

**UTAH STATE UNIVERSITY
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY**

NAME: Scott A. Ensign
TITLE: Professor of Chemistry and Biochemistry
BIRTHDATE: 10-20-61
SPOUSE: Karen K. Ensign
CHILDREN: Stephanie E. Ensign, Michael S. Ensign, Matthew J. Ensign, Mark A. Ensign

EDUCATION

University of Wisconsin-Madison, Ph.D., 1991, Biochemistry

Brigham Young University, B.S., 1986, Chemistry

RESEARCH AND PROFESSIONAL EXPERIENCE

1984 Laboratory assistant under Dr. Dennis McCabe, Agracetus Co., Middleton, Wisconsin

1985-1986 Undergraduate research under Professor Marvin A. Smith, Department of Chemistry and Biochemistry, Brigham Young University. Research Area: Isolation and characterization of chloroplast DNA and RNA from Safflower

1986-1991 Graduate Research Assistant under Professor Paul W. Ludden, Department of Biochemistry, University of Wisconsin-Madison. Research area: Characterization of the nickel and iron-sulfur containing carbon monoxide dehydrogenase from *Rhodospirillum rubrum*.

1991-1993 Postdoctoral Research Associate with Professor Daniel J. Arp, Laboratory for Nitrogen Fixation Research, Oregon State University. Research area: Characterization of ammonia monooxygenase from *Nitrosomonas europaea*; microbial degradation of halogenated hydrocarbons

1993-1998 Assistant Professor, Department of Chemistry and Biochemistry, Utah State University

1998-2002 Associate Professor, Department of Chemistry and Biochemistry, Utah State University

2002-present Professor, Department of Chemistry and Biochemistry, Utah State University

HONORS AND AWARDS

2019 Patriot award for support of students serving in the National Guard and Reserve

2013 Utah State University, Residents Choice Award for Best Professor

- 2007 Recipient, "Excellence in instruction for first year students" award, Utah State University
- 2003 Utah State University College of Science Researcher of the Year
- 2002 Utah State University Eldon J. Gardner award, Teacher of the Year
- 2002 Utah State University College of Science Teacher of the Year
- 2002 Robins Award, Utah State University Professor of the Year
- 2002 Utah State University College of Science Valedictorian Escort
- 2001 Chair, division K, "Microbial physiology and metabolism", American Society for Microbiology
- 2000 Chair-elect, division K, "Microbial physiology and metabolism", American Society for Microbiology
- 1996 NIH-funded research featured in a NIGMS Congressional Research Brief.
- 1996 Research featured in "Journal Highlights", ASM News, May, 1996, vol. 62 (5), p. 260
- 1992 Life Sciences Research Foundation Postdoctoral Fellowship (Oregon State)
- 1991 Abbott Laboratories Research Presentation Award (Wisconsin)
- 1990 College of Agricultural and Life Sciences Fellow (Wisconsin)
- 1987 National Institutes of Health Cellular and Molecular Biology Training Grant (Wisconsin)

PROFESSIONAL SOCIETY AFFILIATIONS

American Society for Microbiology

FUNDING (approximately \$2,940,000 in extramural funds raised to date at USU on grants for which I am the sole P.I. (excludes instrument and co P.I. grants))

National Institutes of Health, Grant number GM51805, "Microbial metabolism of aliphatic alkenes and epoxides". April 1, 1995 to March 31, 2000. \$467,470

National Science Foundation, Science and Technology Infrastructure and Biological Instrumentation. "Purchase of an EPR spectrometer". co P.I. with Vernon Parker (P.I.), Lance Seefeldt, Rick Holz, Danny Blubaugh, Ann Aust, Tom Grover. \$167,000

University Faculty Research Grant Proposal. "Characterization of the Catalytic Mechanism and Metal Centers of Carbon Monoxide Dehydrogenase from *Rhodospirillum rubrum*" July 1 1995 to June 30, 1996. \$15,000.

University Faculty Research Grant Proposal. "Biochemistry of Bacterial Acetone Metabolism". July 1 1996 to June 30, 1997. \$15,000.

The National Science Foundation, Grant number MCB-9630081, "Biochemistry of Bacterial Acetone Metabolism". August 1, 1996 to July 31, 1999. \$295,522.

The National Science Foundation, Grant number MCB-9630081, Research Experience for Undergraduates Supplement,. August 1, 1997 to July 31, 1998. \$8,400. Support for Ruth Anderson and Rachel Merrill.

National Institutes of Health, R-01, Grant number GM51805-06 (competitive renewal), "Microbial metabolism of aliphatic alkenes and epoxides". April 1, 2000 to March 31, 2004, \$849,561.

Dow Chemical Company, Material Transfer Agreement, 2000, \$30,000 direct costs, overhead exempt.

National Institutes of Health, Structure supplement to grant number GM51805 "Microbial metabolism of aliphatic alkenes and epoxides: structure supplement". 2001, \$46,000.

American Society for Microbiology, ASM Undergraduate Research Fellowship program, Research Support for Ryan Sargeant, 2001, \$ 5,000

National Institutes of Health, Bridge money supplement to grant number GM51805 "Microbial metabolism of aliphatic alkenes and epoxide " April 2004, \$67,515.

National Institutes of Health, Bridge money supplement to grant number GM51805 "Microbial metabolism of aliphatic alkenes and epoxide " October 2004, \$67,515.

Department of Energy Division of Energy Biosciences "Proposal to sequence *Xanthobacter autotrophicus* strain Py2" Funded for complete draft sequencing, October, 2004. No monetary award is associated with this proposal, as the sequencing work is performed off site at the Joint Genome Institute.

National Institutes of Health, R-01, Grant number GM51805-10 (competitive renewal), "Microbial metabolism of aliphatic alkenes and epoxides". December 1, 2004 to November 30 2009, \$1,102,720 (direct + indirect).

