Debra (Debbie) T. Hansen, Ph.D.

Contact Information

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Citizenship

U.S. Citizen

Education

Ph.D., Microbiology
University of Georgia

B.S., Biological Sciences & Genetic Biology, Honors Research Program
Purdue University

Work Experience

Associate Research Professor
07/2014 – present Arizona State University Tempe, AZ
Biodesign Center for Applied Structural Discovery

Assistant Research Scientist
01/2012 – 06/2014 Arizona State University Tempe, AZ
Biodesign Center for Innovations in Medicine

Research Assistant Professor
01/2004 – 06/2009 Medical University of South Carolina Charleston, SC
Department of Biochemistry & Molecular Biology

Associate Research Scientist
08/2001 – 07/2003 Yale University New Haven, CT
Molecular Biophysics & Biochemistry

Post-doctoral Fellow
06/1997 – 07/2001 Yale University New Haven, CT
Molecular Biophysics & Biochemistry

Intellectual Property

Hansen D, Antonyrajah J, Fromme P (2024) Concentrated SDS-PAGE loading buffer: compositions, methods of preparation, and applications. U.S. Patent Application 63/700,242 filed September 27, 2024. Provisional patent.

>300 unique **plasmid DNAs** and 2 unique *Escherichia coli* protein expression **strains** are available through the non-profit Addgene and DNASU repositories. Since 8/2020, these materials were distributed to 58 institutions across 18 countries.

Publications

http://www.ncbi.nlm.nih.gov/sites/myncbi/1NS_VusA66fkG/bibliography/43651356/public/?sort=date&direction=descending

Jernigan RJ, Logeswaran D, Doppler D, Nagaratnam N, Sonker M, Yang JH, Ketawala G, Martin-Garcia JM, Shelby ML, Grant TD, Mariani V, Tolstikova A, Sheikh MZ, Yung MC, Coleman MC, Zaare S, Kaschner EK, Rabbani MT, Nazari R, Zacks MA, Hayes B, Sierra RG, Hunter MS Lisova S, Batyuk A, Kupitz C, Boutet S, **Hansen DT**, Kirian RA, Schmidt M, Fromme R, Frank M, Ros A, Chen JJL, Botha S, Fromme P (2023) Room-temperature structural studies of SARS-CoV-2 protein NendoU with an X-ray free-electron laser. *Structure* 31, 138-151. PDB accession number **7K9P**. https://doi.org/10.1016/j.str.2022.12.009

Antonyrajah J, Goode MR, Kaschner EK, **Hansen DT** & Fromme P (2023) Structure determination of outer surface protein BBA57 from the Lyme disease pathogen support the

structure-based design of needed therapeutics. *Acta Cryst* A79: a380. http://dx.doi.org/10.1107/S2053273323096195

Jeyasothy K, Zhang S, Martin-Garcia JM, Aguilar DM, **Hansen DT**, Fromme P & Burnett JC, Jr. (2023) Structural studies of the human particulate guanylyl cyclase receptor A (pGC-A), to support therapeutics for cardiovascular diseases. *Acta Cryst* A79: a371. http://dx.doi.org/10.1107/S2053273323096286

Ranaweera E, Huseby CJ, **Hansen DT**, Chiu PL, Coleman P & Fromme P (2023) Cellular models for the investigation of the structural dynamics and activity of human tau protein aggregate formation. *Biophys J* 122: 41a-42a. http://dx.doi.org/10.1016/j.bpj.2022.11.436

Ranaweera ME, Jernigan RJ, **Hansen DT** & Fromme P (2023) Understanding bioterrorism agent *Francisella tularensis* virulence through CapBCA protein. *Acta Cryst* A79: a361. http://dx.doi.org/10.1107/S2053273323096389

Nagaratnam N, Martin-Garcia JM, Yang JH, Goode MR, Ketawala G, Craciunescu FM, Zook JD, Sonowal M, Williams D, Grant TD, Fromme R, **Hansen DT**, Fromme P (2022) Structural and biophysical properties of FopA, a major outer membrane protein of *Francisella tularensis*. *PLoS One* 17, e0267370. https://doi.org/10.1371/journal.pone.0267370

