

Associate Professor
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EDUCATION

- 6/03-8/06** University of Chicago, Department of Biochemistry and Molecular Biology, Chicago, IL
- Postdoctoral Fellow
 - Advisor: Anthony A. Kossiakoff, Professor, Chair, Ph.D.
- 6/02-5/03** Northwestern Medical School, Department of Molecular Pharmacology and Biological Chemistry, Chicago, IL
- Postdoctoral Fellow
 - Advisor: Brian K. Shoichet, Professor, Ph.D.
- 8/96-5/02** University of Iowa, Department of Biochemistry, Iowa City, IA
- Ph.D. Biochemistry, May 2002
 - Advisor: Kenneth P. Murphy, Associate Professor, Ph.D.
- 8/92-6/96** Knox College, Galesburg, IL
- B.A. Biochemistry, June 1996
 - Honors Research Advisor: Andrew Mehl, Associate Professor, Ph.D.

RESEARCH EXPERIENCE

- 2012-present** ASSOCIATE PROFESSOR – Northern Illinois University, Department of Chemistry and Biochemistry
- Explore methods to engineer protein switches
 - Characterize and develop synthetic antibodies against low-molecular weight targets
 - Investigate novel compounds to inhibit key enzymes of the MEP pathway and methionine aminopeptidase
- 2006-2012** ASSISTANT PROFESSOR – Northern Illinois University, Department of Chemistry and Biochemistry
- 2003-2006** POSTDOCTORAL FELLOW - University of Chicago
Studied structural/energetic properties of protein-protein transition states
- Designed novel approaches to study transition states of protein-protein recognition
 - Acquired expertise in surface plasmon resonance (SPR)
 - Developed proficiency in protein engineering strategies (molecular biology techniques, mutagenesis, phage display)
 - Managed two research technicians and three undergraduate students,

- 2002-2003** POSTDOCTORAL FELLOW - Northwestern University
Examined novel binding characteristics of an allosteric inhibitor
- Developed expertise in computational molecular docking
 - Discovered an allosteric β -lactamase inhibitor with a novel binding mechanism
 - Determined the crystal structure of two inhibitor/ β -lactamase complexes
- 1996-2002** GRADUATE STUDENT/RESEARCH ASSISTANT - University of Iowa
Investigated relationships between protein structure and the thermodynamics of binding and folding.
- Acquired expertise in protein biophysical techniques and analysis including calorimetry (isothermal titration calorimetry-ITC and differential scanning calorimetry), circular dichroism, analytical ultracentrifugation, and fluorescence.
 - Developed computational expertise in calculating binding and folding thermodynamics using empirical structure-based approaches.
 - Performed biophysical analysis/model fitting
 - Acquired proficiency in x-ray protein structure determination through performing crystal screening, collecting x-ray diffraction data, processing data and map fitting.
 - Developed expertise in subcloning, expressing, and purifying recombinant proteins.
- 2000** SUMMER INTERNSHIP- Schering-Plough, Kenilworth, NJ
- Addressed issues of peptide specificity and conformational flexibility in lead peptide-protein complexes
- 1996** UNDERGRADUATE HONORS RESEARCH
Knox College, Galesburg, IL
- Examined the involvement of ATP in the pyruvate dikinase active site using NMR and positional isotope exchange

TEACHING EXPERIENCE

- 2006-present** ASSISTANT/ASSOCIATE PROFESSOR – Northern Illinois University, Department of Chemistry and Biochemistry
- Gen CHEM 1 & 2(210/211), Honors Gen Chem, Enzymes (570), Biophysical Chemistry (475-675), Biochemistry Laboratory (471), undergraduate research (498)
- 2001** CHEMISTRY LAB INSTRUCTOR - Cornell College, Mt. Vernon, IA
- Chemical Principles 121 Laboratory
- 1997-1999** TEACHING ASSISTANT - Dept. of Biochemistry, University of Iowa
- Biochemistry II 99:130, Pharmacy/Dental Biochemistry 99:161-2, Graduate Biophysical Chemistry 99:241

- 1997-1998** BIOCHEMISTRY TUTOR- University of Iowa
- General Biochemistry 99:120 and Medical Biochemistry 99:163
- 1995-1996** FORD FOUNDATION FELLOWSHIP
Knox College, Galesburg, IL
- 1993-1995** TEACHING ASSISTANT- Knox College, Galesburg, IL