Teaching with Technology Innovation Grant Proposal, Development of html5- and javascript-based on line instructional resources for use in general chemistry classes, June 2018-June 2019, \$5,000

REVIEWED RESEARCH PUBLICATIONS

- (1). Ensign, S. A., Bonam, D., and Ludden, P.W[†]. **1989** "Nickel is Required for the Transfer of Electrons From Carbon Monoxide to the Iron-sulfur Center(s) of Carbon Monoxide Dehydrogenase from *Rhodospirillum rubrum* ." *Biochemistry* **28**, 4968-4973.
- (2). Ensign, S. A., Hyman, M. R., and Ludden, P.W[†]. **1989** "Nickel-Specific, Slow-Binding, Inhibition of Carbon Monoxide Dehydrogenase from *Rhodospirillum rubrum* by Cyanide." *Biochemistry* **28**, 4973-4979.
- (3). Stephens, P. J., McKenna, M-C, Ensign, S. A., Bonam, D. and Ludden, P. W[†]. **1989** "Identification of a Ni- and Fe-Containing Cluster in *Rhodospirillum rubrum* Carbon Monoxide Dehydrogenase." *J. Biol. Chem.* **264**, 16347-16350.
- (4). Hyman, M. R., Ensign, S. A., Arp, D. J., and Ludden, P. W[†]. **1989** "Carbonyl Sulfide Inhibition of CO Dehydrogenase from *Rhodospirillum rubrum*." *Biochemistry* **28**, 6821-6826.
- (5). Ensign, S. A., Campbell, M. J., and Ludden, P. W[†]. **1990** "Activation of the Nickel-Deficient Carbon Monoxide Dehydrogenase from *Rhodospirillum rubrum* : Kinetic Characterization and Reductant Requirement." *Biochemistry* **29**, 2162-2168.
- (6). Ensign, S. A., and Ludden, P. W[†]. **1991** "Characterization of the CO oxidation/ H₂ Evolution System of *Rhodospirillum rubrum*. Role of a 22 kDa, Iron-sulfur Protein in Mediating Electron Transfer Between Carbon Monoxide Dehydrogenase and Hydrogenase." *J. Biol. Chem.*, **266**, 18395-18403.
- (7). Tan, G. O., Ensign, S. A., Ciurli, S., Scott, M. J., Hedman, B., Holm, R. H., Ludden, P. W., Korszun, R., Stephens, P. J., and Hodgson, K. O[†]. **1992** "On the Structure of the Ni-Fe-S Center of the Carbon Monoxide Dehydrogenase from *Rhodospirillum rubrum*; an X-ray Absorption Spectroscopy Study." *Proc. Natl. Acad. Sci. USA*, **89**, 4427-4431.
- (8). Smith, E. T., Ensign, S. A., Ludden, P. W., and Feinberg, B. A[†]. **1992** "Direct Electrochemical Studies of Hydrogenase and CO Dehydrogenase." *Biochem. J.*, **285**, 181-185.
- (9). Kerby, R. L., Hong, S. S., Ensign, S. A., Coppoc, L. J., Ludden, P. W., and Roberts, G. P[†]. **1992** "Genetic and Physiological Characterization of the *Rhodospirillum rubrum* Carbon Monoxide Dehydrogenase System." *J. Bacteriol.*, **174**, 5284-5294.
- (10). Ensign, S. A., Hyman, M. R., and Arp, D. J[†]. **1992** "Cometabolic Degradation of Chlorinated Alkenes by Alkene Monooxygenase in a Propylene-Grown *Xanthobacter* strain." *Appl. Environ. Microbiol.*, **58**, 3038-3046.
- (11). Ensign, S. A. Hyman, M. R., and Arp, D. J[†]. **1993** "In vitro Activation of Ammonia Monooxygenase from *Nitrosomonas europaea* by Copper." *J. Bacteriol.*, **175**, 1971-1980
- * (12) Seefeldt, L. C[†]. and Ensign, S. A. **1994** "A Continuous Spectrophotometric Activity Assay for Nitrogenase Using the reductant Titanium (III) Citrate." *Analytical Biochemistry*, **221**, 379-386.

- *(13) Small, F. J., Tilley, J. K. and Ensign, S. A[†]. **1995** "Characterization of a New Pathway for Epichlorohydrin Degradation by Whole Cells of *Xanthobacter* strain Py2." *Appl. Environ. Microbiol.* **61**, 1507-1513.
- *(14) Ensign, S. A[†]. **1995** "Reactivity of Carbon Monoxide Dehydrogenase from *Rhodospirillum rubrum* with Carbon Dioxide, Carbonyl Sulfide, and Carbon Disulfide." *Biochemistry*, **34**, 5372-5381.
- *(15) Seefeldt, L. C[†]., Rasche, M. E., and Ensign, S. A. **1995** "Carbonyl Sulfide and Carbon Dioxide as New Substrates and Carbon Disulfide as a New Inhibitor of Nitrogenase." *Biochemistry*, **34**, 5382-5389.
- *(16) Small, F. J. and Ensign, S. A[†]. **1995** "Carbon Dioxide Fixation in the Metabolism of Propylene and Propylene oxide by *Xanthobacter* strain Py2" *J. Bacteriol.* **177**, 6170-6175.
- *(17) Ensign, S. A[†]. **1996** "Aliphatic and chlorinated alkenes and epoxides as inducers of alkene monooxygenase and epoxidase activities in *Xanthobacter* strain Py2" *Appl. Environ. Microbiol.* **62**, 61-66.
- *(18) Allen, J.R. and Ensign, S.A[†]. **1996** "Carboxylation of Epoxides to β -Keto Acids in Cell Extracts of *Xanthobacter* Strain Py2" *J. Bacteriol.* **178**, 1469-1472.
- *(19) Sluis M. K., Small, F. J., Allen, J.R. and Ensign, S.A[†]. **1996** "Involvement of an ATP-Dependent Carboxylase in a CO₂-Dependent Pathway of Acetone Metabolism by *Xanthobacter* strain Py2" *J. Bacteriol.* **178**, 4020-4026.
- *(20) Allen, J.R. and Ensign, S.A[†]. **1997** "Characterization of Three Protein Components Required for Functional Reconstitution of the Epoxide Carboxylase Multienzyme Complex from *Xanthobacter* strain Py2" *J. Bacteriol.*, **179**, 3110-3115.
- *(21) Sluis M. K. and Ensign, S.A[†]. **1997** "Purification and Characterization of Acetone Carboxylase from *Xanthobacter* strain Py2" *the Proceedings of the National Academy of Sciences*, **94**, 8456-8461.
- *(22) Small, F. J. and Ensign, S. A[†] **1997** "Alkene Monooxygenase from *Xanthobacter* strain Py2: Purification and Characterization of A Four-Component System Central to the Bacterial Metabolism of Aliphatic Alkenes" *the Journal of Biological Chemistry* **272**, 24913-24920.
- *(23) Holz, R. C[†]., Small, F. J., and Ensign, S. A[†]. **1997** "¹H NMR Investigation of the [2Fe-2S]¹⁻ Containing "Rieske-Type" Protein from *Xanthobacter* Strain Py2" *Biochemistry*, **36**, 14690-14696.
- *(24) Allen, J.R. and Ensign, S.A[†]. **1997** "Purification to homogeneity and reconstitution of the individual components of the epoxide carboxylase multiprotein enzyme complex from *Xanthobacter* strain Py2." *the Journal of Biological Chemistry* **272**, 32121-32128.