Zhang S, **Hansen DT**, Martin-Garcia JM, Zook JD, Pan S, Craciunescu FM, Burnett JC Jr & Fromme P (2022) Purification, characterization, and preliminary serial crystallography diffraction advances structure determination of full-length human particulate guanylyl cyclase A receptor. *Sci Rep* 12, 11824. https://doi.org/10.1038/s41598-022-15798-z

Boyd RJ, Olson TL, Zook JD, Stein D, Aceves M, Lin W-H, Craciunescu FM, **Hansen DT**, Anastasiadis PZ, Singharoy A, Fromme P (2022) Characterization and computational simulation of human Syx, a RhoGEF implicated in glioblastoma. *FASEB J* 36, e22378. https://doi.org/10.1096/fj.202101808RR

Olson TL, Zhang S, Labban D, Kaschner E, Aceves M, Iyer S, Meza D, Zook JD, Chun E, Craciunescu FM, Liu W, Shi CX, Stewart AK, **Hansen DT**, Meurice N, Fromme P (2021) Protein expression and purification of G-protein coupled receptor kinase 6 (GRK6), toward structure-based drug design and discovery for multiple myeloma. *Protein Expr Purif* 185, 105890. https://doi.org/10.1016/j.pep.2021.105890

Moran MW, Ramirez EP, Zook JD, Saarinen AM, Baravati B, Goode MR, Laloudakis V, Kaschner EK, Olson TL, Craciunescu FM, **Hansen DT**, Liu J, Fromme P. (2021) Biophysical characterization and a roadmap towards the NMR solution structure of G0S2, a key enzyme in non-alcoholic fatty liver disease. *PLoS One* 16, e0249164. PMCID: PMC8279337. https://doi.org/10.1371/journal.pone.0249164

Echelmeier A, Villarreal JC … **Hansen DT** … Fromme P, Kirian RA, Ros A (2020) Segmented flow generator for serial crystallography at the European X-ray free electron laser. *Nat Commun* 11, 4511. PMCID: PMC7481229. https://doi.org/10.1038/s41467-020-18156-7

Zook JD, Shekhar M, **Hansen DT**, Conrad C, Grant TD, Gupta C, White T, Barty A, Basu S, Zhao Y, Zatsepin NA, Ishchenko A, Batyuk A, Gati C, Li C, Galli L, Coe J, Hunter M, Liang M, Weierstall U, Nelson G, James D, Stauch B, Craciunescu F, Thifault D, Liu W, Cherezov V, Singharoy A, Fromme P (2020) XFEL and NMR structures of *Francisella* lipoprotein reveal conformational space of drug target against tularemia. *Structure* 28, 540-547.e3. PDB accession number **6PNY**. https://doi.org/10.1016/j.str.2020.02.005

Robertson KE, Truong CD, Craciunescu FM, Yang JH, Chiu PL, Fromme P, **Hansen DT** (2019) Membrane directed expression in *Escherichia coli* of BBA57 and other virulence factors from the Lyme disease agent *Borrelia burgdorferi*. *Sci Rep* 9, 17606. PMCID:

PMC6879480. https://doi.org/10.1038/s41598-019-53830-x

Hansen DT, Craciunescu FM, Fromme P, Johnston SA, Sykes KF (2018) Generation of high specificity antibodies against membrane proteins using DNA-gold micronanoplexes for gene gun immunization. *Curr Protoc Protein Sci* 91, 29.20.1-29.20.22. PMCID: PMC5846111. http://doi.org/10.1002/cpps.50

Hansen DT*, Jancovich JK*, Chapman D*, Robida MD, Loskutov A, Craciunescu F, Borovkov A, Kibler K, Goatley L, King K, Netherton CL, Taylor G, Jacobs B, Sykes K, Dixon LK (2018) Immunisation of pigs by DNA prime and recombinant vaccinia virus boost to identify and rank African swine fever virus immunogenic and protective proteins. *J Virol* 92, e02219-17. PMCID: PMC5874426. http://doi.org/10.1128/JVI.02219-17
*Equal first authors.

