

Exponent®
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Professional Profile

Dr. Tsuji is a board-certified toxicologist and a Fellow of the Academy of Toxicological Sciences, who specializes in risk assessment of chemical exposures. She has worked on projects in the United States and internationally for industry, trade associations, U.S. Environmental Protection Agency (EPA) and state agencies, the U.S. Department of Justice, the Australian EPA, municipalities, and private citizens.

Dr. Tsuji's experience includes human health and environmental toxicology related to a wide variety of chemicals in the environment, industrial, commercial, and residential settings. She has designed and directed dietary and environmental exposure studies and community programs involving health education and biomonitoring for populations potentially exposed to metals in the environment, including soil, water, and air, and through food-chain exposures.

In addition to environmental exposures, she has also assessed exposure and health risks associated with substances in foods, medical devices, pharmaceuticals, and a variety of consumer products (e.g., cleaners, cosmetics, personal care products, paints and coatings, carpets, glues, wood preservatives, building materials, and children's products). Dr. Tsuji regularly serves on expert panels on toxicology and health risk issues, such as for the National Academies of Sciences, Engineering, and Medicine, National Research Council (including their Board on Environmental Studies and Toxicology), and federal and state agencies.

Academic Credentials & Professional Honors

Ph.D., Zoology, Environmental Physiology, University of Washington, 1986

B.S., Biological Sciences, Stanford University, 1980

Fox Fund Award for the Outstanding Stanford Graduate in Biological Sciences

Licenses and Certifications

Diplomate of the American Board of Toxicology (DABT)

Prior Experience

Regional Manager of Risk Assessment Practice, Foster Wheeler Environmental, 1998

Senior Toxicologist; Director of Risk Assessment and Toxicology, Kleinfelder, Inc., 1992-1997

Senior Scientist, Program Director, Environmental Toxicology International, Inc., 1987-1992

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Post-doctorate research on quantitative genetics; teaching faculty for course on human physiology, University of Washington, 1986-1987

Professional Affiliations

Fellow of the Academy of Toxicological Sciences

Society of Toxicology

o Member of Nanoscience and Advanced Materials, Risk Assessment, Immunotoxicology, and Medical Device and Combination Product Specialty Sections

o Awards Committee 2019-2021

o Medical Device and Combination Products Specialty Section positions

• Mentoring Committee, Medical Device and Combination Product Specialty Section 2018-2019

o Nanoscience and Advanced Materials Specialty Section positions

• Past- President 2013–2014

• President 2012–2013

• Vice President 2011–2012

• Chair of Program and Nominations Committees, 2011

• Vice President Elect 2010–2011

• Webinar Committee 2009–2010

o Continuing Education Committee 2002-2004

Publications

Taylor AA, Tsuji JS, McArdle ME, Adams WJ, Goodfellow WL Jr. 2022. Recommended reference values for risk assessment of oral exposure to copper. Risk Analysis. DOI: 10.1111/risa.13906.

Tsuji JS, Lennox KP, Watson, HN, Chang, ET. Essential concepts for interpreting the dose-response of low-level arsenic exposure in epidemiological studies. Toxicology 2021. 457:152801. doi.org/10.1016/j.tox.2021.152801.

Bogen KT, Tsuji JS, Taylor MD, Taylor A, Patriarca M. Human biokinetic model for soluble nickel addressing inter-individual variation. Hum. Ecol. Risk Assess. 2021. 27(8):2015-2037.

Taylor AA, Tsuji JS, Garry MR, McArdle ME, Goodfellow WL, Adams WJ, Menzie CM. 2020. Critical review of exposure and effects: implications for setting regulatory health criteria for ingested copper. Environ Manage 65: 131 – 159.

Cohen SM, Arnold LL, Tsuji JS. Inorganic arsenic: a nongenotoxic threshold carcinogen. Curr. Opin. Toxicol. 2019. 14:8−13.

Tsuji JS, Chang ET, Gentry PR, Clewell HJ, Boffetta P, Cohen SM. Dose response for assessing the

cancer risk of inorganic arsenic in drinking water: The scientific basis for use of a threshold approach. Crit. Rev. Toxicol. 2019. E-pub ahead of print. Available at: https://doi.org/10.1080/10408444.2019.1573804.