- * (25) Ensign, S. A.†, Small, F. J., Allen, J. R., and Sluis, M. K. **1998** "New Roles for CO₂ in the Microbial Metabolism of Aliphatic Epoxides and Ketones" *Archives of Microbiology*, **169**, 179-187.
- * (26) Allen, J.R. and Ensign, S.A†. **1998** "Identification and characterization of epoxide carboxylase activity in cell extracts of *Nocardia corallina* strain B276" *the Journal of Bacteriology*, **180**, 2072-2078.
- * (27) Allen, J.R. and Ensign, S.A†. **1999** " Two Short-Chain Dehydrogenases Confer Stereoselectivity for Enantiomers of Epoxypropane in the Multiprotein Epoxide Carboxylating Systems of *Xanthobacter* strain Py2 and *Nocardia corallina* B276." *Biochemistry*, **38**, 247-256.
- * (28) Clark, D. D. and Ensign, S. A†. **1999** "Evidence for an inducible nucleotide-dependent acetone carboxylase in *Rhodococcus rhodochrous* strain B276" *J. Bacteriol.*, **181**, 2752-2758.
- * (29) Allen, J.R., Clark, D. D., Krum, J. G., and Ensign, S.A†. **1999** "A role for coenzyme M (2-mercaptoethanesulfonic acid) in a bacterial pathway of aliphatic epoxide carboxylation" *the Proceedings of the National Academy of Sciences*, 96:8432-8437.
- * (30) Meckenstock R.U., Krieger R., Ensign S., Kroneck P.M., Schink B.† **1999**" Acetylene hydratase of *Pelobacter acetylenicus*: Molecular and spectroscopic properties of the tungsten iron-sulfur enzyme" *Eur. J. Biochem.*, 264:176-182.
- * (31) Clark, D. D., Allen, J. R. and Ensign, S. A. † **2000** " Characterization of Five Catalytic Activities Associated with the NADPH:2-ketopropyl-Coenzyme M [2-(2-ketopropylthio)ethanesulfonate] Oxidoreductase/Carboxylase of the *Xanthobacter* Strain Py2 epoxide carboxylase system" *Biochemistry*. 39:1294-1304.
- * (32) Krum, J. G. and Ensign, S. A†. **2000** "Heterologous expression of bacterial epoxyalkane:coenzyme M transferase and inducible coenzyme M biosynthesis in *Xanthobacter* strain Py2 and *Rhodococcus rhodochrous* B276" *J. Bacteriol.* 182: 2629-2634.
- * (33) Krum, J. G. and Ensign, S. A†. **2001** "Evidence that a linear megaplasmid in *Xanthobacter* strain Py2 encodes enzymes of aliphatic alkene and epoxide metabolism and Coenzyme M (2-mercaptoethanesulfonate) biosynthesis" *J. Bacteriol.* 183, 2172-2177.
- * (34) Jang, S. B., Jeong, M. S., Clark, D. D., Ensign, S. A., Peters, J. W†. **2001** "Characterization and preliminary X-ray analysis of a NADPH:2-ketopropyl-Coenzyme M Oxidoreductase/ Carboxylase" *Acta Crystallographica*, 57, 445-447.
- * (35) Ensign, S. A†. **2001** "Microbial Metabolism of Aliphatic Alkenes", *Biochemistry*, 40, 5845-5853.
- * (36) Clark, D. D. and Ensign, S. A† **2002** "Characterization of the 2-[(R)-2-hydroxypropylthio] ethanesulfonate Dehydrogenase from *Xanthobacter* strain Py2: Product Inhibition, pH-Dependence of Kinetic Parameters, Site-Directed Mutagenesis, Rapid-Equilibrium Inhibition, and Chemical Modification". *Biochemistry*, 41, 2727-2740.