Hansen DT, Thiyagarajan T, Larson AC, Hansen JL (2016) Telomerase repeat amplification protocol (TRAP) activity upon recombinant expression and purification of human telomerase in a bacterial system. *Protein Expr Purif* 123, 6–13. http://doi.org/10.1016/j.pep.2016.03.001

Hansen DT, Robida MD, Craciunescu FM, Loskutov AV, Dörner K, Rodenberry JC, Wang X, Olson TL, Patel H, Fromme P, Sykes KF (2016) Polyclonal antibody production for membrane proteins *via* genetic immunization. *Sci Rep* 6, 21925. PMCID: PMC4764931. http://doi.org/10.1038/srep21925

Hansen JL, Thiyagarajan T, Larson AK, Rideout A, **Hansen DT** (2016) Expression and assembly of active human telomerase in *Escherichia coli*. *FASEB J* 30, 1051.5. http://www.fasebj.org/doi/abs/10.1096/fasebj.30.1_supplement.1051.5

Gong Z, Martin-Garcia JM, Daskalova SM, Craciunescu FM, Song L, Dörner K, **Hansen DT**, Yang JH, LaBaer J, Hogue BG, Mor TS, Fromme P (2015) Biophysical characterization of a vaccine candidate against HIV-1: the transmembrane and membrane proximal domains of HIV-1 gp41 as a maltose binding protein fusion. *PLoS One* 10, e0136507. PMCID: PMC4546420. http://doi.org/10.1371/journal.pone.0136507

Zook J, Mo G, Sisco NJ, Craciunescu FM, **Hansen DT**, Baravati B, Cherry BR, Sykes K, Wachter R, Van Horn WD, Fromme P (2015) NMR structure of *Francisella tularensis* virulence determinant reveals structural homology to Bet v 1 allergen proteins. *Structure* 23, 1116–1122. PMCID: PMC4835214. PDB accession number **2MU4**. http://doi.org/10.1016/j.str.2015.03.025

Zook JD, Sisco N, Mo G, **Hansen DT**, Craciunescu F, Cherry B, Sykes K, Wade Van Horn W & Fromme P (2014) High-resolution NMR spectroscopy reveals structure of lipoprotein Flpp3. *Biophys J* 106: 193a. http://dx.doi.org/10.1016/j.bpj.2013.11.1142

Martin-Garcia JM, **Hansen DT**, Zook J, Loskutov AV, Robida MD, Craciunescu FM, Sykes KF, Wachter RM, Fromme P, Allen JP (2014) Purification and biophysical characterization of the CapA membrane protein FTT0807 from *Francisella tularensis*. *Biochemistry* 53, 1958-1970. PMCID: PMC3985703. http://doi.org/10.1021/bi401644s

Martin-Garcia JM, **Hansen DT**, Loskutov A, Robida MD, Craciunescu FM, Sykes K, Wachter RM, Fromme P & Allen JP (2014) Sequence analysis and biophysical characterization reveals the presence of a long disordered region in the CapA membrane protein from *F. tularensis*. *Biophys J* 106: 688a. http://dx.doi.org/10.1016/j.bpj.2013.11.3806

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requires a conserved proline in the anticodon-binding loop for $tRNA^{Asn}$ recognition *in vivo*. *J Biol Chem* 280, 20638-20641. http://doi.org/10.1074/jbc.M500874200

Feng L, Sheppard K, **Tumbula-Hansen D**, Söll D (2005) Gln-$tRNA^{Gln}$ formation from Glu-$tRNA^{Gln}$ requires cooperation of an asparaginase and a Glu-$tRNA^{Gln}$ kinase. *J Biol Chem* 280, 8150-8155. http://doi.org/10.1074/jbc.M411098200

