Curriculum vitae for

David E. Graham

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Oak Ridge National Laboratory
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Education:

Ph.D. Microbiology, University of Illinois at Urbana-Champaign (UIUC), 2000.
M.S. Microbiology, University of Illinois at Urbana-Champaign, 1998.
A.B. Biological Sciences and Economics, Cornell University, 1995.

Research and Teaching Experience:

2009-current Biochemistry & Metabolic Engineer, Microbial Ecology & Physiology Group. Oak Ridge National Laboratory. Research areas: biofuels, microbial biochemistry, metabolism, biosynthesis, methanogenesis and proteomics.

2009-current Adjunct Research Faculty, Microbiology Department, University of Tennessee Knoxville.

2009-current Adjunct Research Faculty, Genome Science & Technology graduate program. University of Tennessee Knoxville.

2003-2009 Assistant Professor, Department of Chemistry and Biochemistry, University of Texas at Austin. Research areas: identification of novel biosynthetic enzymes in archaea and metabolic biochemistry of chlamydia.

2000-2003 Postdoctoral research in the laboratory of Prof. Robert White, Virginia Tech. Identification and characterization of archaeal cofactor biosynthesis enzymes, including coenzyme M, coenzyme F_{420}, riboflavin and spermidine.

1999-2000 Teaching assistant. Experimental microbiology laboratory course, UIUC.

1997-2000 Graduate research in the laboratory of Prof. Gary Olsen, UIUC. Identification, purification and characterization of novel tRNA-modifying enzymes from a marine euryarchaeon, *Methanococcus jannaschii.* Genome analysis and molecular evolution of hyperthermophilic archaea and bacteria (in collaboration with Prof. Carl Woese).

1996, 1997 Teaching assistant and course microscopist at the Microbial Diversity summer course - Marine Biological Laboratory, Woods Hole, MA

1995-1997 Graduate research in the laboratory of Prof. Jordan Konisky, UIUC. Purification and characterization of surface layer proteins from *Methanococci*.

1992-1995 Undergraduate research in the laboratory of Prof. William Ghiorse, Cornell. Quantitative fluorescence *in situ* hybridization and confocal microscopy of bacteria and *Cryptosporidium parvum*.

Peer-reviewed Publications:

Jeyakanthan, J., R. M. Drevland, D. R. Gayathri, D. Velmurugan, A. Shinkai, S. Kuramitsu, S. Yokoyama, and **D. E. Graham**. 2010. Substrate Specificity Determinants of the Methanogen Homoaconitase Enzyme: Structure and Function of the Small Subunit. Biochemistry.

D.E. Graham, S.M. Taylor, R.Z. Wolf and S.C. Namboori. 2009. Evolution of a cysteic acid synthase from a methanogen threonine synthase enzyme. Biochem J. 424:467-478.

Zhou, L., M. Zhao, R.Z. Wolf, **D.E. Graham** and G. Georgiou. 2009. Transcriptional regulation of the *Escherichia coli* gene *rraB*, encoding a protein inhibitor of RNase E. J. Bacteriol. **191:**6665-6674.

Giles, T.G., D.J. Fisher and **D.E. Graham**. 2009. Independent inactivation of arginine decarboxylase genes by nonsense and missense mutations in *Chlamydia trachomatis* L2 and D strains. BMC Evol. Biol. 9:166.

Boyd, J.M., R.M. Drevland, D.M. Downs and **D.E. Graham**. 2009. Archaeal ApbC/Nbp35 homologs function as iron-sulfur cluster carrier proteins. J. Bacteriol. 191:1490-1497.

Smith, C.B. and **D.E. Graham**. 2008. Outer and inner membrane proteins compose an arginine-agmatine exchange system in *Chlamydophila pneumoniae.* J. Bacteriol. 190:7431-7440.

Drevland, R.M., Y. Jia, D. Palmer and **D.E. Graham**. 2008. Methanogen homoaconitase catalyzes both hydro-lyase reactions in coenzyme B biosynthesis. J. Biol. Chem. 283:28888-28896.