- * (37) Krum, J. G., Ellsworth, H. Sargeant, R., Rich, G., and Ensign, S. A[†]. **2002** "Kinetic and Microcalorimetric Analysis of Substrate and Cofactor Interactions in Epoxyalkane:CoM Transferase: a Zn-Dependent Epoxidase". *Biochemistry*, *41*, 5005-5014.
- * (38) Sluis M. K., Larsen, RA., Krum, J. G., Anderson, R., Metcalf, W. W. and Ensign, S.A[†]. **2002** "Biochemical, molecular and genetic characterization of the acetone carboxylases from *Rhodobacter capsulatus* and *Xanthobacter* strain Py2". *J. Bacteriol.* *184*, 2969-2977.
- * (39) Nocek, B., Clark, D.D., Ensign, S.A., Peters, J.W[†]. **2002** "Crystallization and preliminary X-ray analysis of an R-2-hydroxypropyl-coenzyme M dehydrogenase" *Acta Crystallographica*, *58*: 1470-1473.
- * (40) Nocek, B., Jang, S. B., Jeong, M. S., Clark, D. D., Ensign, S. A., Peters, J. W[†]. **2002** "Structural basis for CO₂ fixation by a novel member of the disulfide oxidoreductase family of enzymes: 2-ketopropyl-Coenzyme M Oxidoreductase/ Carboxylase" *Biochemistry*, *41*, 12907-12913.
- * (41) Ensign, S. A[†]. and Allen, J. R. **2003** "Aliphatic Epoxide Carboxylation" *Annual Review of Biochemistry*, *72*, 55-76.
- * (42) Nocek B, Boyd J, Ensign SA, Peters JW[†] **2004** "Crystallization and preliminary X-ray analysis of an acetone carboxylase from *Xanthobacter autotrophicus* strain Py2" *ACTA CRYSTALLOGRAPHICA D* *60*: 385-387
- * (43) Clark, D. D., Boyd, J.M., and Ensign, S. A[†] **2004** "The Stereoselectivity and Catalytic Properties of *Xanthobacter autotrophicus* 2-[(R)-2-Hydroxypropylthio]ethanesulfonate Dehydrogenase Are Controlled by Interactions between C-Terminal Arginine Residues and the Sulfonate of Coenzyme M" *Biochemistry*, *43*, 6763-6771.
- * (44) Boyd, J. M., Ellsworth, H. and Ensign, S. A[†]. **2004** "Bacterial acetone carboxylase is a manganese-dependent metalloenzyme" *The Journal of Biological Chemistry*, *279*, 46644-46651.
- * (45) Boyd, J. M. and Ensign, S. A[†]. **2005** "ATP-dependent Enolization of Acetone by Acetone Carboxylase from *Rhodobacter capsulatus*" *Biochemistry*, *44*, 8543-8553.
- * (46) Wampler, D. A. and Ensign, S. A[†]. **2005** "Photoheterotrophic metabolism of Acrylamide by a Newly Isolated Strain of *Rhodospseudomonas palustris*" *Appl. Environ. Microbiol.* *71*, 5850-5857.
- * (47) Boyd, J. M. and Ensign, S. A[†]. **2005** "Evidence for a Metal-Thiolate Intermediate in Alkyl Group Transfer from Epoxypropane to Coenzyme M and Cooperative Metal Ion Binding in Epoxyalkane:CoM Transferase" *Biochemistry*, *44*, 13151-13162.
- * (48) Pandey, A. S., Nocek, B., Clark, D.D. Ensign, S.A. and Peters, J. W[†]. **2006** "Mechanistic Implications of the Structure of the Mixed-Disulfide Intermediate of the Disulfide

Oxidoreductase, 2-Ketopropyl-Coenzyme M Oxidoreductase/Carboxylase” *Biochemistry*, 45, 113-120.

*(49) Krishnakumar, A. M. Nocek, B. P., Clark, D.D. Ensign, S. A. and Peters, J.W.†. **2006** “Structural Basis for Stereoselectivity in the (*R*)- and (*S*)-Hydroxypropylthioethanesulfonate Dehydrogenases” *Biochemistry*, 45, 8831-8840.

*(50) Ensigns, S.A.†. **2006** “Revisiting the glyoxylate cycle: alternative pathways for microbial acetate assimilation” *Molecular Microbiology*, 61, 274-276.

*(51) Boyd, J. M., Ellsworth, A., and Ensign, S. A.†. **2006** “Characterization of 2-Bromoethanesulfonate as a Selective Inhibitor of the Coenzyme M-Dependent Pathway and Enzymes of Bacterial Aliphatic Epoxide Metabolism” *The Journal of Bacteriology*, 188, 8062-8069.

* (52) Krishnakumar, A.M. Sliwa, D. Endrizzi, J. A., Boyd, E.S., Ensign, S.A. and Peters, J.W. **2008** “Getting a Handle on the Role of Coenzyme M in Alkene Metabolism” *Microbiol. Mol. Biol. Rev.* 2008 72: 445-456.

* (53) Sliwa, D., Krishnakumar, A., Peters, J.W., and Ensign S.A.†. **2010** “Molecular basis for enantioselectivity in the (*R*)- and (*S*)-hydroxypropylthioethanesulfonate dehydrogenases, a unique pair of stereoselective short-chain dehydrogenases/reductases involved in aliphatic epoxide carboxylation”. *Biochemistry*, 49, 8831-8840.

*(54) Boyd, J.M. Clark, D.D. Kofoed, M.A. and Ensign, S.A. † **2010** "Mechanism of Inhibition of Aliphatic Epoxide Carboxylation by the Coenzyme M Analog 2-Bromoethanesulfonate" *The Journal of Biological Chemistry* 285: 25232-25242.

*(55) Kofoed, M.A. DA Wampler, AS Pandey, JW Peters, and Ensign, S.A. † **2011** “Roles of the redox active disulfide, and histidine residues forming a catalytic dyad, in reactions catalyzed by 2-Ketopropyl-Coenzyme M Oxidoreductase/Carboxylase” *The Journal of Bacteriology* 193,, 4904-4913.

*(56) Arti S Pandey, David W Mulder, Scott A Ensign, John W Peters. “Structural basis for carbon dioxide binding by 2-ketopropyl coenzyme M oxidoreductase/carboxylase” *FEBS letters*, 585, 459-464.

(57) Mathangi Soundararajan, Rhesa Ledbetter, Paul Kusuma, Shuyang Zhen, Paul Ludden, Bruce Bugbee, Scott Ensign, Lance C Seefeldt **2019** "Phototrophic N₂ and CO₂ Fixation using a Rhodospseudomonas palustris-H₂ Mediated Electrochemical System with Infrared Photons. *Frontiers Microbiology*, 10, 1817.

*publications submitted/published at Utah State University

†corresponding author/P. I.

Other publications.

Copeland A., Lucas S., Lapidus A., Barry K., Glavina del Rio T., Hammon N., Israni S., Dalin E., Tice H., Pitluck S., Sims D., Brettin T., Bruce D., Detter J.C., Han C., Tapia R., Brainard J., Schmutz J., Larimer F., Land M., Hauser L., Kyrpides N., Kim E., **Ensigns S.A.**, Richardson P. ; "Complete sequence of chromosome of *Xanthobacter autotrophicus* Py2."; Submitted (JUL-2007) to the EMBL/GenBank/DDBJ databases. (Note: I was the sole PI on the proposal to sequence *X. autotrophicus* and provided the genomic and plasmid DNA for the project. The sequencing and annotation was performed by JGI. I am listed as the contact person for the project.