Kerger, BD, Gerads R, Gurleyuk H, and Tsuji J. Metals measurement in body tissues and fluids: toxicological and clinical importance of standardizing quality analytical methods for differentiating cobalt partitioning on a molecular level. Pages 229-244 in Beyond the Implant: Retrieval Analysis Methods for Implant Surveillance. 2018. ASTM STP1606, WM Mihalko, JE Lemons, AS Greenwald, and SM Kurtz, Eds, ASTM International, West Conshohocken, PA. http://dx.doi.org/10.1520/STP160620170034.

Lemberg, J, Guyer, E, Seidel, S, Garry, M, Tsuji, J, Valenty, S. Utilizing a combination of TGA and GC-MS to estimate health-based risks from off-gassed volatile compounds. Journal of Failure Analysis and Prevention 2018; 18(2): 246-249.

Scrafford CG, Barraj LM, Tsuji JS. Considerations when using longitudinal cohort studies to assess dietary exposure to inorganic arsenic and chronic health outcomes. Food Chem Toxicol 2016; 93:111–118.

Tsuji JS, Garry MR, Perez V, Chang ET. Low-level arsenic exposure and developmental neurotoxicity in children: A systematic review and risk assessment. Toxicology 2015; 337:91-107.

Tsuji JS, Perez V, Garry MR, Alexander DD. Association of low-level arsenic exposure in drinking water with cardiovascular disease: A systematic review and risk assessment. Toxicology 2014; 323:78-94.

Tsuji JS, Alexander DD, Perez V, PJ Mink. Arsenic exposure and bladder cancer: Quantitative assessment of studies in human populations to detect risks at low doses. Toxicology 2014; 317:17-30.

Garcia HD, Tsuji JS, James JT. Establishment of exposure guidelines for lead in spacecraft drinking water. Aviation, Space, and Environmental Medicine 2014; 85(7):715-20.

Garcia HD, Hays SM, Tsuji JS. Modeling of blood lead levels in astronauts exposed to lead from microgravity-accelerated bone loss. Aviation, Space, and Environmental Medicine 2013; 84(12):1229-1234.

Menzie CA, Ziccardi LM, Lowney YW, Fairbrother A, Shock SS, Tsuji JS, Hamai D, Proctor D, Henry E, Su SH, Kierski MW, McArdle ME, Yost LJ. Importance of considering the framework principles in risk assessment for metals. Environ Sci Technol 2009; 43(22):8478-8482.

Tsuji JS, Garry MR. Advances in toxicity testing herald improvements and challenges for risk assessment. Risk Anal 2009; 29(4):490-491.

Mink PJ, Alexander DD, Barraj LM, Kelsh MA, Tsuji JS. Low-level arsenic exposure in drinking water and bladder cancer: A review and meta-analysis. Regul Toxicol Pharmacol 2008; 52:299-310.

Tsuji JS, Yost LJ, Barraj LM, Scrafford CG, Mink PJ. Use of background inorganic arsenic exposures to provide perspective on risk assessment results. Regul Toxicol Pharmacol 2007; 48:59-68. [One of Elsevier's Top 10 cited articles on ScopusTM 2007-2008].

Barraj LM, Tsuji JS, Scrafford CG. The SHEDS-Wood Model: Incorporation of observational data to estimate exposure to arsenic for children playing on CCA-treated wood structures. Environ Health Perspect 2007; 115(5):781-786.

Barraj LM, Tsuji JS. Letter to the editor. Risk Anal 2007; 27(1):1-3.

Tsuji JS, Maynard AD, Howard PC, James JT, Lam C-W, Warheit DB, Santamaria AB. Research strategies for safety evaluation of nanomaterials. Part IV: Risk assessment of nanoparticles. Toxicol Sci

2006; 89(1):42-50.

Tsuji JS, Van Kerkhove MD, Kaetzel RS, Scrafford CG, Mink PJ, Barraj LM, Crecelius EA, Goodman M. Evaluation of exposure to arsenic in residential soil. Environ Health Perspect 2005; 113(12):1736-1740.

Tsuji JS, Benson R, Schoof RA, Hook GC. Response to additional support for derivation of an acute/subchronic reference level for arsenic. Regul Toxicol Pharmacol 2004; 40:372.

Tsuji JS, Benson R, Schoof RA, Hook GC. Health effect levels for risk assessment of childhood exposure to arsenic. Regul Toxicol Pharmacol 2004; 39:99-110.

Schoof RA, Tsuji JS, Benson R, Hook GC. Response to Byrd et al. (2004) comment on health effect levels for risk assessment of childhood exposure to arsenic. Regul Toxicol Pharmacol 2004; 40:374-375.