AFFILIATIONS

- 2002-present** American Association for the Advancement of Science
- 2005-2010** American Chemical Society
- 1997-2002** Student Member of the Biophysical Society

AWARDS AND HONORS

- 2015** Co-organizer for 29th Annual Gibbs Conference
- 2011** NIU Faculty Mentor of the Year Award
- 2010** NSF CAREER Award
- 2010** American Heart Association Scientist Development Grant
- 2010** Honors Program Improvement Summer Grant
- 2009** NIU Summer Research and Artistry Award
- 2008** David W. Raymond Grant for Use of Technology in Teaching
- 2007** NIU Summer Research and Artistry Award
- 2005-2006** American Heart Association Postdoctoral Fellowship
- 2002-2004** Northwestern NIH Drug Discovery Postdoctoral Scholar Fellowship
- 1998-2000** NIH Pre-Doctoral Training Fellowship in Biotechnology
- 1997-1998** University of Iowa Center for Biocatalysis & Biotechnology Fellowship
- 1996** Sigma Xi Research Award
- 1996** Biochemistry Award, Knox College
- 1995-1996** Ford Foundation Fellowship
- 1993-1996** Mortar Board Society
- 1992-1996** Hermann R. Muelder Scholarship

PEER REVIEWED PUBLICATIONS

Sean W. Fanning, Richard Walter, **James R. Horn** (2014)
Structural Basis of an Engineered Dual-Specific Antibody: Conformational Diversity Leads to a Hypervariable Loop Metal Binding Site
Protein Engineering Design and Selection 27 (10): 391-397.

Zheng Zhang, Sriram Jakkaraju, Joy Blain, Kenneth Gogol, Lei Zhao, Robert C. Hartley, Courtney A. Karlsson, Bart L. Staker, Lance J. Stewart, Peter J. Myler, Michael Clare, Darren W. Begley, **James R. Horn**, Timothy J. Hagen (2013) Cytidine derivatives as IspF inhibitors of Burkholderia pseudomallei.
Bioorganic and Medicinal Chemistry Letters, 23 (15), 6860-6863.

Phumvadee Wangtrakuldee, Matthew S. Byrd, Cristine G. Campos, Michael W. Henderson, Zheng Zhang, Michael Clare, Ali Masoudi, Peter J. Myler, **James R. Horn**, Peggy A. Cotter, and Timothy J. Hagen (2013) Discovery of Inhibitors of Burkholderia pseudomallei Methionine Aminopeptidase with Antibacterial Activity. ACS Med. Chem. Lett., 4 (8), 699-703

- Sztuba-Solińska, J., Fanning, S.W., **Horn, J.R.**, and Bujarski, J.J. (2012) Mutations in the coat protein-binding cis-acting RNA motifs debilitate RNA recombination of Brome mosaic virus. *Virus Research*. 170, 138–149
- Megan L. Murtaugh, Sean W. Fanning, Tressa M. Sharma, Alexandra M. Terry, and **James R. Horn** (2011) A Combinatorial Histidine Scanning Library Approach to Engineer Highly pH-Dependent Protein Switches. *Protein Science*. 20 (9), 1619-1631 (Featured Cover Art)
- Sean W. Fanning, Megan L. Murtaugh, and **James R. Horn** (2011) A Combinatorial Approach to Engineer a Multispecific Metal Switch Antibody. *Biochemistry*, 50 (23), 5093–5095.
- Sean W. Fanning and **James R. Horn** (2011) Structure and Thermodynamic Evaluation of an Anti-Hapten Camelid Antibody Reveal High Affinity and Specificity are Facilitated through a Non-Hypervariable Loop. *Protein Science*. 20 (7), 1196–1207. (Featured Cover Art)
- Elliott J. Franco, Gregory J. Sonneson, Thomas J. DeLegge, Heike Hofstetter, **James R. Horn**, and Oliver Hofstetter. (2010) Production and characterization of a genetically engineered anti-caffeine camelid antibody and its use in immunoaffinity chromatography. *J Chromatography B*, 878, 177-186
- Sonneson, G.J. and **Horn, J.R.** (2009) Hapten Induced Dimerization of a Single-Domain VHH Camelid Antibody *Biochemistry*. 48, 6693–6695
- Horn, J.R.**, Sosnick, T., and Kossiakoff, A.K. (2009) Principal determinants leading to transition state formation of a protein-protein complex, orientation trumps side chain interactions. *PNAS* 106, 2559-2564
- Rich, R.L., et. al. (2009) A global benchmark study using affinity-based biosensors *Analytical Biochemistry*. 386, 194-216
- Horn, J.R.**, Kraybill, B., Petro, E., Coales, S.J., Hamuro, Y., and Kossiakoff, A.K. (2006) The role of protein dynamics in increasing binding affinity for an engineered protein-protein interaction established by H/D exchange mass spectrometry *Biochemistry*. 45: 8488-8498
- Kouadio, J.-L., **Horn, J.R.**, Pal, G., and Kossiakoff, A.K. (2005) Evaluation of the binding of “shotgun-alanine shaved” growth hormone variants. *J. Biol. Chem.* 280: 25524-25532
- Horn, J.R.** and Shoichet, B.K. (2004) Allosteric Inhibition through Core Disruption. *J.Mol.Biol.* 336: 1283-91
- Horn, J.R.**, Ramaswamy, S., Murphy, K.P. (2003) Structure and Energetics of Protein-Protein Interactions: The Role of Conformational Heterogeneity in OMTKY3 Binding to Serine Proteases. *J.Mol.Biol.* 331: 497-508
- Horn, J.R.**, Brandts, J, and Murphy, K.P. (2002) Van't Hoff and Calorimetric Enthalpies II: Effects of Linked Equilibria. *Biochemistry* 41:7501-7507.