INVITED TALKS (presented while at Utah State University)

November 18, 1993, Department of Chemistry and Biochemistry, Brigham Young University.

March 7, 1994, Biochemistry Colloquium Seminar Series, Department of Biochemistry, University of Wisconsin-Madison.

June 15, 1995, *Joint Northwest and Rocky Mountain Regional Meeting of the American Chemical Society*, Park City Utah.

September 12, 1996, Department of Microbiology, Michigan State University.

October 22, 1996, Department of Biochemistry, University of Nebraska.

December 30, 1996 Scripps Research Institute, San Diego, CA.

January 28, 1997, Department of Chemistry and Biochemistry, Brigham Young University.

March 10, 1997, Department of Biochemistry, Kansas State University.

April 1, 1998, Department of Microbiology, University of Freiburg, Germany

April 3, 1998, Department of Biology, University of Konstanz, Germany

April 8, 1998, *Novel Reactions and Catalytic Mechanisms in Anaerobic Microorganisms symposium*, Rothenburg, Germany

April 9, 1998, Max Planck Institute for Terrestrial Biology, Marburg, Germany

July, 1998, *Gordon Research Conference on The Molecular Basis of Microbial One-Carbon Metabolism*, June 28 to July 3, 1998, Henniker, New Hampshire.

August, 1998, Department of Biochemistry, University of Wisconsin-Madison

August, 1998, Biocatalysis session of *the National Meeting of the American Chemical Society*, August 23-27, Boston, Massachusetts.

September 30, 1998, Department of Biochemistry, University of Minnesota

May 1999 Speaker and Session co-convener, "Microbial metabolism of aliphatic hydrocarbons", *the 99th General meeting of the American Society for Microbiology*, Chicago, Illinois.

September 9, 1999, Department of Microbiology, University of Illinois, Urbana Champaign

September 23, 1999, Department of Bacteriology, University of Wisconsin-Madison

March 2, 2000 Department of Microbiology, The Ohio State University

May 2000 Speaker and Session co-convener, "Parallel catabolic components of methanogenic archaea and bacterial methylotrophs and actinomycetes" *the 100th General meeting of the American Society for Microbiology* Los Angeles, CA.

July 2000 *Gordon Research Conference on the Molecular Basis of Microbial One-Carbon Metabolism*, New London, Connecticut.

September 2000 Department of Biochemistry, Virginia Polytechnic University

October 2000, Dow Chemical Company, San Diego, CA

October 2000, *J.C. Ensign Retirement Symposium on Microbial Diversity*, University of Wisconsin-Madison, Madison, WI.

June 2002, Dow Chemical Company, San Diego, CA

August 2003, Society for Industrial Microbiology Annual Meeting, Minneapolis, MN

May 2004, Program in Molecular and Cellular Biology, University of California-Berkeley

September 2006 Department of Chemistry and Biochemistry, Brigham Young University.

February 2007 Program in cellular and molecular biology, Oregon State University

April 2007, Department of Chemistry and Biochemistry, Montana State University

May 2007, Department of Chemistry and Biochemistry, California State University-Chico

December 2009, Opening plenary lecture, West Coast Bacterial Physiologists Meeting, Asilomar, CA

May 2010, Department of Microbiology, University of Iowa

MEETING ABSTRACTS /PAPERS/ POSTER PRESENTATIONS (while at Utah State University)

August, 1993, *International Conference on Bioinorganic Chemistry*, San Diego, CA. Ensign, S. A[†] §., Hyman, M. R., and Arp, D. J. Poster presentation: "In vitro Characterization of Ammonia Monooxygenase from *Nitrosomonas europaea*"

May 1995, *10th International Congress on Nitrogen Fixation*, St. Petersburg, Russia, Published Abstract and Poster presentation. Seefeldt, L. C[†] §., Rasche, M. E., and Ensign, S. A. "Carbonyl Sulfide and Carbon Dioxide as New Substrates and Carbon Disulfide as a New Inhibitor of Nitrogenase."

June 1995, *Joint Northwest and Rocky Mountain Regional Meeting of the American Chemical Society*, Park City Utah. Chair, Biochemistry session, Thursday, June 15.

August 1995, *8th International C₁ Symposium*, San Diego, CA. Small, F. J. § and Ensign, S. A[†]. Published Abstract and Poster presentation: "Possible Involvement of Carbon Dioxide Fixation in the Metabolism of Aliphatic Alkenes and Epoxides by *Xanthobacter* Strain Py2".

August 1995, *8th International C₁ Symposium*, San Diego, CA. Published Abstract and Poster presentation: Ensign, S. A[†] §., Seefeldt, L. C., Rasche, M. E. "Reactivities of carbon dioxide, carbonyl sulfide, and carbon disulfide with the metalloenzymes nitrogenase and carbon monoxide dehydrogenase".

August 1995, *8th International C₁ Symposium*, San Diego, CA. Allen, J. R. §. and Ensign, S. A[†]. Published Abstract and Poster presentation: "In vitro studies of epoxide carboxylation in *Xanthobacter* strain Py2".

May, 1996, *96th General Meeting of the American Society for Microbiology*, New Orleans, LA. Allen, J.R., Small, F. J. and Ensign, S.A[†] §. Published Abstract and Poster presentation: "Characterization of a Novel CO₂-Dependent Route for Aliphatic Epoxide Metabolism in *Xanthobacter* Strain Py2"

May, 1997, *97th General Meeting of the American Society for Microbiology*, Miami, Florida. Sluis, M. K. § and Ensign, S.A[†] . Published Abstract and Poster presentation: "Purification and Characterization of Acetone Carboxylase from *Xanthobacter* strain Py2"

June, 1997, *25th Steenbock Symposium*, Madison, WI. Convenor, Session on biosynthesis and function of nickel centers in proteins.

