

Characterization of Transportation Biofuel Energy and Emissions

Biofuels and The Environment: Research Need, Motivation and Intellectual Merit

The chemistry and fate/transport of current vehicle-derived emissions, especially particles, is poorly understood. The particles and gases that are emitted from vehicles are transformed within the exhaust system and through interactions and transport in the environment after emission. Many hydrocarbon-based gases and ultrafine particles in particular are known toxins for plants and animals, including humans. Current energy demand, security, concern over global warming and global economies are accelerating our creation of new fuel formulations without a comprehensive understanding of the science, especially for fuels based on biomass. Existing research work focuses primarily on cost and energy aspects of the biomass source. Our seminal work would consider the composition of both the fuel and emissions and how this varies based on biomass source.

Biofuels, of which there are very many different types of very different chemical composition, have been touted as an opportunity for energy independence as well as sustainability—in terms of agricultural production opportunities and reduced environmental impacts. More detailed recent studies have revealed, however, that significant research is still needed to advance our understanding of the composition of these fuels throughout the cycle of production, combustion and transformation in the environment. Recent mandates to generate biofuels for transportation have proceeded without the collection of quantitative data to examine and understand the relationships between biofuel characteristics, fuel production methods, energy life-cycle and the resultant environmental effects of biofuel use (tailpipe emissions, global climate change, food supply).

The immediate focus of the proposed research is to fill the gap in knowledge on the **gas and particle chemical composition and transformation processes resulting from combustion of biofuels, especially biodiesel**. This research will complement NSF's 2009 EFRI topic "Hydrocarbons from Biomass" by providing fundamental data and analysis on transportation biofuel energy and emissions. The research also addresses the NSF theme, "Complexity in Engineered and Natural Systems" as well as the UVM Complex Systems focus via use of the new data for development of models characterizing the feedstock-fuel composition-energy-emissions complexity.

The current state-of-knowledge with respect to biofuel source materials, production techniques and biofuel physical-chemical properties on resulting emissions is so undeveloped that highly controlled laboratory emissions testing of various fuel compositions is the prudent first step to gain thorough unbiased evaluation of the emission costs and benefits of these new fuels. The proposed project's immediate focus will develop a unique UVM research capability building upon preliminary investments of the UVM Transportation Research Center. State-of-the-art light-duty diesel engine dynamometer and emissions instrumentation will be used to quantify tailpipe emissions (ultrafine particulate, air toxic and greenhouse gases) as a function of engine operating parameters. The secondary formation of polar species upon reaction of exhaust gases and particles in the atmosphere will also be quantified and compared to petrodiesel. Modeling the complex energy-GHG futures potential of feedstock biofuels will generate a new framework for feedstock comparison.

The proposed research will initiate studies on biofuels development and processing, but, unlike other biofuels work, will include the full energy and environmental costs/benefits including GHG emissions which is only possible if the fuel and emissions are carefully characterized and chemical properties understood. The proposed project will enable UVM to become a key player in biofuels research with respect to the full environmental effects of biofuel after-products as they are transported and transformed in our environment.

Broader Impacts. The science of this work is truly cross-campus and transdisciplinary. It overlaps with the research and outreach of the Matrix Centers for Translational Health and Transportation and with the Leading by Design Sustainability Center currently under review. Furthermore, the scientific discoveries can form the basis of community education and policy decisions for how to generate more and safer local fuels for transportation. Most importantly perhaps to state-wide interests of Vermont, biofuels generated from the appropriate plant matter can form the basis of a sustainable economy for rural America. With this investment we can both be at the leading edge of fundamental research related to processes on biofuels production, use and energy/environment analysis and provide a needed resource for the region's emerging biodiesel industry.

Plan for sustainability. Sustainability will be achieved by ensuring all of the interconnected topics in Figure 1 below are pursued in addition to the activities directly funded by the NSF EPSCoR grant. The biofuels research team will become competitive not only for the NSF-fundable areas in Figure 1, but also important applied research topics fundable by DOE, USDA, USDOT and NIEHS.

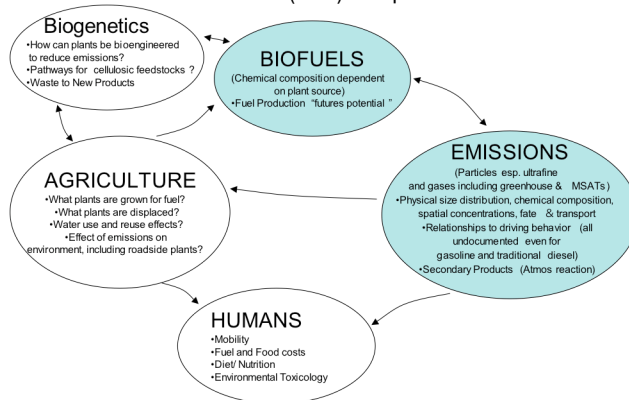
Biofuels Research and The University of Vermont

Current campus expertise in targeted focus area. Faculty from four Colleges and our two new Matrix Centers have expertise that is either directly or indirectly applicable to the targeted research area on Biofuels and Emissions: Engineering (Britt Holmén, Bob Jenkins), Chemistry (Joe Petrucci), CAS (Sarah Lovell, plant biologists), CALS (agricultural growers, animal scientists), College of Medicine (Naomi Fukagawa), UVM Transportation Research Center (Aultman-Hall), UVM Extension (Heather Darby, Sid Bosworth), State biofuels startups (Green Technologies LLC); VT Sustainable Jobs Fund; Vermont Climate Collaborative (Jennifer Jenkins), and the Rubenstein School of Natural Resources.