Giles, T.N. and **D.E. Graham**. 2008. Crenarchaeal arginine decarboxylase evolved from an *S*-adenosylmethionine decarboxylase enzyme. J. Biol. Chem. 381:94-100.

Namboori, S.C. and **D.E. Graham**. 2008. Enzymatic analysis of uridine diphosphate *N*-acetyl-D-glucosamine. Anal. Biochem. 381:94-100.

Elkins, J.G. et al. 2008. A korarchaeal genome reveals new insights into the evolution of the Archaea. Proc. Natl. Acad. Sci. USA. 105:8102-8107.

Graham, D.E. and H.K. Huse. 2008. Methanogens with pseudomurein use diaminopimelate aminotransferase in lysine biosynthesis. FEBS Lett. 582: 1369-1374.

Namboori, S.C. and **D.E. Graham**. 2008. Acetamido sugar biosynthesis in the Euryarchaea. J. Bacteriol. 190: 2987-2996.

Giles, T.N. and **D.E. Graham**. 2007. Characterization of an acid-dependent arginine decarboxylase enzyme from *Chlamydophila pneumoniae*. J. Bacteriol. 189: 7376-7383.

Lee, C., G. Kramer, **D.E. Graham** and D.R. Appling. 2007. Yeast mitochondrial initiator tRNA is methylated at G37 by the *TRM5*-encoded RNA (Guanine-N1-)-methyltransferase. J. Biol. Chem. 282:27744-27753.

Drevland, R.D., A. Waheed, and **D. E. Graham**. 2007. Enzymology and evolution of the pyruvate pathway to 2-oxobutyrate in *Methanocaldococcus jannaschii*. J. Bacteriol. 189:4391-4400.

Graham, D.E. and G. Kramer. 2007. Identification and characterization of archaeal and fungal tRNA methyltransferases. Meth. Enzymol. 425:185-209.

Helgadóttir, S. G. Rosas-Sandoval, D. Söll and **D.E. Graham**. 2007. Biosynthesis of phosphoserine in the *Methanococcales*. J. Bacteriol. 189:575-582.

Lindahl, P.A. and **D. E. Graham**. 2007. Acetyl-CoA synthetases and nickel-containing carbon monoxide dehydrogenases. In *Nickel and Its Surprising Impact in Nature*, vol. 2 of *Metal Ions in Life Sciences*, A. Sigel, H. Sigel and R.K.O. Sigel, eds. John Wiley & Sons, Ltd. Chichester, UK. 357-416.

Kezmarsky, N.D., H. Xu, **D.E. Graham** and R.H. White. 2005. Identification and characterization of a L-tyrosine decarboxylase in *Methanocaldococcus jannaschii*. Biochim. Biophys. Acta. 1722:175-182.

Hendrickson, E.L. et al. 2004. Complete genome sequence of the genetically tractable hydrogenotrophic methanogen *Methanococcus maripaludis*. J. Bacteriol. 186:6956-6969.

Graham, D.E., H. Xu and R.H. White. 2003. Identification of the 7,8-didemethyl-8-hydroxy-5-deazariboflavin synthase required for coenzyme F_{420} biosynthesis. Arch. Microbiol. 180:455-464.

Waters, E. et al. 2003. The genome of *Nanoarchaeum equitans*: Insights into early archaeal evolution and derived parasitism. *Proc. Natl. Acad. Sci.* USA. 100:12984-12988.

Wise, E.L., **D.E. Graham**, R.H. White and I. Rayment. 2003. The structural determination of phosphosulfolactate synthase from *Methanococcus jannaschii* at 1.7 Å resolution: an enolase that isn't an enolase. J. Biol. Chem. 278:45858-45863.

Li, H., H. Xu, **D.E. Graham** and R. H. White. 2003. Glutathione synthetase homologs encode α-L-glutamate ligases for methanogenic coenzyme F_{420} and tetrahydrosarcinapterin biosyntheses. Proc. Natl. Acad. Sci. USA. 100: 9785-9790.

Graham, D.E., K.C. Harich and R.H. White. 2003. Reductive dehalogenation of monobromobimane by tris(2-carboxyethyl)phosphine. Anal. Biochem. 318:325-328.