June, 1997, *25th Steenbock Symposium*, Madison, WI. Small, F. J. §. and Ensign, S. A[†]. Published Abstract and Poster presentation: "Purification of a Four Component Alkene Monooxygenase from *Xanthobacter* strain Py2:

June, 1997, *25th Steenbock Symposium*, Madison, WI. Allen, J. R. §. and Ensign, S. A[†]. Published Abstract and Poster presentation: "Characterization of Four Protein Components

Required for Functional Reconstitution of the Epoxide Carboxylase Multienzyme Complex from *Xanthobacter* strain Py2"

June, 1997, *25th Steenbock Symposium*, Madison, WI. Ensign, S.A.^{† §} and Sluis, M. K. Published Abstract and Poster presentation: "Purification and Characterization of an ATP-Dependent Acetone Carboxylase from *Xanthobacter* strain Py2"

April, 1998, *Deutsche Forschungsgemeinschaft Symposium on Novel Reactions and Catalytic Mechanisms in Anaerobic Microorganisms*, Rothenburg, Germany

July, 1998, *Gordon Research Conference on The Molecular Basis of Microbial One-Carbon Metabolism*, Henniker, New Hampshire. M. K. Sluis[§], D. D. Clark, S. A. Ensign[†], Poster presentation, "Characterization of the CO₂- and nucleotide-dependent acetone carboxylases from *Xanthobacter* Py2 and *Nocardia corallina* B276"

July, 1998, *Gordon Research Conference on The Molecular Basis of Microbial One-Carbon Metabolism* Henniker, New Hampshire. J. R. Allen[§] and S. A. Ensign[†], Poster presentation, "Purification and characterization of the epoxide carboxylase from *Nocardia corallina* strain B276 and comparison to the epoxide carboxylase from *Xanthobacter* Py2"

August, 1998, *National Meeting of the American Chemical Society*, Boston, Massachusetts. Published abstract, S.A. Ensign[†], F.J. Small, J.R. Allen, J. G. Krum, "Biochemistry of microbial aliphatic alkene and epoxide transformations"

January 1999, *Gordon Research Conference on Bioinorganic chemistry/Graduate Research Seminar* Ventura, CA. J. R. Allen[§] and S. A. Ensign[†], Seminar by J. R. Allen entitled "Role of a zinc metalloenzyme in activation of epoxides for the multiprotein epoxide carboxylating systems from *Xanthobacter* strain Py2"

February 1999, *American Society for Microbiology Intermountain Branch Meeting*, Ogden, UT. "Cloning, Expression, and Activation of the Microbial Pathway for Epoxide Degradation from *Xanthobacter* strain Py2 in *E. coli*." JONATHAN G. KRUM[§] and SCOTT A. ENSIGN[†].

May 1999. *99th General meeting of the American Society for Microbiology*, Chicago, Illinois, Session organizer "Microbial metabolism of aliphatic hydrocarbons"

May, 1999, *99th General Meeting of the American Society for Microbiology*, Chicago, Illinois. Sluis, M. K.[§] and Ensign, S.A.[†]. Published Abstract and Poster presentation: "ATP-dependent Acetone Carboxylases from *Xanthobacter* strain Py2 and *Rhodobacter capsulatus* strain B10"

May, 1999, *99th General Meeting of the American Society for Microbiology*, Chicago, Illinois. Clark, D. D.[§] and Ensign, S.A.[†]. Published Abstract and Poster presentation: " Evidence for an inducible nucleotide-dependent acetone carboxylase in *Rhodococcus rhodochrous* strain B276"

May, 1999, *99th General Meeting of the American Society for Microbiology*, Chicago, Illinois. Krum, J. G. [§] and Ensign, S.A.[†]. Published Abstract and Poster presentation: " Cloning and expression of the epoxide carboxylase from *Xanthobacter* strain Py2 in *E. Coli*."

May 2000, *American Society for Microbiology Intermountain Meeting*, Provo, UT. JONATHAN G. KRUM[§] and SCOTT A. ENSIGN[†] Paper presentation, “Development of a CoM (Coenzyme M, 2-mercaptoethansulfonate) bioassay for the identification of the inducible CoM biosynthetic pathway with aliphatic alkene utilization in *Xanthobacter* strain Py2 and *Rhodococcus rhodochrous* B276”.

June 2000, *Gordon Research Conference on The Molecular Basis of Microbial One-Carbon Metabolism*, New London, Connecticut. Clark, D. D.[§] and Ensign, S.A[†] Poster, “New insight into the coenzyme M-dependent pathway of epoxide metabolism and CO₂ fixation in *Xanthobacter* strain Py2”

June 2000, *Gordon Research Conference on The Molecular Basis of Microbial One-Carbon Metabolism*, New London, Connecticut. Krum, J. G. [§] and Ensign, S.A[†] “Location of the CoM employing propylene metabolic pathway on a linear megaplasmid in *Xanthobacter* strain Py2”.

May 2001, *American Society for Microbiologist Intermountain Meeting*, Pocatello, Idaho. JONATHAN G. KRUM[§] and SCOTT A. ENSIGN[†]. Paper presentation , “Novel Strategy for Determining the Genetic Location of the Alkene Oxidation genes in *Xanthobacter* strain Py2”

May 2001, *American Society for Microbiology Intermountain Meeting*, Pocatello, Idaho. MATT MCIFF[§], JONATHAN G. KRUM, and SCOTT A. ENSIGN[†]. Paper presentation, “pKa Determination of Enzyme Bound Coenzyme M with the Epoxyalkane:Coenzyme M Transferase”

May 2001, *American Society for Microbiology Intermountain Meeting*, Pocatello, Idaho. RYAN SARGEANT[§], JONATHAN G. KRUM, GREGORY RICH, and SCOTT A. ENSIGN[†]. Poster presentation, “Isothermal Titration Calorimetry Studies of the Epoxyalkane:Coenzyme M Transferase from *Xanthobacter* strain Py2”.