Specific areas of immediate (first 5 years) research focus.

- i. fuel composition—pollutant formation processes
- ii. fuel use – emissions processes
- iii. agricultural sources – emissions processes
- iv. crop and emissions effects on plant and animal systems
- v. future "potential" analysis (ecological stoichiometry/thermodynamics model on limits on fuel production from different sources and emissions over time).

Figure 1 shows the immediate research areas (blue) and potential future research topics (unshaded).



Vision at 5 Years. UVM will have a larger critical mass of investigators and unique lab facilities that will drive future externally funded transdisciplinary work on the characterization of biofuels and their emissions into the environment after combustion. An extension to regional colleges (i.e. VGN-supported colleges) would be essential as this New England consortium would ensure a connection to groups involved with rural studies, agriculture and economic development.

To enable the future vision, EPSCoR plays a vital role by helping develop a core facility for biofuels processing, combustion and characterization and funding for a new tenure-track faculty position in biofuels engineering.

- a. New School of Engineering faculty with expertise in Chemical Engineering and new Core Facility
- b. Potential areas of future investigation
 - i. Physiochemical, thermochemical, photobiological and biochemical process studies of biomass to transportation fuels.
 - ii. Regional biomass fuels characterization – fuel properties; emission properties; waste cycles
 - iii. Biofuel systems modeling (societal, agricultural, environmental, economic life-cycle analysis);
 - iv. Crop Systems/Land Use modeling (sustainable; adaptive systems)
 - v. Bioengineered Crop Systems Analysis (biology, genetics)
 - vi. Agricultural and Food Biosecurity

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PROFESSIONAL PREPARATION

Colby College	B. A.	1982	Geology/Environmental Science
University of Washington	M.S.	1985	Oceanography
Massachusetts Institute of Technology	Ph.D.	1995	Civil & Environ. Engineering
University of California, Davis	post-doc	1994-1997	Land, Air and Water Resources

APPOINTMENTS

8/06- <i>present</i>	University of Vermont, Civil & Environmental Engineering.	<i>Associate Professor</i>
8/05 – 8/06	University of Connecticut, Civil & Environmental Engineering.	<i>Associate Professor</i>
7/05 – <i>present</i>	University of California, Davis, Civil & Environmental Engineering.	<i>Associate Adjunct Professor</i>
8/01- 8/05	University of Connecticut, Civil & Environmental Engineering.	<i>Assistant Professor</i>
7/98-7/05	University of California, Davis, Civil & Environmental Engineering.	<i>Assistant Adjunct Professor</i>
4/97-7/01	University of California, Davis, Crocker Nuclear Laboratory	<i>Assistant Research Geochemist</i>
1994-1997	University of California, Davis, CA. Land, Air and Water Resources.	<i>Post-doc</i>
1988- 1989	Cambridge Analytical Associates, Boston, MA	<i>Environmental Geochemist</i>
1985- 1988	Smithsonian Astrophysical Observatory, Cambridge, MA	<i>Geologist / Microprobe Lab Supervisor</i>
1985	Harvard University Geology Department, Cambridge, MA	<i>Isotope Geochemistry Lab Technician</i>

HONORS

2005 UConn, School of Engineering, *Outstanding Junior Faculty Award*
2005 UConn, Civil & Environmental Engineering, *Klewin Award for Teaching Excellence*
2002 National Science Foundation, CAREER Award, Vehicle-Derived Particulate Matter

RESEARCH INTERESTS

Real-world Particulate Matter Emissions: vehicle-derived ultrafine and nanoparticles, crystalline silica.
Environmental Particle Interface Chemistry: sorption of inorganic and organic anthropogenic chemicals; redox reactions; mineral dissolution; air-particle partitioning; airborne particles as contaminant transport agents.
Nonpoint Source Contaminant Transport: heavy metals and PAHs in stormwater; agricultural PM.

PEER-REVIEWED PUBLICATIONS

Selected Relevant Journal Articles (* = graduate student co-author)

Chua, B.; Wexler, A. S.; Tien, N. C.; Niemeier, D. A.; Holmén, B. A., (2008) Design, fabrication, and testing of a microfabricated corona ionizer. *Journal of Microelectromechanical Systems*, 17, 115-123.

Yang, W. L.; **Holmén, B. A.**, (2007) Effects of relative humidity on chloroacetanilide and dinitroaniline herbicide desorption from agricultural PM_{2.5} on quartz fiber filters. *Environmental Science & Technology*, 41, (11), 3843-3849.

Vikara, D.* and **B.A. Holmén** (2007) Ultrafine Particle Number Concentrations from Hybrid Urban Transit Buses Using Onboard Single-Diameter Scanning Mobility Particle Sizer Measurements, (in press) *Transportation Research Record*.

Jackson, E.* , Y. Qu* , **B.A. Holmén** and L. Aultman-Hall (2007) Driver and Road Type Effects on Light-duty Gas and Particulate Emissions, (in press) *Transportation Research Record*.