Yost LJ, Tao S-H, Egan SK, Barraj LM, Smith KM, Tsuji JS, Lowney YW, Schoof RA, Rachman NJ. Estimation of dietary intake of inorganic arsenic in U.S. children. Hum Ecol Risk Assess 2004; 10:473-483.

Massot M, Huey RB, Tsuji J, van Berkum FH. Genetic, prenatal, and post natal correlates of dispersal in hatchling fence lizards. Behav Ecol 2003; 14:650-655.

Tsuji JS, Williams PRD, Edwards MR, Allamneni KP, Kelsh MA, Paustenbach DJ, Sheehan PJ. Evaluation of mercury in urine as an indicator of exposure to low levels of mercury vapor. Environ Health Perspect 2003; 111(4):623-630.

Tsuji JS, Robinson S. Separating potential source exposure from background exposure in subsistence populations in developing countries. Toxicology 2002; 181-182:467-470.

Tsuji JS, Serl KM. Current uses of the EPA lead model to assess health risk and action levels for soil. Environ Geochem Health 1996; 18(1):25-33.

Kalvig BA, Maggio-Price L, Tsuji JS, Giddens WE. Salmonellosis in laboratory-housed iguanid lizards (Sceloporus spp). J Wildl Dis 1991; 27(4):551-556.

Tsuji JS, Huey RB, van Berkum FH, Garland Jr. T, Shaw RG. Locomotor performance of hatchling fence lizards (Sceloporus occidentalis): Quantitative genetics and morphological correlates. Evolut Ecol 1989; 3:240-252.

van Berkum FH, Huey RB, Tsuji JS, Garland Jr. T. Repeatability of individual differences in locomotor performance and body size during early ontogeny of the lizard Sceloporus occidentalis (Baird & Girard). Funct Ecol 1989; 3:97-105.

Tsuji JS. Seasonal profiles of standard metabolic rate of lizards (Sceloporus occidentalis) in relation to latitude. Physiol Zool 1988; 61:230-240.

Tsuji JS. Thermal acclimation of metabolism in Sceloporus lizards from different latitudes. Physiol Zool 1988; 61:241-253.

van Berkum FH, Tsuji JS. Interfamilial differences in sprint speeds of hatchling Sceloporus occidentalis (Reptilia: Iguanidae). J Zool London 1987; 212:511-519.

Tsuji JS, Kingsolver JG, Watt WB. The in-flight thermal physiological ecology of a butterfly (Colias). Oecologia 1986; 69:161-170.

Stevenson RD, Peterson CR, Tsuji JS. The thermal dependence of locomotion, tongue flicking, digestion and oxygen consumption in the wandering garter snake. Physiol Zool 1985; 58:46-57.

Tracy CR, van Berkum FH, Tsuji JS, Stevenson RD, Nelson J, Barnes B, Huey RB. Errors resulting from linear approximations of heat balance equations in biophysical ecology. J Thermal Biol 1984; 9:261-264.

Feder ME, Gibbs AG, Griffith GA, Tsuji JS. Thermal acclimation in salamanders: Fact or artifact? J Thermal Biol 1984; 9:255-260.

Book Chapters

National Academies of Sciences, Engineering, Medicine, Health and Medicine Division. 2020. Compounded topical pain creams: review of select ingredients for safety, effectiveness, and use. National Academy Press, Washington, D.C. Co-authored with committee members.

National Academies of Sciences, Engineering, Medicine, Health and Medicine Division. 2017. Assessment of the Department of Veterans Affairs airborne hazards and open burn pit registry. National Academy Press. Washington, D.C. Co-authored with committee members.

Institute of Medicine. 2011. Breast cancer and the environment: A life course approach. National Academy Press. Co-authored parts of the report with other committee members.

Tsuji JS, Mowat FS, Donthu S, Reitman M. Application of toxicology studies in assessing the health risks of nanomaterials in consumer products. pp. 543-580. In: Nantoxicity: From In Vitro and In Vivo Models to Health Risks. S.C. Sahu and D.A. Casciano (eds), John Wiley & Sons, Chichester, West Sussex, UK, 2009.

Presentations

Tsuji JS. Introduction and moderator: Environmental Exposomics to Quantitative Exposure Assessment: Are We There Yet? The Toxicology Forum 2021 Summer Meeting. July 29.

Tsuji JS. Effect of individual-specific conditions on biomonitoring results: metals as case examples. Workshop on the Feasibility of Addressing Environmental and Occupational Health Exposure Questions Using Department of Defense Biorepositories. National Academies of Science, Engineering, and Medicine, Board on Environmental Studies and Toxicology. June 15, 2018. Washington, DC.