May 2001, *American Society for Microbiology Intermountain Meeting*, Pocatello, Idaho. HEATHER ELLSWORTH[§], JONATHAN G. KRUM, GREGORY RICH, and SCOTT A. ENSIGN[†]. Poster presentation, “Kinetic Characterization of the Epoxyalkane:Coenzyme M Transferase from *Xanthobacter* strain Py2”.

May, 2002, *102nd General Meeting of the American Society for Microbiology*, Salt Lake City, Utah. Heather Ellsworth, Jonathan G. Krum and Ensign, S.A[†] . Published Abstract and Poster presentation: " Kinetic investigation of the epoxyalkane:Coenzyme M transferase"

May, 2002, *102nd General Meeting of the American Society for Microbiology*, Salt Lake City, Utah. Rachel A. Larsen and Ensign, S.A[†] . Published Abstract and Poster presentation: " Acetone metabolism in *Xanthobacter autotrophicus* strain Py2"

May, 2002, *102nd General Meeting of the American Society for Microbiology*, Salt Lake City, Utah. Jeffrey M. Boyd, Rachel A. Larsen and Ensign, S.A[†] . Published Abstract and Poster presentation: "Cloning and characterization of a putative aldehyde dehydrogenase required for growth on alkenes from *Xanthobacter autotrophicus* strain Py2"

August, 2003, Annual Meeting of the Society for Industrial Microbiology, Minneapolis, MN. Abstract and talk, D. D. Clark and S. A. Ensign* "A new method for altering stereoselectivity of chiral alcohol formation in an aqueous biocatalysis system using *Xanthobacter autotrophicus* R-2-hydroxypropyl-CoM dehydrogenase and enantioselective modulators"

May, 2004, *104th General Meeting of the American Society for Microbiology*, New Orleans, LA. D. Wampler and Ensign, S.A[†]. Published Abstract and Poster presentation: "An Anaerobic Photoheterotrophic Degradation Pathway of a Toxic Alkene-Amide: Acrylamide"

May, 2004, *104th General Meeting of the American Society for Microbiology*, New Orleans, LA. A. Bucio and Ensign, S.A[†]. Published Abstract and Poster presentation: ""Expression and Characterization of NADPH: 2-Ketopropyl-Coenzyme M Oxidoreductase/Carboxylase (2-KPCC) of *Xanthobacter autotrophicus* Strain Py2"

July, 2004 *Gordon Research Conference on The Molecular Basis of Microbial One-Carbon Metabolism*, New London, Connecticut. Boyd, J.M.[§] and Ensign, S.A[†] Poster, "TITLE"

May, 2006 *106th General Meeting of the American Society for Microbiology*, New Orleans, LA. G. Velazquez and Ensign, S.A[†]. Published Abstract and Poster presentation: "Molecular and biochemical characterization of the acetone carboxylase from *Azotobacter vinelandii*"

August, 2008, *236th ACS National Meeting & Exposition*, Philadelphia, PA., Sliwa, D.A., Krishnakumar, A.M., Peters, J.W. and Ensign S.A[†]. Published Abstract and Poster presentation: "Stereoselectivity and kinetics of R- and S-hydroxypropyl-CoM dehydrogenases from *Xanthobacter autotrophicus* Py2"

March 2010, ACS National Meeting, San Francisco Sliwa, D.A., Krishnakumar, A.M., Peters, J.W. and Ensign S.A[†]. Published Abstract and Poster presentation: "Understanding the mechanism of catalysis and stereoselectivity of R- and S-hydroxypropyl CoM dehydrogenases from *Xanthobacter autotrophicus* strain Py2"

PROFESSIONAL ACTIVITIES

1/2009 – 12/2011, Editorial Board, *Journal of Bacteriology*

2007-2011, Chartered member, Prokaryotic and Cellular Molecular Biology Study Section (MBC-1), National Institute of General Medical Sciences, National Institutes of Health.

2006, Ad-hoc Member, Prokaryotic and Cellular Molecular Biology Study Section (MBC-1), National Institute of General Medical Sciences, National Institutes of Health.

2002-2008, Editorial Board, *Applied and Environmental Microbiology*

2001: Chair, Division K, American Society for Microbiology

2001, Member, National Institutes of Health Center for Scientific Review Special Emphasis Panel, July 16, 2001

2000: Chair-Elect, Division K, American Society for Microbiology

1999: Ad-hoc Member, Microbial Physiology and Genetics Study Section (MBC-1), National Institute of General Medical Sciences, National Institutes of Health. Washington, D. C., Oct. 27-28, 1999.

1998 to 2005: Editor for *Archives of Microbiology*.

1997: Ad-Hoc Member, Microbial Physiology and Genetics Study Section (MBC-1), National Institute of General Medical Sciences, National Institutes of Health. Washington, D. C., Feb. 26-28, 1997.

Grant reviews: Among others: U. S. Department of Energy-Energy Biosciences, United States Department of Agriculture, National Science Foundation , National Institutes of Health.

Manuscript reviews: *Journal of Biological Chemistry, Biochemistry, Applied and Environmental Microbiology, The Journal of Bacteriology, Microbiology (UK), European Journal of Biochemistry, Archives of Microbiology, Journal of Biological Inorganic Chemistry, Molecular Microbiology, Biotechnology and Bioengineering, Journal of Inorganic Biochemistry* (among others).

POSTDOCTORALS TRAINED

Rachel Larsen, PhD, University of Illinois-Urbana, April 2001 to August 2003, present position: Research scientist, UC-San Diego, San Diego, CA.

GRADUATE STUDENTS TRAINED

Fred Small, Ph. D. candidate, 1994 to 1997 (deceased, July 15, 1997). Fred's Ph.D. degree was conferred posthumously at Spring commencement, 1998.

Jeff Allen, Ph. D. candidate, 1995 to 1999, Ph.D. conferred, spring '99, present position: Senior Scientist and Group leader, Dow Chemical Biotechnology, San Diego, CA.

Miriam Sluis, Ph. D. candidate, 1995 to 2000, Ph.D. conferred, August '00, present position: Research scientist, Gene Check Co., Fort Collins, CO.