Jackson, E.* , L. Aultman-Hall, **B.A. Holmén** and Jianhe Du* (2005) Evaluating the Ability of Global Positioning System Receivers to Measure Real World Operating Mode for Emissions Research, *Transportation Research Record* #1941, pp.43-50.

Gao, O.H.* , **B.A. Holmén**, D.A. Niemeier (2005) Nonparametric Factorial Analysis of Daily Weigh-in-Motion Traffic: Implications for the Ozone “Weekend Effect” in Southern California. *Atmospheric Environment*, 39, 1669-1682.

Holmén, B.A. and Y. Qu* (2004) Uncertainty in Particle Number Modal Analysis during Transient Operation of Compressed Natural Gas, Diesel and Trap-Equipped Diesel Transit Buses, *Environ. Sci. Technol.* 38, 2413-2423.

Nanzetta, M.K.* and **B. A. Holmén**. (2004) Roadside Particle Number Distributions and Relationships between Number Concentrations, Meteorology, and Traffic along a Northern California Freeway, *J. Air & Waste Manage. Assoc.*, 54, 540-554.

Ayala, A., N.Y. Kado, R.A. Okamoto, **B.A. Holmén**, K. E. Stiglitz. Diesel and CNG (2002) Heavy-duty Transit Bus Emissions over Multiple Driving Schedules: Regulated Pollutants and Project Overview. *SAE Transactions Journal of Fuels and Lubricants*, 735-747.

Holmén, B.A. and A. Ayala (2002) Ultrafine PM Emissions from Natural Gas, Oxidation-Catalyst Diesel and Particle-Trap Diesel Heavy-Duty Transit Buses, *Environ. Sci. & Technol.* 36, 5041-5050.

Shiraki, R. and **B. A. Holmén**. (2002) Airborne respirable silica near a sand and gravel facility in central California: XRD and elemental analysis to distinguish source and background quartz, *Environ. Sci. Technol.*, 36, 4956-4961.

SYNERGISTIC ACTIVITIES

- Principal Investigator, *Women in Engineering Leadership Summit*, May 2004, Storrs, CT (national conference, 80 participants). Conference bringing collaborators together with aim to increase number of women leaders in academia, government and industry.
- *Academic advisor to UConn “Women in Math, Engineering and Science” cluster*, 2002-2004. Residential dormitory housing cluster of women majoring in STEM disciplines.

COLLABORATORS & OTHER AFFILIATIONS

Collaborators

L. Aultman-Hall, C. Anastasio, L. Ashbaugh, A. Ayala, T. Hefner, J. Higa, W. Eichinger, R. Flocchini, Y. Meng, D. Niemeier, K. Trzepla-Nabaglo, J. Utts, T. Young, O. Gao, D.R Miller

Undergraduate, Graduate Student & Post-doc Researchers

Undergraduate Researchers: E. Moon, M. Graham, L. O’Neill, L. Radice, J. Lewandowski

M.S. Researchers: K. Kuhna, A. Clymo, S. van Bergen, Y. Qu, A. Weeks. N.T. Stevens

Ph.D. Researchers: Y. Meng , C. Johns, K. Nanzetta-Converse, W. Yang, Y. Qu, A. Hiscox, T. Barrett

Postdoctoral Scholars: B. Buyuktas, J. Suro, R. Shiraki, T. Hefner, JY Shin, Z Chen. D. Nielsen

Thesis Advisors and Post-doc Sponsor

Post-Doc Advisor: William H. Casey (UC Davis)

Graduate Advisors: Philip M. Gschwend (MIT) and John R. Delaney (University of Washington)

Lisa Aultman-Hall, Ph.D.

Professor, School of Engineering

Professor, Community Development and Applied Economics

Director, UVM National University Transportation Center

University of Vermont

210 Colchester Avenue

Burlington, VT 05403

802-656-1245 fax 860-656-9892

PRIOR ACADEMIC EMPLOYMENT

University of Connecticut

Associate Professor, Dept. of Civil and Environmental Engineering (2001 - 2006)

Director, Connecticut Transportation Institute (2003 – 2006)

University of Kentucky

Assistant Professor, Department of Civil Engineering (August 1996 - August 2001)

EDUCATION

Ph.D. 1996

Dept. of Civil Engineering (Transportation), McMaster University, Hamilton, Ontario

Dissertation: Commuter Bicycle Route Choice: Analysis of Major Determinants and Safety Implications

Advisors: Drs. Fred L. Hall and Brian W. Baetz

Master of Science 1993

Dept. of Civil Engineering, Traffic Engineering, Queen's University, Kingston, Ontario

Thesis: An Evaluation of the Modeling of Freeways in the INTEGRATION Simulation Model

Advisor: Dr. Michel Van Aerde

Bachelor of Engineering 1991

Dept. of Civil Engineering, McMaster University, Hamilton, Ontario

TEACHING EXPERTISE

- Transportation Planning, Traffic Engineering and Transportation Safety
- Geographic Information Systems (GIS) & Global Positioning Systems (GPS), Surveying
- *Professional Short Courses*: Bicycle Facility Design, Highway Capacity Analysis and Traffic Signal Optimization

AREAS OF RESEARCH SPECIALIZATION

- Travel Behavior, especially route choice
- Vehicle Tailpipe Emissions Modeling
- Freight Transportation Planning
- Transportation Safety
- Bicycle Transportation
- Spatial Analysis using Geographic Information Systems (GIS) and Global Positioning Systems (GPS) for Transportation

SUMMARY OF PROFESSIONAL ACCOMPLISHMENTS

Lisa Aultman-Hall, Ph.D.