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Ambrogelly A, Kamtekar S, Sauerwald A, Ruan B, **Tumbula-Hansen D**, Kennedy D, Ahel I, Söll D (2004) Cys-$tRNA^{Cys}$ formation and cysteine biosynthesis in methanogenic archaea: two faces of the same problem? *Cell Mol Life Sci* 61, 2437-2445. http://doi.org/10.1007/s00018-004-4194

Feng L, Sheppard K, Namgoong S, Ambrogelly A, Polycarpo C, Randau L, **Tumbula-Hansen D**, Söll D (2004) Aminoacyl-tRNA synthesis by pre-translational amino acid modification. *RNA Biology* 1, 16-20. http://doi.org/10.4161/rna.1.1.953

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*Equal first authors.

Tumbula DL, Teng Q, Bartlett MG, Whitman WB (1997) Ribose biosynthesis and evidence for an alternative first step in the common aromatic amino acid pathway in *Methanococcus maripaludis*. *J Bacteriol* 179, 6010-6013. PMCID: PMC179501. http://doi.org/10.1128/jb.179.19.6010-6013.1997

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Proposals Written as Lead PI

**** INVITED FULL PROPOSAL – FULL PROPOSAL IS PENDING **** Department of Defense, Congressionally Directed Medical Research Programs, Tick-Borne Disease Research Program, Idea Award. "Membrane Translocation is a New Approach to Tick-Borne Disease Drug Development." Co-PIs Petra Fromme & Abhishek Singharoy. Pre-Proposal submitted 6/26/2024; full proposal submitted 10/3/2024.

NIH NIAID R01 (resubmission), "Biological significance of a key virulence and arthritogenic factor in Lyme disease pathogens." Co-PIs Utpal Pal & Petra Fromme. Submitted 8/7/2024.

NIH NIAID R01 (new), "Mechanism of borrelial host immune evasion and pathogenesis." Co-PIs Utpal Pal & Petra Fromme. Submitted 4/7/2023.

Department of Defense, Congressionally Directed Medical Research Programs, Tick-Borne Disease Research Program, Idea Award. "A New View for Tick-Borne Disease Drug Development: Imaging Membrane-Translocated Outer Surface Proteins." Co-PIs Petra Fromme & Abhishek Singharoy. Pre-Proposal submitted 5/25/2023.

**** INVITED FULL PROPOSAL **** **Department of Defense,** Congressionally Directed Medical Research Programs, Tick-Borne Disease Research Program, Therapeutic/ Diagnostic Research Award. "A New View for Tick-Borne Disease Drug Development: Imaging Membrane-Translocated Outer Surface Proteins." Co-PIs Petra Fromme & Abhishek Singharoy. Pre-Proposal submitted 5/23/2022; full proposal submitted 8/25/2022.

Bay Area Lyme Foundation, "A New View for Lyme Disease Drug Development: Imaging Membrane-Translocated Outer Surface Proteins." Co-PI Petra Fromme. Submitted 6/30/2022.

**** FUNDED **** **ASU Women and Philanthropy,** "A New View for Drug Design Against Lyme Arthritis: Imaging Proteins at the Bacterial Outer Surface." Co-PI Petra Fromme. Funded period 07/01/2022-12/31/2023. Pre-proposal & final proposal submitted 9/3/2021 & 2/23/2022.

**** SCORED **** **NIH NIAID R21 (new),** "A New View for Lyme Disease Drug Development: Imaging Membrane-translocated Outer Surface Proteins." Co-PI Petra Fromme. Submitted 2/14/2022.

Bay Area Lyme Foundation, "A New View for Lyme Disease Drug Development: Imaging Membrane-Translocated Outer Surface Proteins." Co-PI Petra Fromme. Submitted 9/30/2021.

Bay Area Lyme Foundation, "A New View for Lyme Disease Drug Development: Imaging Membrane-Translocated Outer Surface Proteins." Co-PI Petra Fromme. Submitted 1/31/2021.