Horn, J.R., Russel, D.J., Lewis, E.A., and Murphy, K.P. (2001)

Van't Hoff and calorimetric enthalpies from isothermal titration calorimetry: are there significant discrepancies? *Biochemistry* 40:1774-8.

Murphy, K.P., Baker, B.M., Edgcomb, S.P, and **Horn, J.R.** (1999)

Structural Energetics of Serine Protease Inhibition.

Pure Appl. Chem. 71, 1207-1213.

SELECTED PRESENTATIONS

Dionne H. Griffin, Christopher Smith, and James R. Horn. Engineering pH-Dependent Antibody-Hapten Interactions. 28th Annual Gibbs Conference on Biothermodynamics, national meeting, September 20-23, 2014, Carbondale IL

Joy M. Blain, Zheng Zhang, Gashaw M. Goshu, Timothy J. Hagen, and James R. Horn. Investigation of Small Molecule-Enzyme Interactions of *B. pseudomallei* IspF. 28th Annual Gibbs Conference on Biothermodynamics, national meeting, September 20-23, 2014, Carbondale IL

Kyle Mondron, Benjamin Nagy, Christopher Smith, and James R. Horn. Controlling the Biophysical Properties of a VHH Antibody Fusion Protein by Varying Linker Length 28th Annual Gibbs Conference on Biothermodynamics, national meeting, September 20-23, 2014, Carbondale IL

Dionne H. Griffin, Christopher A. Smith, Megan Murtaugh and James R. Horn Engineering pH Dependent Antigen Recognition Through the Incorporation of Histidine Residues into the Binding Interface, 12th Annual Chicago Biomedical Consortium: Protein Engineering: From Computers to Cells to Clinic, Oct. 17th, 2014, University of Illinois, Chicago

Sriram Jakkuraju, Robert James Hoey IV and James R. Horn Understanding Thermodynamic Origins of Enhanced affinity and Its Residue Specific Contributions 12th Annual Chicago Biomedical Consortium: Protein Engineering: From Computers to Cells to Clinic, Oct. 17th, 2014, University of Illinois, Chicago

James R. Horn. Working Collaboratively with Wikis. Teaching with Technology Summit (NIU), June 5th, 2014

Wangtrakuldee, Phumvadee; Sciotti, Richard J.; Miter, Gabriel A.; Zhang, Zheng; Horn, James R.; Hagen, Timothy. Inhibitors of plasmodium falciparum methionine aminopeptidase 2 with antimalarial activities. J. ACS National Meeting & Exposition, Dallas, TX, United States, March 16-20, 2014

Joy M. Blain, Zheng Zhang, Gashaw M. Goshu, Timothy J. Hagen, and James R. Horn "Investigation of Small Molecule-Enzyme Interactions of *B. pseudomallei* IspF Center for Molecular Innovation and Drug Discovery's 19th Annual Drug Discovery Symposium October 9, 2014

Phumvadee Wangtrakuldee, Congling Chen, Bart Staker, Travis Helgren, John M. Wilk, James R. Horn, and Timothy J. Hagen. Discovery of Rickettsia prowazekii Methionine aminopeptidase Inhibitors" Center for Molecular Innovation and Drug Discovery's 19th Annual Drug Discovery Symposium October 9, 2014