Teaching Evaluations: University of Connecticut (10 point scale)

Spring 2006 – 9.2	Fall 2005 – no teaching
Spring 2005 – 9.4	Fall 2004 – 8.7
Spring 2004 – no teaching	Fall 2003 – 8.8
Spring 2003 – 9.0	Fall 2002 – 8.7
Spring 2002 – no teaching	Fall 2001 – 8.7 and 8.2

Research Grants (1995 – 2007):

Total Number of Research Grants - 31 - \$2.4M
PI for 21 Grants - \$1.5M
Grants managed as director of Centers: Approximately \$15M

Dissemination of Research:

Refereed Journal Papers: 29 total, 25 in print, 4 in-press (5 additional papers in review)
Book Chapters: 1
Conference Participation: total 55 (those not cited as papers in other categories)
 Full Papers in Conference Proceedings (full paper-reviewed) - 5
 Full Papers in Conference Proceedings (abstract reviewed) - 12
 Presentations by Dr. Aultman-Hall or graduate students under her supervision – 22
 Presentations by Other Co-authors (and not cited as papers in other categories) - 4
 Invited Conference Presentations - 12
Invited Academic Seminars: 11
Technical Reports: 65

Graduate Students Supervised:

Current: 2 Ph.D. Candidates
Completed: 11 Master's students, 1 Ph.D.

Highlights of Recent Service:

- Member, TRB Committee on Safety Data, Analysis, and Evaluation (2005-)
- Member, TRB Committee on Travel Survey Methods (2005-)
- Co-host, Women in Engineering Leadership Summit (NSF funded), May 3-5 2004
- Chair, Transportation Research Board, Committee on Bicycle Transportation (2002-2004)
- Managed Review - 13-19 TRB papers/yr - Bicycle Transportation Committee (2002-2005)
- NSF Panel, November 2002, CAREER, Civil and Mechanical Systems
- NSF Panel, May 2002, Division of Operations Research, Service Enterprise Engineering
- NSF IGERT(Integrative Graduate Education and Research Training) Program Review - Content Specialist for Geographic Information Science at SUNY Buffalo, May 2002
- NCHRP (National Cooperative Highway Research Program) Panels – 2 (2001-2005)

Robert G. Jenkins PhD, CEng.

Professor of Mechanical Engineering, University of Vermont

- Education:** 1963-1967, University of Leeds, England, B.Sc. (Hons) Fuel Science
1967-1970, University of Leeds, England, Ph.D., Fuel Science.
- Experience:** **January 2005 - present** Professor of Mechanical Engineering, UVM
August 1999 – Dec 2004 Dean, College of Engineering & Mathematics, UVM, tenured Professor of Mechanical Engineering.
Jan 1998 – April 1999 Interim Dean, College of Engineering, University of Cincinnati
September 1997 - Dec 1997 Interim Dept. Head, Chemical Engineering, UC.
January 1996 - Dec 1997 Director of Graduate Studies & Associate Dept. Head, Chemical Engineering, University of Cincinnati.
September 1991 – August 1999 Professor of Chemical Engineering, UC.
August 1988 to September 1991 – Assoc. Dean for Research, College of Eng., UC.
August 1988 to September 1991 - Joint Appointment as Professor in Departments of Chemical Engineering & Materials Science & Engineering, UC. Tenured in ChE – 1988.
January 1983 to August 1988 - Chairman, Fuel Science Program, Penn State University
July 1978 to August 1988 - Assistant Professor, Associate Professor (1982-86), Professor of Fuel Science, Penn State University. Tenured 1983.
July 1978 to August 1982 - Director of the Combustion Laboratory, Penn State University.
March 1975 to June 1978 - Senior Research Associate, Fuel Science Program, Penn State University.
September 1973 to February 1975 - Research Assistant to Prof. R.M. Barrer, Physical Chemistry Laboratories, Department of Chemistry, Imperial College of Science and Technology, London.
November 1970 to June 1973 - Research Associate, Fuel Science Program, Dept. of Materials Science, Penn State University.
- Professional:** Registered Chartered Engineer with Council of Engineering Institute, UK
Member, AIChE
Member, American Chemical Society, Member Fuel & Petroleum Chemistry Divisions, Member, Executive Committee of the Fuel Chemistry Division, (1986-89, 91-93), Member Divisional Policy Committee (1991-93)
Member, American Society for Engineering Education; Member Engineering Research Council Executive Committee(1991-92), Member Chemical Eng., & Energy Divisions.
Member of the Combustion Institute; Member of the Program Sub-Committee for the 21st. - 29th. International Symposia on Combustion (1986-2004)
Member, American Carbon Society
Tri-State Catalyst Club (1996 -1999)
- Awards/Honors:** Chairman, Fuel Chemistry Division, American Chemical Society, [ACS] (1992)
Program Chairman for National Meetings, Fuel Chemistry Division, [ACS] (1989)
Elected Fellow of the Institute of Energy (1988) – now the Energy Institute
Chairman, American Chapter of the Institute of Energy (1989-),
Member, National Asphalt Advisory Committee, Strategic Highway Research Program, National Research Council, (1989-1993)
Member, Advisory Committee for the DOE-funded University Consortium for Fossil Fuel Liquefaction Science, (1989 - 94).
Appointed Editorial Board, Fuel & Energy Abstracts, Institute of Energy, Butterworths
Outstanding Professor of Chemical Engineering, UC, 1994-95.
Nominated for the University of Cincinnati's Cohen Teaching Award (1998)
Sigma Xi