Tsuji, JS. Low dose arsenic risk versus benefits of rice consumption in U.S. populations. Invited presentation in session titled Overview on Sources of Exposure, Issues in Arsenic Risk Assessment. Toxicology Forum. Colorado Springs. CO. July 15, 2015.

Tsuji JS. Risk/benefit analysis of rice consumption in the U.S. — Nutrition-related health benefits relative to risk. ILSI Food Safety Case Study: Arsenic. International Life Sciences Institute Annual Meeting, Southampton, Bermuda, January 21, 2014.

Tsuji JS. Health risk evaluation of nanomaterial composites. Invited speaker. Life Cycle Considerations for Engineered Nanomaterials: Case Studies for Polymer-Based Nanomaterials. Society for the Advancement of Materials and Process Engineering (SAMPE) Conference, Long Beach, CA, May 8, 2013.

Tsuji JS, Eaton DL. New directions for future research on environmental influences on breast cancer. Presentation within the Symposium on Breast Cancer as a Multifactorial Disease: Interaction of Genetics, Life Stage, and the Environment. Symposium organizer and co-chair with DL Eaton. Annual Meeting of the Society of Toxicology, San Francisco, CA, March 12, 2012.

Tsuji JS. Evaluation of nickel release from cardiovascular occlusion devices based on serum data in patients. Invited presentation and panelist at the FDA Cardiovascular Metallic Implant Workshop, Silver Spring, MD, March 9, 2012.

Tsuji JS, Bogen K. Human biokinetic model of nickel release from medical devices. Poster Presentation, 50th Annual Meeting of the Society of Toxicology, Washington, D.C., March 6-10, 2011.

Tsuji JS, Li AA. Mechanism-based evaluation of xenobiotic toxicity: Translation of National Academy of Sciences recommendations to practice. Invited speaker. 8th International Conference on Early Toxicity Screening: Mechanism-based Evaluation of Adverse Drug Effects: Early Elimination of NCE [new chemical entity] with Hepatotoxicity and Idiosyncratic Toxicity: Scientific Concepts, Challenges and Promising Approaches, Seattle, WA, June 17-18, 2010.

Tsuji JS. Invited panel participant. Product safety: How companies can minimize their risk of product liability litigation. Nanotech 2010 Conference sponsored by the Nano Science and Technology Institute, Anaheim, CA, June 21-24, 2010.

Tsuji JS, Hentz K, Rosenbloom, S. Health risk of internal nickel exposure from medical devices. Poster presentation. Annual Meeting of the Society of Toxicology, Salt Lake City, UT, March 7-11, 2010.

Tsuji JS. Health risks of nanotechnology in consumer products. Invited speaker. Environmental Health and Safety: Policy, Regulation, and Product Safety. Nanotech 2009 Conference sponsored by the Nano Science and Technology Institute, Houston, TX, May 3-7, 2009.

Tsuji JS, Mowat FS. Application of toxicity studies for risk assessment in the real world. Presentation within workshop on Agglomeration Versus Dispersion: How Nanoparticle Behavior Affects Exposure and Toxicity In Vitro, In Vivo, and in the Real World. Workshop organizer and chairperson. Annual Meeting of the Society of Toxicology. Baltimore, MD, March 15-19, 2009.

Tsuji JS. Environmental health: Nanomaterials: nifty or naughty? Invited panel participant. Society for Environmental Journalists. Stanford University, Stanford, CA, September 7, 2007.

Tsuji JS. Background arsenic exposure from diet and water provide perspective for assessing arsenic exposure from other sources. Invited speaker for session on Risk Characterization and Risk Assessment. Conference on Urban Environmental Contamination and Health Under the Microscope: The Aftermath of Hurricane Katrina. The Society for Environmental Geochemistry and Health, New Orleans, LA, July 22-25, 2007.

Tsuji JS. From slippery slope factor to drinking water standard: How risk assessment affects the arsenic MCL. Invited speaker for session on Natural Poisons and Unnatural Products. American Water Works Association Annual Conference, Toronto, Ontario, June 27, 2007.

Tsuji JS, Mowat FS. Exposure and toxicology of nanomaterials. Invited speaker for Nano Safety and Health Forum. Society for the Advancement of Materials and Process Engineering (SAMPE) Conference, Baltimore, MD, June 6, 2007.