James R. Horn. Engineering linked-equilibria into protein interfaces to allow regulation of protein

Interactions. 27th Annual Gibbs Conference on Biothermodynamics, national meeting, October 5-8, 2013, Carbondale IL

Sriram Jakkaraju, Robert James Hoey IV and James R. Horn. Dissection of molecular driving forces of affinity maturation . 27th Annual Gibbs Conference on Biothermodynamics, national meeting, October 5-8, 2013, Carbondale IL

Christopher Smith and James R. Horn. Development of a Selectively Fluorescent VHH Dimer Variant for Small Molecule Detection. 27th Annual Gibbs Conference on Biothermodynamics, national meeting, October 5-8, 2013, Carbondale IL

Katarzyna Bujarska, Christopher Smith, Kyle Muelhausen, and James R. Horn. Generating pH-Dependent Caffeine Recognition in an Anti-Caffeine VHH Antibody through Linked pH-Dependent VHH Dimerization. 26th Annual Gibbs Conference on Biothermodynamics, national meeting, September 22-25, 2012, Carbondale IL

Sriram Jakkaraju and James R. Horn. Thermodynamic Origins of an Enhanced Affinity Antibody: Implications for High-Affinity Protein Engineering. 26th Annual Gibbs Conference on Biothermodynamics, national meeting, September 22-25, 2012, Carbondale IL

Megan Murtaugh and James R. Horn. Investigation of the Thermodynamic Binding Mechanism of an Engineered pH-Dependent Single Domain (VHH) Antibody. 26th Annual Gibbs Conference on Biothermodynamics, national meeting, September 22-25, 2012, Carbondale IL

Christopher Smith, Kevin King, Oliver Hofstetter, and James R. Horn. Development of pH Dependent Single Domain Hapten Binding Antibodies in Immunoaffinity Chromatography. 26th Annual Gibbs Conference on Biothermodynamics, national meeting, September 22-25, 2012, Carbondale IL

Sean Fanning and James R. Horn. Structural and Biophysical Investigations of an Engineered Dual-Function Camelid Antibody Reveal the Mechanism of Metalloregulation. 25th annual Gibbs Conference on Biothermodynamics, national meeting, accepted and scheduled September 17-20, 2011, Carbondale IL

Megan L. Murtaugh and James R. Horn. Characterization of an engineered pH-dependent single domain (VHH) antibody to explore the role of individual histidines in the observed pH sensitivity. 25th annual Gibbs Conference on Biothermodynamics, national meeting, accepted and scheduled September 17-20, 2011, Carbondale IL

Christopher Smith and James R. Horn. Characterization of the Anti-Methotrexate VHH Interface to Engineer pH Dependent Recognition. 25th annual Gibbs Conference on Biothermodynamics, national meeting, accepted and scheduled September 17-20, 2011, Carbondale IL

Kimberly Martin and James R. Horn. Homodimerization of a Single Domain Anti-Picloram (VHH) Antibody. 25th annual Gibbs Conference on Biothermodynamics, national meeting, accepted and scheduled September 17-20, 2011, Carbondale IL

Interface Histidine-Scanning of a Protein Interface to Modulate Protein-Protein Binding
James R. Horn*, Megan L. Murtaugh, Sean Fanning
Protein Society, August 1-5, 2010, San Diego CA

Biophysical Analysis of an Anti-Methotrexate VHH Reveals a Novel Small Molecule-Antibody Binding Mechanism

Sean Fanning* and James R. Horn
Protein Society, August 1-5, 2010, San Diego CA

Homodimeric Hapten Recognition by a Heavy-Chain Only Camelid Antibody
Gregory J. Sonneson* and James R. Horn
Protein Society, August 1-5, 2010, San Diego CA

Presented Talk: Bringing Inquiry-Based Projects into the Biochemistry Lab and the Development of an Online Community Resource to Aid Their Development and Transferability
James R. Horn*
24th annual Gibbs Conference on Biothermodynamics, September 25-28, 2010, Carbondale IL

Engineering pH and Ligand Dependent Binding in a VHH Antibody/Antigen Complex Using Interface Histidine-Scanning
Sean Fanning , Megan L. Murtaugh, Christopher Smith, and James R. Horn*
24th annual Gibbs Conference on Biothermodynamics, September 25-28, 2010, Carbondale IL

Biophysical and Structural Characterization of the Hapten-Induced Dimerization of a Single Domain VHH Camelid Antibody
Christopher Smith*, Greg Sonneson, and James R. Horn
24th annual Gibbs Conference on Biothermodynamics, September 25-28, 2010, Carbondale IL

Murtaugh, M.L, Fanning, S., and Horn, J.R. pH and Ligand Dependent Binding in a VHH Antibody/Antigen Complex Using Interface Histidine-Scanning. 23rd Annual Gibbs Conference on Biothermodynamics. Carbondale IL, October 3-6, 2009.