Tau Beta Pi
Affiliate Member, Vermont Academy of Science & Engineering (2003 -)
Member, Vermont Technology Council (2000 - 2005)

Technical Reviewer: ACS (PRF, ACS Books), Ben Franklin Partnership (Comm. of PA) BoM (Dept. of Interior), USDA (National Res. Init. Competitive Grants Prog.), USDOE (Fossil Energy, Basic Energy Sciences, SBIR), US Department of Education, FL Inst. for Phosphate Res., GRI, Harper Collins, NSF, Pennsylvania Research Corporation, State of Illinois (Dept. of Energy & Nat. Resources, Center for Research on S in Coal), State of Ohio (OATC Planning Proposal), Israel Science Foundation, US/Israel Binational Science Foundation, Consortium for Plant Biotechnology Research, Bioresource Technology, John Wiley, US Civilian Research & Development Foundation for the Independent States of the FSU.

Journals/Paper Reviews for: Adsorption, AIChE Journal, AC S (Symp. Series), ASME, Canadian Journal of Chemical Engineering, Carbon, Chemical Kinetics, Combustion & Flame, Energy & Fuels, Fuel, Environmental Sci. & Techn., Fuel Processing Technol., Ind. & Eng. Chem. Research, Int. Symposia on Combustion (1986-2006), Langmuir, Materials Chemistry, Scanning Electron Microscopy, Chemical Technology & Biotechnology

Publications: 130+ research and review publications (70+ refereed publications, 6 book contributions)

Citations: Total publications cited over 1,800 times. Two papers have been cited over 200 times each, two other papers have over 100 citations.

Fields of Interest: Mechanisms of thermal degradation of fuels and organic materials; coal & carbon chemistry & characterization; carbons as molecular sieves, catalysts and electrodes; activated carbon preparation, modification & characterization; surface functionality on carbons and coals, adsorption, coal conversion chemistry, Small Angle X-Ray Scattering, catalysis, and zeolite modification.

Research Funds As PI ~ \$3.4 million: Most Recent Support: General Dynamics Armaments & Technical Products: "Fuel Cell Characterization", \$173,000 – 2005/06, RGJ: PI.

Graduate Students Supervised to Completion 14 PhD (3 of whom hold academic positions at rank of Professor or Associate Professor)
8 MS

Post-Doctoral/Visiting Scientists Supervised 8 (From Japan, USA, Holland, Spain, & China)

Recent Publications Otake, Y., and R. G. Jenkins, Hydrogen Chemisorption/desorption at Edge Carbon Atoms Created by Thermal Decomposition of Oxygen Complexes Present on Carbon Surfaces. Submitted to Carbon 2006 (under revision)

Smirniotis, P.G., Srekanth, P.V., Peña, D. A., , R.G. Jenkins, P. G., "Manganese Oxide Catalysts Supported on Titania, Alumina, & Silica". Industrial and Engineering Chemistry Research, in press 2006

Khan, M. R., R. G. Jenkins. G. A. Somerjai, H. Heinemann, "Effects of K-Ca Additives in Combination on Swelling and Plastic Properties of Coal and on the Reactivity of the Resulting Char". Energy Sources, 25 (7), 729 – 731 (2003)

Naomi K. Fukagawa, MD PhD

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University of Vermont College of Medicine
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Burlington, Vermont 05405-0068
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PROFESSIONAL PREPARATION

Northwestern University	M.D.	1976	Medicine (Honors Program in Medical Education)
Mass. Instit. of Tech. (MIT)	Ph.D.	1985	Nutritional Biochemistry & Metabolism

POSITIONS & HONORS

1976-1978	Intern/Junior Assistant Resident in Pediatrics, Children's Hospital of Philadelphia, PA
1978-1979	Chief Resident in Pediatrics, University of Vermont, Burlington, VT
1979-1981	Clinical Instructor in Pediatrics, University of Vermont, Burlington, VT
	Attending Physician in Pediatrics, Medical Center Hospital of Vermont, Burlington, VT
1981-1985	Research and Clinical Fellow in Pediatrics, Harvard Medical School, Children's Hospital Medical Center, Division of Gastroenterology and Nutrition, Boston, MA
1981-1984	Research Fellow, Clinical Research Center, MIT, Cambridge, MA
1985-1986	Postdoctoral Associate, Department of Applied Biological Sciences, MIT, Cambridge, MA
1984-1986	NIH GCRC Clinical Associate Physician, MIT Clinical Research Center, Cambridge, MA
1985-1988	Instructor in Pediatrics, Harvard Medical School, Boston, MA
	Assistant in Medicine, Children's Hospital Medical Center, Boston, MA
1986-1988	Director, Nutrition Support Service, The Children's Hospital, Boston, MA
1986-1990	Assistant Program Director, MIT Clinical Research Center, Cambridge, MA
1987-1991	Instructor, Whitaker College, MIT, Cambridge, MA
1988-1995	Assistant Professor of Pediatrics, Harvard Medical School, Boston, MA
	Associate in Medicine, Beth Israel Hospital, Boston, MA
1990-1993	Associate Program Director, MIT Clinical Research Center, Cambridge, MA
1991-1993	Assistant Professor, Division of Health Sciences and Technology, MIT, Cambridge, MA
1993-present	Visiting Scientist, MIT Clinical Research Center, Cambridge, MA
1993-1995	Assistant Professor, Rockefeller University, New York, NY
	Associate Program Director, Clinical Research Center, Rockefeller University
1995-2004	Associate Professor of Medicine (Tenured), Acting Director, Gerontology Unit, Department of Medicine, University of Vermont
2004-present	Professor of Medicine (Tenured), Acting Director, Gerontology Unit, Department of Medicine; Associate Program Director, Clinical Research Center, University of Vermont, Burlington, VT