Li, H., H. Xu, **D.E. Graham** and R.H. White. 2003. The *Methanococcus jannaschii* dCTP deaminase is a bifunctional deaminase and diphosphatase. J. Biol. Chem. 278:11100-11106.

Potters, M.B. et al. 2003. Phosphoprotein with phosphoglycerate mutase activity from the archaeon *Sulfolobus solfataricus*. J. Bacteriol. 185:2112-2121.

Tolbert, W.D., **D.E. Graham**, R.H. White and S.E. Ealick. 2003. Pyruvoyl-dependent arginine decarboxylase from *Methanococcus jannaschii*: crystal structures of the self-cleaved and S53A proenzyme forms. Structure 11:285-294.

Graham, D.E., H. Xu and R.H. White. 2002. A member of a new class of GTP cyclohydrolases produces formylaminopyrimidine nucleotide monophosphates. Biochemistry 41:15074-15084.

Rosas-Sandoval, G., A. Ambrogelly, J. Rinehart, D. Wei, L.R. Cruz-Vera, **D.E. Graham**, K.O. Stetter, G. Guarneros and D. Söll. 2002. Orthologs of a novel archaeal and of the bacterial peptidyl-tRNA hydrolase are nonessential in yeast. Proc. Natl. Acad. Sci. USA. 99:16707-16712.

Graham, D.E., H. Xu and R.H. White. 2002 *Methanococcus jannaschii* uses a pyruvoyl-dependent arginine decarboxylase in polyamine biosynthesis. J. Biol. Chem. 277:23500-23507.

Graham, D.E., H. Xu and R.H. White. 2002.A divergent archaeal member of the alkaline phosphatase binuclear metalloenzyme superfamily has phosphoglycerate mutase activity. FEBS Letters. 517:190-194.

Graham, D.E., H. Xu and R.H. White. 2002. Identification of coenzyme M biosynthetic phosphosulfolactate synthase: a new family of sulfonate-biosynthesizing enzymes. J. Biol. Chem. 277:13421-13429.

Galagan, J.E. et al. 2002. The genome of *M. acetivorans* reveals extensive metabolic and physiological diversity. Genome Res. 12:532-542.

Min, B., J.T. Pelaschier, **D.E. Graham**, D. Tumbula-Hansen and D. Söll. 2002. Transfer RNA-dependent amino acid biosynthesis: an essential route to asparagine formation. Proc. Natl. Acad. Sci. USA. 99:2678-2683.

Graham, D.E. and R.H. White. 2002. Elucidation of methanogenic coenzyme biosyntheses: from spectroscopy to genomics. Nat. Prod. Rep. 19:133-147.

McCloskey, J.A., **D.E. Graham**, S. Zhou, P.F. Crain, M. Ibba, J. Konisky, D. Söll and G.J. Olsen. 2001. Post-transcriptional modification in archaeal tRNAs: identities and phylogenetic relations of nucleotides from mesophilic and hyperthermophilic *Methanococcales*. Nucleic. Acids Res. 29:4699-4706.

Graham, D.E., M. Graupner, H. Xu and R.H. White. 2001. Identification of coenzyme M biosynthetic 2-phosphosulfolactate phosphatase: A member of a new class of Mg^{2+}-dependent acid phosphatases. Eur. J. Biochem. 268:5176-5188.

Graham, D.E., N. Kyrpides, I.J. Anderson, R. Overbeek and W.W. Whitman. 2001. Genome of *Methanocaldococcus* (*Methanococcus*) *jannaschii*. Meth. Enzymol. 330:40-123.

Bonheyo, G., **D. Graham**, N.B. Shoemaker and A.A. Salyers. 2001. Transfer region of a *Bacteroides* conjugative Transposon, CTnDOT. Plasmid. 45:41-51.

Bunjun, S., C. Stathopoulos, **D. Graham**, B. Min, M. Kitabatake, A.L. Wang, C.C. Wang, C.P. Vivarès, L.M. Weiss and D. Söll. 2000. A dual-specificity aminoacyl-tRNA synthetase in the deep-rooted eukaryote *Giardia lamblia*. Proc. Natl. Acad. Sci. USA. 97:12997-13002.