Sonneson, G.J. and Horn, J.R. Biophysical and Structural Characterization of the Hapten-Induced Dimerization of a Single Domain VHH Camelid Antibody. 23rd Annual Gibbs Conference on Biothermodynamics. Carbondale IL, October 3-6, 2009.

Horn, J.R. Exploring Protein Binding and Design with Minimalist Antibodies. CBBS Seminar, NIU, April 24th, 2009

Horn, J.R. David W. Raymond Grant Award Presentation: Using Wiki-Based Collaborative Authoring in the Lab and Classroom to Enhance Writing and Understanding. NIU, April 16, 2009.

Hoey, R.J. and Horn, J.R. Residue Specific Origins of Enhanced Affinity for an *in vitro* Matured Camelid (VHH) Antibody. 22nd Annual Gibbs Conference on Biothermodynamics. Carbondale IL, October 2008.

Sonneson, G.J. and Horn, J.R. A Non-Conventional Binding Stoichiometry for an Anti-Caffeine VHH Antibody. 22nd Annual Gibbs Conference on Biothermodynamics. Carbondale IL, October 2008.

Horn, J.R., Energetics of Protein-Protein Recognition: Insights into Binding Mechanisms, Design, and Biotherapeutics. ACS Rock River Section, Rockford, IL Feb 26, 2008

Hoey, R. J. and Horn, J.R., Thermodynamic Origins of Enhanced Affinity for an *in vitro* Matured Camelid (VHH) Antibody. 21st Annual Gibbs Conference on Biothermodynamics. Carbondale IL, October 2007.

Horn, J.R., Thermodynamics of Protein-Protein Recognition: Insight into Binding Mechanisms. Presented talk at Current Trends in Microcalorimetry Symposium, Rosemont IL. October 15th, 2007

Hoey R. J. and Horn, J.R. Characterization of an In Vitro Matured Camelid (VHH) Antibody Current Trends in Microcalorimetry Conference. Boston, MA July 18-21, 2007

Horn, J.R. Recognition Pathways and Mechanisms for Enhanced Affinity in Protein-Protein Interactions. Biomolecular Interaction Symposium, University of Chicago, Chicago IL, December 2005

Horn, J.R., Mapping the Binding Pathway Between Human Growth Hormone Variants and Human Growth Hormone Receptor. Institute of Biophysical Dynamics Seminar Series, University of Chicago, Chicago IL, May 2005.

Horn, J.R. Mapping the Binding Pathway Between Human Growth Hormone Variants and Human Growth Hormone Receptor Presented talk at Microcal's Current Trends in Microcalorimetry Symposium, Rosemont IL, November 2004.

Horn, J.R. and Shoichet, B.K. Energetics of Molecular Recognition Between Human Growth Hormone Variants and Human Growth Hormone Receptor Poster presentation at *NW Drug Design Symposium*, Northwestern University, Chicago IL, November 2003

Horn, J.R. High Resolution Docking *Molecular Pharmacology and Biological Chemistry Seminar Series*, Northwestern University, Chicago, IL, February 2003.

Horn, J.R. Structural Insight into the Energetics of Protease-Protease Inhibitor Binding. Presented talk at *Biocatalysis and Bioprocessing Conference*, Iowa City, IA, March 2001.

Horn, J.R. and Murphy, K.P. Analysis of Van't Hoff and Calorimetric Enthalpies From ITC. Poster presentation at *Biophysical Society Meeting*, New Orleans, LA, February 2000.

Horn, J.R. and Murphy, K.P. Analysis of Structure-Energetic Correlations for the Prediction of Protein-Protein Binding Energetics. Poster presentation at *Gibbs Conference on Biothermodynamics*, Carbondale, IL, September 1999.

Horn, J.R. and Murphy, K.P. Evaluation of the Relationship Between Structure and Energetics for the Binding of an Inhibitor to a Serine Protease. Poster presentation at *Biophysical Society Meeting*, Baltimore, MD, February 1999.