Honors, Societies, and Committee Appointments: National Board of Medical Examiners (1977); Diplomate, American Board of Pediatrics (1981); Assistant Editor, Journal of Nutritional Biochemistry; NIH General Clinical Research Centers Committee (1991-95), Chairperson (1994-95); Executive Board, National GCRC Program Directors' Association (1992-98;2002-05); Nominating Committee, The American Society for Clinical Nutrition (ASCN) (1996); Chair, Search Committee for the Editor-in-Chief, American Journal of Clinical Nutrition (1996); American Society for Clinical Investigation (1996); US Food and Drug Administration, Food Advisory Committee (1995-2000); ASCN Committee on Clinical Nutrition Internship Program (1998-2000); American Society for Nutritional Sciences, Program Planning Committee for the Experimental Biology Meetings (1999-2002); NIH NCRR Clinical Research Working Group (1999-present); ASCN Council Member (2000-03); ASCN Vice-President Elect (2003); ASCN Vice-President (2004) and President (2005); American Society for Nutrition, President (with Dennis Bier) 2005; Delegate-At-Large, White House Conference on Aging, (2005); Associate Editor, American Journal of Clinical Nutrition (2007-present); NIH Integrative Physiology of Obesity and Diabetes Study Section

(2004-present); Association for Professors of Medicine Physician-Scientist Initiative Consensus Conference “Revitalization of the Nation’s Physician-Scientist Workforce”, 15 Nov 2007.

SELECTED REFEREED PUBLICATIONS

- Fukagawa NK, Minaker KL, Young VR, Matthews DE, Bier DM, Rowe JW: Leucine metabolism in aging humans: Effect of insulin and substrate availability. *Am J Physiol (Endocrinol Metab)* 1989;256:E288-E294
- Fukagawa NK, Bandini LG, and Young JB: Effect of age on body composition and resting metabolic rate. *Am J Physiol (Endocrinol Metab)* 1990;259:E233-E238
- Fukagawa NK, Anderson JW, Hageman G, Young VR, Minaker KL: High-carbohydrate, high-fiber diets increase peripheral insulin sensitivity in healthy young and old adults. *Am J Clin Nutr* 1990;52:524-528
- Fukagawa NK, Bandini LG, Lim PH, Roingard F, Lee MA, Young JB: Protein-induced changes in energy expenditure in young and old individuals. *Am J Physiol (Endocrinol Metab)* 1991; 260:E345-E352
- Hiramatsu T, FUKAGAWA NK, Marchini JS, Cortiella J, Yu YM, Chapman TE, Young VR: Methionine and cysteine kinetics at different intakes of cystine in healthy adult men. *Am J Clin Nutr* 1994;60:525-533
- Fukagawa NK, Bandini LG, Lee MA, Young JB: Effect of age on dopaminergic responses to protein feeding. *Am J Physiol (Renal Fluid Electrolyte Physiol)* 1995;268:F613-F625
- Fukagawa NK, Veirs H, Langeloh G: Acute effects of fructose and glucose ingestion with and without caffeine in young and old humans. *Metabolism* 1995;44:630-638
- Fukagawa NK, Ajami AM, Young VR: Plasma methionine and cysteine kinetics in response to an intravenous glutathione infusion in adult humans. *Am J Physiol (Endocrinol Metab)* 1996;E209-E214
- Liang P, Hughes V, Fukagawa NK: Increased mitochondrial DNA deletions in the skeletal muscle of older individuals with impaired glucose tolerance. *Diabetes* 1997;46:920-923
- Fukagawa NK, Yu YM, Young VR: Methionine-cysteine kinetics at different intakes of methionine and cystine in elderly men and women. *Am J Clin Nutr* 1998; 68(2):380-388
- Fukagawa NK, Li M, Liang P, Russell JC, Sobel BE, Absher PM: Aging and high concentrations of glucose potentiate injury to mitochondrial DNA. *Free Rad Biol Med* 1999;27(11/12):1437-1443
- MacCoss MJ, Fukagawa NK, Matthews DE: Measurement of homocysteine concentration and stable isotope tracer enrichments in human plasma. *Analytical Chemistry* 1999;71(20):4527-4533
- Fukagawa NK, Hercules E, Ajami AM: ¹³C-Labeled L-2-oxothiazolidine-4-carboxylic acid: a probe for precursor mobilization for glutathione status. *Am J Physiol (Endocrinol Metab)* 2000;278:E171-E176
- Hopkins WE, Fukagawa NK, Sobel BE, Schneider DJ: Plasminogen activator inhibitor type I in adults with Down Syndrome and protection against macrovascular disease. *Am J Cardiol* 2000;85(6):784-786
- Haisch M, Fukagawa NK, Matthews DE: Oxidation of glutamine by the splanchnic bed in humans. *Am J Physiol* 2000;278:E593-E602
- Fukagawa NK, Martin JM, Wurthmann A, Prue AH, Ebenstein D, O’Rourke B: Sex-related differences in methionine metabolism and plasma homocysteine concentrations. *Am J Clin Nutr* 2000;72:22-29
- Fukagawa NK, Timblin CR, Buder-Hoffman S, Mossman BT: Strategies for evaluation of signaling pathways and transcription factors altered in aging. *Antioxidants and Redox Signaling* 2000;2:379-389
- Li M, Absher PM, Liang P, Russell JC, Sobel BE, Fukagawa NK: High glucose concentrations induce oxidative damage in mitochondrial DNA in explanted vascular smooth muscle cells. *Exp Biol Med* 2001;226:450-457
- MacCoss MJ, Fukagawa NK, Matthews DE: Measurement of intracellular sulfur amino acid metabolism in humans. *Am J Physiol (Endocrinol Metab)* 2001;280(6):E947-E955
- Fukagawa NK, Li M, Timblin CR, Mossman BT: Modulation of cell injury and survival by high glucose and advancing age. *Free Rad Bio Med* 2001; 31(12):1560-1569
- Li M, Mossman BT, Kolpa E, Timblin CR, Shukla A, Taatjes DJ, Fukagawa NK: Age-related differences in MAP kinase activity in VSMC in response to glucose or TNF- α . *J Cellular Physiol* 2003; 197: 418-425
- Shukla A, Jung M, Fukagawa NK, Taatjes DJ, Sawyer D, Van Houten B, Mossman BT: Asbestos induces mitochondrial DNA damage and oxidant localization linked to the development of apoptosis. *Am J Physiol (Lung Cell. Mol Physiol)* 2003; 285:L1018-1025
- Hopkins WE, Chen X, Fukagawa NK, Knot, HJ, Hall C, LeWinter MM: Increased atrial and brain natriuretic peptides in adults with cyanotic congenital heart disease: Enhanced understanding of the relationship between hypoxia and natriuretic peptide secretion. *Circulation* 2004; 109: 2872-2877