Kim, A.D., **D.E. Graham**, S.H. Seeholzer and G.D. Markham. 2000. *S*-adenosylmethionine decarboxylase from the archaeon *Methanococcus jannaschii*: Identification of a novel family of pyruvoyl enzymes. J. Bacteriol. 182:6667-6672

Graham, D.E., R. Overbeek, G.J. Olsen and C.R. Woese. 2000. An archaeal genomic signature. Proc. Natl. Acad. Sci. USA. 97:3304-3308.

Graham, D.E., C. L. Bock, C. Schalk-Hihi, Z.J. Lu and G. D. Markham. 2000. Identification of a highly diverged class of *S*-adenosylmethionine synthetases in the archaea. J. Biol. Chem. 275:4055-4059.

Li, T., **D.E. Graham**, C. Stathopoulos, P.J. Haney, H-S Kim, U. Vothknecht, M. Kitabatake, K-W Hong, G. Eggertsson, A.W. Curnow, W. Lin, I. Celic, W. Whitman and D. Söll. 1999. Cysteinyl-tRNA formation: the last puzzle of aminoacyl-tRNA synthesis. FEBS Letters. 462:302-306.

Deckert, G., et al. 1998. The complete genome of the hyperthermophilic bacterium *Aquifex aeolicus*. Nature. 392:353-358.

Klenk, H-P. et al. 1997. The complete genome sequence of the hyperthermophilic, sulphate- reducing archaeon *Archaeoglobus fulgidus*. Nature. 390:364-370.

Selected External Research Presentations (Primary presenter):

Archaea: Ecology, Metabolism & Molecular Biology Gordon Research Conference (July 2009) Waterville Valley, NH. Invited talk. "Convergent evolution in methanogenic coenzyme biosynthesis"

Department of Microbiology, University of Tennessee Knoxville (June 2009). Invited seminar "Co-opting amino acid metabolism for microbial cofactor biosyntheses"

Forest Products Laboratory (May 2009), Madison, WI. Invited seminar: "Biochemistry of methanogen coenzyme biosynthesis -modulating methane in the coproduction of biofuels"

Washington State University Tri-cities (May 2009), Richland, WA. Invited seminar: "Biochemistry of methanogen coenzyme biosynthesis -modulating methane in the coproduction of biofuels"

Oak Ridge National Laboratory (Apr. 2009), Oak Ridge, TN. Invited seminar: "Biochemistry of methanogen coenzyme biosynthesis -modulating methane in the coproduction of biofuels"

Department of Biology, University of Kentucky (Oct. 2008), Lexington, KY. Invited seminar: "Divergent, parallel and convergent evolution shaped biosynthesis in methanogens"

Molecular Basis of One-Carbon Microbial Metabolism Gordon Research Conference (July 2008), Bates College, Lewiston, ME. Invited talk: "2-Oxoacid metabolism in methanogenic CoM and CoB biosynthesis"

Iron-sulfur Gordon Research Conference (Jun. 2008), Colby-Sawyer College, NH. Invited talk: "Function and Evolution of Methanogen Homoaconitase"

Department of Bacteriology, University of Wisconsin-Madison (Mar. 2008), Madison, WI. Invited seminar: "Convergent evolution in microbial biosynthesis"

Department of Microbiology, Ohio State University (Mar. 2008), Columbus, OH. Invited seminar: "Convergent evolution in microbial biosynthesis"

Department of Chemistry, Texas A&M University (Feb. 2008), College Station, TX. Invited seminar: "Convergent evolution in microbial biosynthesis"

Archaea: Ecology, Metabolism & Molecular Biology Gordon Research Conference (Aug. 2007), Andover, NH. Poster: "Coenzyme B and acetamido sugar biosynthesis in methanogenic archaea."

American Society for Microbiology (May 2007), Toronto, Canada. Poster: "Identification and characterization of two iron-sulfur hydro-lyase enzymes in methanogens."

Chlamydia Basic Research Society Meeting (Mar. 2007), Louisville, KY. Poster: "Identification and characterization of arginine decarboxylase in *Chlamydophila pneumoniae*."