Infectious Diseases Society of America, "The role of the Lyme neuroborreliosis outer surface lipoprotein VlsE in Alzheimer's disease." Co-PI Petra Fromme. Submitted 9/21/2021.

Bay Area Lyme Foundation, "A new view for the structure-based design of Lyme disease therapeutics: outer surface proteins oligomerize at the cell surface." Co-PI Petra Fromme. Submitted 6/30/2020.

Department of Defense, Congressionally Directed Medical Research Programs, Tick-Borne Disease Research Program, Idea Development Award. "Multimerization of outer surface proteins as a new paradigm for targeting the Lyme disease pathogen." Co-PI Petra Fromme. Pre-Proposal submitted 5/26/2020.

FUNDED **ASU/NASA Space Grant, Undergraduate Internship,** "Toward structure-based drug design against natively-folded P66, a key to Lyme disease infectivity & dissemination in heart & ear." Served as mentor for Christopher Ramirez. Fall 2020 – Spring 2021.

FUNDED **ASU Graduate and Professional Student Association JumpStart Research Grant,** "What the human immune system really sees during Lyme disease infection: purification of the Lyme disease vaccine component, outer surface protein A (OspA), toward the first described atomic-resolution images of its cell-membrane embedded form." Served as mentor for Emily Kaschner. Awarded 5/18/2020.

FUNDED **ASU Graduate and Professional Student Association JumpStart Research Grant,** "*Francisella* lipoprotein 3 has potential to be a drug target for the deadly disease tularemia." Served as mentor for Matthew Goode. Awarded 5/18/2020.

NIH NIAID R21 (new), "Structural analysis of a membrane-translocated form of lipoprotein BBA57, a multifactorial modulator of Lyme disease early infection." Co-PI Petra Fromme. Submitted 10/14/2019.

Steven & Alexandra Cohen Foundation, "Structural Studies of Membrane-Translocated BBA57, an Arthritogenic, Immune Modulating Lipoprotein." Co-PI Petra Fromme. Submitted 8/15/2019.

Global Lyme Alliance, "Structural Studies of a Membrane-Translocated Form of the Arthritogenic Lipoprotein BBA57." Co-PI Petra Fromme. Submitted 7/22/2019.

Department of Defense, Congressionally Directed Medical Research Programs, Tick-Borne Disease Research Program, Investigator-Initiated Research Award. "Mechanisms of Lyme Disease Pathogenesis Revealed by Structures of Membrane-Translocated Virulence Determinants." Co-PI Petra Fromme. Pre-Proposal submitted 5/22/2019.

SCORED **NIH NIAID R21 (resubmission),** "Structural analysis of a membrane-translocated form of lipoprotein BBA57, a multifactorial modulator of Lyme disease early infection." Co-PI Petra Fromme. Submitted 3/15/2019.

Bay Area Lyme Foundation, Emerging Leader Award, "Structures of membrane-translocated virulence determinants from the Lyme disease pathogen." Co-PI Petra Fromme. Submitted 3/1/2019.

NIH NIAID R21 (new), "Structural analysis of a membrane-translocated form of lipoprotein BBA57, a multifactorial modulator of Lyme disease early infection." Co-PI Petra Fromme. Submitted 6/16/2018.

Global Lyme Alliance, "Developing Structure-based Treatments for Lyme Disease." Co-PIs Petra Fromme & Ying Zhang (Johns Hopkins Univ.). Submitted 9/15/2017.

FUNDED **ASU Biodesign Institute Seed Grant,** "Development of Genetic Immunization Approaches to Produce Novel Ligands for Membrane Protein Targets of Structural and Therapeutic Interest." Co-PI Stephen A. Johnston. 07/01/2015-06/30/2016.

FUNDED **Postdoctoral Fellowship,** NIH National Institute of General Medical Sciences, F32GM019278, "Novel Components in Archaeal Translation." Mentor, Dieter Söll. 12/1997-01/2000.

Manuscript Reviewer

PLoS ONE
Molecular Biology Reports
Applied Microbiology and Biotechnology
Microbial Cell Factories
Virulence
Archives of Microbiology
Future Microbiology

Service & Mentorship

Proposal Reviewer, ASU Limited Submissions panels, 04/2020-.