Jon Krum, Ph. D. candidate, 1997 to 2001, Ph. D. conferred 2002: Present position: Department head in Biology, College of Eastern Utah, Price, UT

Dan Clark, Ph. D. candidate, 1997 to 2001, Ph. D. conferred 2002 Present position: Assistant Professor, California State University, Chico CA.

Jeff Boyd, Ph. D. candidate, 2000 to 2005. Ph.D. conferred 2006 Present position: Assistant Professor, Dept. of Microbiology, Rutgers University

Antonio Bucio, M. S. candidate, July 2001 to 2005. M.S. conferred 2005

David Wampler, Ph. D. candidate, January 2003 to 2007; present position, Assistant Professor, University of Texas Health Science Center San Antonio

Gabriel Velazquez, Ph. D. candidate, June 2003 to 2008; dismissed from PhD program.

Dariusz Sliwa, Ph. D. candidate, January 2005 to present

Ashwini Wagh, M. S. 2008. Present: PhD student with Marie Walsh

Missy Beighley, Ph. D. candidate, January 2006 to present

Ameya Mashrumala, Ph. D. candidate, January 2007 to present
Brandon Russell, Ph. D. candidate, September 2008 to 2010. left program in 2010 for family reasons.

UNDERGRADUATE STUDENTS TRAINED

Jim Tilley, 1993-1994
Parrish Balcena, 1994-1996
Carrie Layton, 1996
Jason Olsen, 1996-97
Justin Wilkinson, 1996 to 97
Lee Crosby, 1997
Mark Harris, 1997-1998
Scott Hansen, 1998
Rachel Merrill, 1998 to 2000
Ruth Anderson, 1998-1999
Collin Anderson, 1998
Jenny Virgin, 1998-2000
Katie Pilkington, 1999-2000
Greg Rich, 1999 to 2000
Matt McIff, 1999 to 2001
Lillian Buehler, 2000
Ryan Sargent, 2000 to 2002
Mike Wilkinson, 2000 to 2001
Yamille Powell, 2000 to 2002
Pamela Ohler, 2000 to 2002
Heather Ellsworth, 2001-2003
Chris Pobanz, 2001-2002
Ashley Ellsworth, 2002-2006
Justin Wilkinson, 2002-2003
Calli Hancock, 2002-2004
Shawn Averill, 2003
Cory Jurgensmeier, 2003
Matt Wheatley, 2003-2005
Zachary Reed, 2003-2005
Jessica Gardner, 2003-2004
Mitra Ghaofourian, 2004-2007
Aaron Crandall, 2004-2005
Scott Jorgensen, 2005
Brett Hamilton, 2005-2008
Joshua Schliesser, 2005-2006
Nick Larsen, 2005-2007
Jeran Stratford, 2006-2007
Dustin Ellsworth, 2006-2008
Colby Bingham, 2006 - present
Lydia Howes, 2007-present
Travis Coleman, 2007
Chris Potter, 2008-present

Summer Werner, 2008-2009
Lance Dickey, 2009

VISITING SCIENTISTS HOSTED

Mike Hyman, Research Assistant Professor, Departments of Botany and Biochemistry, Oregon State University, July-August, 1994. Collaborative research on mechanism of CO dehydrogenase

Rainer Meckenstock, Senior Scientist, University of Konstanz, Germany, June 12-July 14, 1997. Collaborative research on the roles of metal centers in the mechanism of acetylene hydratase from *Pelobacter acetylenicus*.

UNIVERSITY COMMITTEES

Departmental:

I currently serve as the chair of the general chemistry steering committee, and as members of the Hansen advisory committee and capital expenditures committee

Student Committees:

Currently serving on 4 PhD student committees. I have served on well over 80 of these committees during my time at USU.

Promotion/tenure/5 year review committees:

John Peters, Promotion and tenure
Alvan Hengge, Promotion to Full Professor
Alex Boldyrev, Promotion to Full Professor
Daryll Dewald (Biology), Promotion and tenure
Daryll Dewald (Biology), Promotion to Full Professor
Joan Hevel, Promotion and tenure
Steven Aust, 5 year review
Peter Ruben (Biology), 5 year review
Paul Cliften (Biology), Promotion and tenure
Sean Johnson, Promotion and tenure
Lisa Berreau, Promotion to Full Professor

MISCELLANEOUS UNIVERSITY/DEPARTMENTAL SERVICE

1993 Departmental representative, Rick's College Transfer day
1994 Departmental representative, Rick's College Transfer day
2000 Chaperone, Chemistry Club, Thiokol Field trip
2000 USU Discovery Summer Science Camp, Chemistry demonstrations
2001-present, Prehealth Admissions Committee
2001 USU Discovery Summer Science Camp, Chemistry demonstrations (4 sessions)
2001-2002 Adviser for USU Chemistry Club, Chemical Demonstrations Education
2002 USU Discovery Summer Science Camp, Chemistry demonstrations (7 sessions)

2002 USU Aggie Family day, Chemistry displays and demonstrations
2003 USU Aggie Family day, Chemistry displays and demonstrations
2003-2005: College of Science Ambassadors adviser
2004 USU Aggie Family day, Chemistry displays and demonstrations
2005 USU Aggie Family day, Chemistry displays and demonstrations
2006 USU Aggie Family day, Chemistry displays and demonstrations
2007 USU Aggie Family day, Chemistry displays and demonstrations
2007 Emcee for USU Science quiz bowl
2007 Instructional Technology Mediated Classroom Prioritization Committee
2007-present I.T. User Advisory Committee

TEACHING: Courses taught

I currently teach large sections of chemistry 1210 (700 total students fall semester), chemistry 1220 (480 students spring 2018), on line sections of chemistry 1210 and 1220, and a graduate course in enzymology (chem 6720). Attached is the IDEA center evaluation summary of my teaching over the last 7 years (2011-2018).

TEACHING: PEDAGOGY

2009: Developed and produced a series of problem-solving videos to accompany “Biochemistry a Short Course”, 1st Edition. Featured and credited in the text along with my photograph.

2008: Developed and produced a series of problem-solving videos to accompany “Lehninger Principles of Biochemistry”, 5th Edition. Featured and credited in the text along with my photograph, and videos published as a CD with ISBN number 978-1-4292-2920-3