vice-President, Board of Governors,

Children's Learning Center, DeKalb, IL **Jan. 2015—present**

The nonprofit Children's Learning Center provides high quality, comprehensive early education and child care in a safe and nurturing environment for DeKalb area families

Organizer, Applied Math Seminar

Department of Mathematical Sciences **Sept. 2015—Dec. 2015**

Honors Advisor, Department of Mathematical Sciences, NIU **Sept. 2015—present**

Undergraduate Curriculum Commitee,

Department of Mathematical Sciences, NIU **Sept. 2015—present**