Enzyme Mechanisms Conference (Jan. 2007), St. Pete Beach, FL. Poster: "Identification and characterization of two iron-sulfur hydro-lyase enzymes from *Methanocaldococcus jannaschii*."

Texas Enzyme Mechanisms Conference (2006), Austin, TX. Invited talk: "Methanogenic coenzyme biosynthesis: a tale of two thiols"

Joint International Symposia for Subsurface Microbiology and Environmental Biogeochemistry Jackson Hole, WY, (2005) Invited talk: “Evolution of coenzyme M biosynthesis”

Texas Branch of the American Society for Microbiology (Fall meeting 2004), Houston, TX. Invited talk: “Enzymology and evolution of microbial biosynthesis”

Southwest ACS Conference (2004), Forth Worth, TX. Invited seminar: “Evolution of methanogenic coenzyme biosynthesis”

Lost Pines Conference (2003), Smithville, TX. Invited seminar: “Enzymology and evolution of archaeal coenzyme biosyntheses.”

Molecular Basis of Microbial One-Carbon Metabolism Gordon Research Conference (2002), New London, CT. with H. Xu and R.H. White. Poster: "Enzymology and evolution of coenzyme M biosynthesis"

Enzymes, Coenzymes and Metabolic Pathways Gordon Research Conference (2001), Meriden, NH. With R.H. White. Poster: "The first two enzymes of coenzyme M biosynthesis: phosphoenolpyruvate sulfonotransferase and phosphosulfolactate phosphatase."

Honors, Awards and Fellowships:

NSF Postdoctoral Fellowship in Microbial Biology. 2002-2003.
Excellent Teaching Assistant ranking, UIUC. 2000.
NIH Training Grant Fellowship, UIUC. 1998-1999.
Chairperson, NIH Cell and Molecular Biology Training Grant Seminar Series, UIUC. 1997-1999.
Distinguished Fellowship, UIUC. 1995-1998
Theodore I. Urbanski award. Dept. Microbiology, UIUC. 1995, 1996, 1998, 1999.
Paul J. VanDemark Memorial Award in Microbiology, Cornell University. 1995
Phi Beta Kappa honor society, Cornell University. 1995.
Honorable mention, NSF Graduate Fellowship Program. 1995
Honorable mention, Howard Hughes Graduate Fellowship Program. 1995
cum laude honors in Biology, Cornell University. 1995
Hughes Scholar, Cornell University. 1994

Professional Memberships:

American Association for the Advancement of Science (AAAS)
American Chemical Society (ACS)
American Society for Biochemistry and Molecular Biology (ASBMB)
American Society for Microbiology (ASM)
Chlamydia Basic Research Society (CBRS)
Society for Industrial Microbiology (SIM)

Academic Teaching & Thesis Supervision

Courses taught at UT Knoxville:
LS615 – Graduate Journal Course: Microbial Systems (Spring 2010)

Courses taught at UT-Austin:
Bio393 – Graduate Journal Course: Microbial Diversity (Spring 2006)
CH192G – Graduate seminar course, various topics
CH391L – Graduate course, Genomes: From Molecules to Ecosystems (Fall 2003, 2005, 2007)
CH339K – Undergraduate course, Biochemistry I (Fall 2004, 2006, 2008)

Ph.D. dissertations supervised
Teresa N. Giles (Dec. 2008, Biochemistry, UT-Austin) "Pyruvoyl dependent arginine decarboxylases from Chlamydiae and Crenarchaea"
Randy M. Drevland (Aug. 2009, Biochemistry, UT-Austin) "Coenzyme B, Amino Acid, and Iron-Sulfur Cluster Biosynthesis in Methanogenic Archaea"
Conor B. Smith (Dec. 2009, Microbiology, UT-Austin) "The AAX system from *Chlamydia pneumoniae*"

Masters theses/projects supervised
Seema C. Namboori. (Aug. 2008, Cellular and Molecular Biology, UT-Austin) "Elucidation of the archaeal uridine diphosphate-sugar metabolic pathway: implications for enzymatic analysis"

Undergraduate honors theses supervised
Thao Nguyen (May 2009, Biochemistry, UT-Austin)