Fukagawa NK, Palmer BM, Barnes WD, Leavitt BJ, Littleman FP, LeWinter MM, Mulieri LA, Maughan DW: Acto-myosin crossbridge kinetics in humans with coronary artery disease: Influence of sex and diabetes mellitus. *J Molec Cell Cardiol* 2005; 39: 743-753

Li M, Liu RM, Timblin CR, Meyer SG, Mossman BT, Fukagawa NK: Age affects ERK1/2 and NRF2 signaling in the regulation of GCLC expression. *J Cellular Physiol* 2006; 206: 518-525

Li M, Chiu HF, Mossman BT, Fukagawa NK. Down-regulation of manganese-superoxide dismutase through phosphorylation of FOXO3a by Akt in explanted vascular smooth muscle cells from old rats. *J Biol Chem.* 2006 Dec 29;281(52):40429-39. Epub 2006 Nov 1.

Li M, Chiu HF, Gagne J, Fukagawa NK. Age-related differences in Insulin-Like Growth Factor-1 receptor signaling regulates AKT/FOXO3A and ERK/FOS pathways in vascular smooth muscle cells. *J Cellular Physiol* 2008 (in press)

Fukagawa NK, Li M, Sabo-Attwood T, Timblin CR, Butnor KJ, Gagne J, Steele C, Taatjes DJ, Huber S, Mossman BT. Inhaled asbestos exacerbates atherosclerosis in ApoE-deficient mice via CD4+ T cells. *Environ Health Perspect.* 2007 (in press) Epub 2008 May 22.

OTHER SUPPORT

Ongoing

NIH NIA AG01106-01A1 (Fukagawa, PI) 07/01/2003 - 06/30/2009

Age-related Changes in Glutathione Synthesis

The goal is to determine the effects of age and diabetes mellitus on glutathione synthesis in vivo in humans using stable isotope probes. Studies will integrate diverse findings obtained in animal and cell culture systems to increase our understanding of the regulation of GSH homeostasis.

NIH NCRR M01 RR00109 (R. Morin, PI) 12/01/2006– 11/30/2010

General Clinical Research Center

The major goal of this project is to create and sustain specialized institutional resources in which clinical investigators can observe and study human physiology as well as treat disease with innovative approaches. Dr. Fukagawa is the Associate Director (salary only).

Ajinomoto Amino Acid Research Program (Fukagawa, PI) 10/01/2008-09/30/2010

Synergistic Effects of the Branched Chain Amino Acids and Carnosine Precursors on Exercise-induced Muscle Damage and Performance in Humans

The goal is to determine the effect of amino acid supplementation on exercise-induced muscle damage and exercise performance in human volunteers.

Completed

NIH NIA AG00947-01A1 (Fukagawa, PI) 06/01/2000 - 05/31/2006

Effect of Age and Glycemia on Transcription Factors

The goal will be to determine whether oxidative stress associated with aging and/or high glucose contributes to alterations in vascular smooth muscle cell apoptosis or proliferation. Award is primarily for salary support. There is some scientific overlap (methods).