Member, Academic Professional Personnel Committee, ASU Office of Knowledge

Enterprise Development, 01/2019-.

Member, ASU Biodesign Faculty Chalk Talk committee, 08/2020-07/2023 (3 year term).

Conference Chair, International SMALP Conference, 12/2022.

Mentor, ASU/NASA Space Grant, 07/2020-08/2021.

Mentor, ASU Barrett Honors undergraduate theses, 01/2014-05/2021.

Conference Chair, "Structural Biology Studies for Development of Antibodies against Membrane Protein Targets," Cambridge Healthtech Institute's Discovery on Target symposium, Antibodies Against Membrane Protein Targets, Boston, Massachusetts, 2016.

Scientific Meetings

Targeting the bacterial outer surface of tick-borne pathogens. Talk & poster. **Outstanding Poster Award**. 18th International Conference on the Crystallization of Biological Macromolecules, Tempe, Arizona, 2024.

Membrane translocation reveals that oligomerization is a recurring theme in the structures of outer membrane (lipo)proteins from pathogenic bacteria. Poster. Symposium: Aspects of Imaging, Diffraction, and Crystallography: Where John Spence's Legacy Takes Us, Tempe, Arizona, 2022.

Advances in the structural biology of the outer surface proteins from the Lyme disease pathogen support the structure-based design of needed therapeutics. Poster. 9th Annual BioXFEL International Conference, Tempe, Arizona, 2022.

The first images of a membrane-translocated virulence determinant from the Lyme disease pathogen. Invited seminar. ASU Biodesign Faculty Chalk Talks, Tempe, Arizona, 2020.

In vivo presentation to generate antibody-based structural ligands against membrane proteins. Talk & Poster. *Nature* Conference: Functional dynamics – visualizing molecules in action, Tempe, Arizona, 2019.

Generation of high specificity antibodies against membrane proteins using DNA-gold micronanoplexes for gene gun immunization. Poster. Cambridge Healthtech Institute's Discovery on Target symposium Antibodies Against Membrane Protein Targets, Boston, Massachusetts, 2017.

Heterologous expression of bacterial inner and outer membrane proteins in *E. coli* for structural studies. Invited seminar. GTCbio's 4th Protein Expression, Purification & Characterization Conference, Boston, Massachusetts, 2016.

Efficiency of genetic immunization for the generation of antibodies against membrane proteins. Invited seminar. Cambridge Healthtech Institute's Discovery on Target symposium Antibodies Against Membrane Protein Targets, Boston, Massachusetts, 2016.

Expression strategies towards the structural determination of membrane proteins from *Francisella tularensis* SCHU S4. Poster. Cambridge Healthtech Institute's PepTalk: Membrane Proteins, A Valuable Resource and Target, San Diego, California, 2015.

Production and characterization of high-specificity polyclonal antibodies against membrane proteins from highly infectious agents in the absence of purified membrane protein. Poster. Cambridge Healthtech Institute's Discovery on Target symposium, Antibodies Against Membrane Protein Targets Parts 1 & 2, Boston, Massachusetts, 2014.

Reagents for membrane proteins from highly infectious agents: generation of target-specific mouse polyclonal antibodies in the absence of membrane protein. Poster. NIGMS Structural Biology Horizons Workshop, Bethesda, Maryland, 2013.

Production and characterization of polyclonal antibodies against membrane proteins from

infectious microbes in the absence of soluble protein. Poster. PSI:Biology Technologies Workshop, Bethesda, Maryland, 2012.

hTR and hTERT assemble into active human telomerase in the absence of all other eukaryotic factors. Poster. Cold Spring Harbor Meeting on Telomeres and Telomerase, Cold Spring Harbor, New York, 2009.

Expression and assembly of active human telomerase in bacteria. Poster. Hollings Cancer Center Scientific Research Retreat, Charleston, South Carolina, 2008.