POR Pilot Project Award (Fukagawa, PI) 03/01/2002 - 08/31/2003

Fletcher Allen Health Care/University of Vermont

Patient Oriented Research Program

Effect of Age on Measures of Stiffness and Power in Human Skeletal Muscle: Is it Modified by Diabetes Mellitus?"

This pilot study is to determine whether old age and/or diabetes mellitus are associated with changes in skeletal muscle stiffness and power generation.

NIH NIA AG19564-01 (D. Maughan, PI) 09/30/2000 - 08/31/2004

Molecular Basis of Diabetic Cardiomyopathy

The goal of this project is to determine the contribution of protein cross-linking and oxidative damage of myofibrillar proteins to the observed stiffness in diabetic cardiomyopathy. Dr.

Fukagawa's effort is a co-investigator. There is no overlap.

Sarah Taylor Lovell

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Burlington, VT 05405
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EDUCATION

M.L.A. (Master's in Landscape Architecture). University of Illinois, Urbana-Champaign	2005
Ph.D. in Agronomy. University of Illinois, Urbana-Champaign	2000
M.S. in Agronomy. University of Illinois, Urbana-Champaign	1995
B.S. in Agricultural Science. University of Illinois, Urbana-Champaign	1992

PROFESSIONAL EXPERIENCE

Assistant Professor, Department of Plant and Soil Science, University of Vermont. 2006-Present.

Postdoctoral Research Associate, Departments of Landscape Architecture and Natural Resources & Environmental Sciences, University of Illinois, Urbana, Illinois, Spring 2006.

Postdoctoral Research Associate, The Environmental Council, University of Illinois, Urbana, Illinois, 2003-2005.

Senior Research Biologist, Midwest Research and Development Unit, Dow AgroSciences, Iowa, 2000-2003.

Graduate Research Assistant/Fellow, Agronomy Department, University of Illinois, Urbana, Illinois. 1997-2000.

Field Research Biologist, Midwest Field Station, Zeneca Agricultural Products, Champaign, Illinois. 1995-1997.

Graduate Research Assistant/Fellow, Agronomy Department, University of Illinois, Urbana, Illinois. 1992-1995.

Teaching Assistant, Agronomy Department, University of Illinois, Urbana, Illinois, 1991.

RESEARCH EXPERTISE

Multifunctional Landscapes • Ecological Design • Landscape Ecology • Landscape Visualization

PUBLICATIONS

Related to Project:

- Lovell, S. Taylor**, Johnston, J.M. Creating multifunctional landscapes – How can the field of ecology inform the design of the landscape? *Frontiers in Ecology and the Environment*. In press.
Available online: http://www.esajournals.org/archive/1540-9295/preprint/2009/pdf/10.1890_070178.pdf
- Taylor Lovell, S.**, Sullivan, W.C. 2006. Environmental benefits of conservation buffers in the United States: Evidence, promise, and open questions. *Agriculture, Ecosystems & Environment* 112(4):249-260.
- Sullivan, W.C., Anderson, O.M., and **Taylor Lovell, S.**, 2004. Agricultural buffers at the rural-urban fringe: an examination of approval by farmers, residents, and academics in the Midwestern United States. *Landscape and Urban Planning* 69:299-313.

Other Significant:

- Taylor-Lovell, S.**, Sims, G.K., and Wax, L.M. 2002. Effects of moisture, temperature, and biological activity on the degradation of isoxaflutole in soil. *Journal of Agricultural and Food Chemistry* 50:5626-5633.
- Taylor-Lovell, S.**, Sims, G.K., Wax, L.M., and Hassett, J.J. 2000. Hydrolysis and soil adsorption of the labile herbicide isoxaflutole. *Environmental Science and Technology* 34:3186-3190.
- Taylor Lovell, S.**, Wax, L.M., Horak, M.J., and Peterson, D.E. 1996. Imidazolinone and sulfonyleurea resistance in a biotype of common waterhemp (*Amaranthus rudis*). *Weed Science* 44:789-794.

SYNERGISTIC ACTIVITIES

Share findings as invited presentations (11 presentations) and papers (8 presentations).
Serve the scientific community by reviewing journal manuscripts (7 separate journals) and through membership in Agronomy Society of America, International Association for Landscape Ecology, Ecological Society of America, and American Society of Landscape Architects.
Promote landscape design on the national level by organizing a symposium entitled “Advancing Ecological Function in Managed Ecosystems: Restoring, Revealing, and Reinventing the Landscape” for the 2007 Ecological Society of America Conference.
Teach courses in Landscape Design Fundamentals, Ecological Landscape Design, and Agroecology & Multifunctional Landscapes.
Mentor undergraduate students by serving as an advisor, developing independent study projects, and supervising honors thesis projects.
Mentor graduate students by serving as a graduate advisor (primary advisor for 1 PhD student and 2 MS students), serving as a committee member (1 MS student currently), and organizing the departmental seminar series to reflect interests of graduate students.

COLLABORATORS FOR LAST 48 MONTHS

Ernesto Mendez (UVM faculty), Douglas Johnston (University of Illinois faculty), Wesley Jarrell (University of Illinois faculty), Daniel Erickson (UVM advisee), Chloe Nathan (UVM advisee), Hisashi Kominami (UVM advisee).