Large scale purification and crystallography of tipin, a cell cycle checkpoint protein. Poster. Symposium for Structural Biology, Medical University of South Carolina Center for Structural Biology, Charleston, South Carolina, 2008.

Structural studies of the assembly and function of human telomerase. Poster. Hollings Cancer Center Scientific Research Retreat, Charleston, South Carolina, 2005.

Naturally-occurring mischarging aminoacyl-tRNA synthetases. Poster. Gordon Research Conference, Nucleic Acids, Bristol, Rhode Island, 2002.

Indirect aminoacyl-tRNA synthesis in *Methanothermobacter thermautotrophicus*. Poster. Gordon Research Conference on Archaea, Andover, New Hampshire, 2001.

An archaeal-specific glutamyl-tRNA^{Gln} amidotransferase. Invited seminar. 18th tRNA Workshop, Cambridge, United Kingdom, 2000.

A genetics system for *Methanococcus maripaludis*. Invited seminar. Gordon Conference on Archaea: Ecology, Metabolism & Molecular Biology, Plymouth, New Hampshire, 1996.

Skills

Project design, management and budgets.

Proposals, manuscripts, intellectual property, technical reports, standard operating procedures, oral presentations.

Technology development and data analysis.

Supervision, training and mentoring of laboratory technicians and students (graduate, medical, undergraduate, and high school).

Management of the laboratory's equipment, supplies, bacterial and archaeal strain collections, nucleic acid collections, chemicals, radiochemicals, biosafety (BSL1 and BSL2), chemical safety, and relevant scientific literature.

Advanced cloning techniques and plasmid design; PCR, DNA sequencing & transformation, transduction, nucleic acid and protein sequence analyses.

Protein and RNA biochemistry, expression, purification, assays.

Immunological methods: ELISAs, Westerns, B cell isolation for monoclonal antibodies.

Antibody generation by DNA and protein immunizations.

Mouse handling.

Development & management of IACUC protocols.

In vitro transcription and in vitro translation.

Peptide microarrays, protein microarrays, array analyses.

Vaccine development against cancer and viruses.

Identification and characterization of novel genes, enzymes, biochemical pathways.

Genetics and gene knockouts in bacteria and archaea.

Chromatographic techniques (FPLC, HPLC, TLC, GC) and spectrophotometry.

Radiolabel and stable isotope methods (^{14}C, ^{13}C, ^{3}H, ^{32}P, ^{35}S).

Sterile microbiological technique.

Microbial growth in fermentors and on gaseous substrates.

Growth and culturing of diverse microbes, including strict anaerobes, thermophiles, photosynthetic bacteria, radioresistant microbes, and archaea.

Compressed gas handling systems and gas measurements (methane, CO_2, H_2, N_2, Ar).

Characterization of natural microbial populations and isolates.

Additional Information

Lead, Lyme Disease table, ASU Open Door public outreach events, 2024, 2023, 2020.

Volunteer, Highland High School, Gilbert, AZ, 11/2021-5/2024.

Volunteer, Val Vista Lakes Elementary School, Gilbert, AZ, 09/2011-01/2012.

Volunteer, Superstition Springs Elementary School, Mesa, AZ, 10/2010-05/2011.

Volunteer, Val Vista Lakes Elementary School, Gilbert, AZ, 09/2009-04/2010.

Assistantship, "Prokaryotic Diversity-An Organismal Approach," National Science Foundation Research and Training Group, 09/1994-08/1996.

Teaching Assistant, Summer Workshop in Microbial Physiology, University of Georgia, 07-08/1995 and 07-08/1996.

Microbial Diversity Course, Marine Biological Laboratory, Woods Hole, MA, 06-07/1994.

Assistantships, University-Wide, Graduate School, University of Georgia, 09/1991-06/1994.

Member, American Society for Microbiology, 1991-2011.

Teaching Assistant, Department of Microbiology, University of Georgia, 09/1990-06/1991.

Biology Honors Research Program, Purdue University, 09/1988-05/1990.