Tsuji JS, Mowat FS. Health risks of carbon nanotubes: What can we learn from mineral fibers or ultrafine particulates? Workshop organizer and chairperson. Annual Meeting of the Society of Toxicology. Charlotte, NC, March 25-29, 2007. Toxicologist 2007; 96(1):7.

Mowat FS, Tsuji JS. Assessment of health risks of carbon nanotubes: Where do we go from here? Toxicologist 2007; 96(1):8.

Tsuji JS, Mowat FS, Kaetzel RS. Approaches for risk assessment and risk management of nanomaterials: "Inert" metal oxides. Toxicologist 2006; 90(1), Abstract 2201. Society of Toxicology Annual Meeting.

Mink PJ, Alexander DD, Barraj LM, Kelsh MA, Tsuji JS. Meta-analysis of low level arsenic exposure and bladder cancer: Implications for risk assessment in the United States. Toxicologist 2006; 90(1), Abstract 2184. Society of Toxicology Annual Meeting.

Yost LJ, Tsuji JS, Scrafford CG. Implications of changes in the arsenic cancer slope factor for risk communication. Toxicologist 2006; 90(1), Abstract 2180. Society of Toxicology Annual Meeting.

Tsuji J, Mowat F. Assessment of products containing nanomaterials. Symposium entitled, "Regulating nanotechnology: Developing stakeholder consensus for future rulemaking by EPA, FDA and OSHA." Division of Chemistry and the Law of the 232nd American Chemical Society National Meeting. San Francisco, CA, September 10-14, 2006.

Tsuji JS, Mowat FS. Risk assessment of nanoscale metal particles. Invited presentation at the Environmental Protection Agency (EPA) Region 5 Nanotechnology for Site Remediation Workshop. Chicago, IL, September 6-7, 2006.

Mowat FS, Tsuji J. Nanotechnology and the water market: Applications and health effects. Abstract 747. Presented at 9th Annual NSTI Nanotechnology Conference and Trade Show. Boston, MA, May 7-11, 2006.

Tsuji JS, Mowat FS. Potential benefits and hazards of nanotechnology in water. Session on Natural Poisons and Unnatural Products. American Water Works Association Annual Conference. San Francisco, CA, 2005.

Tsuji JS. Emerging issues in risk assessment and risk perception of nanomaterials. Symposium organizer and chairperson at the Society of Toxicology annual meeting, New Orleans, LA, 2005. Toxicologist 2005; 78(1-S) Abstract 648.

Tsuji JS, Kerkhove MD, Scrafford CS, Kaetzel RS. Biomonitoring of a community for soil arsenic exposure. Toxicologist 2005; 78(1-S), Abstract 693.

Tsuji JS. Assessing children's exposure to arsenic treated wood. Society of Toxicology continuing education course on Fundamentals of Risk Assessment and Applications of Recent Methods to Difficult Problems, Salt Lake City, UT, 2003.

Tsuji JS. Childhood lead exposure pathways and risk factors for lead exposure at U.S. mining and smelting sites. Plenary speaker for Local Solutions Smart Future Conference and Celebration, Working and Living with Lead, Port Pirie, South Australia, 2003.

Tsuji JS, Yost L, Barraj L. Background inorganic arsenic exposures in children. Session on CCA Treated Wood — Regulations, Science, and Risk Assessment. The Annual International Conference on Soils Sediments and Water, University of Massachusetts, Amherst, MA, October 22, 2003.

Tsuji JS, Williams PR, Edwards MR, Avadhanam KP, Paustenbach DJ. Is mercury in urine indicative of exposure to low levels of mercury vapor? Toxicol Sci 2002; 66(1-S), Abstract 979.

Garry MR, Tsuji JS. Evaluating lead exposure at mining sites with heterogeneous soil types and lead bioavailability. Toxicol Sci 2002; 66(1-S), Abstract 500.

Tsuji JS, Williams P. Use of biomonitoring versus risk assessment methods for evaluating human exposures. Platform presentation at the Society of Risk Analysis Annual Meeting, New Orleans, LA, 2002.

Tsuji JS, Benson R, Schoof RA, Hook GC. Childhood Health Effect Levels for Arsenic. Poster presentation at the 5th International Conference on Arsenic Exposure and Health Effects, San Diego, CA, 2002.

Tsuji JS, Robinson S. Separating potential source exposure from background exposure in subsistence populations in developing countries. Invited symposium presentation at the 9th International Congress of Toxicology Conference, Brisbane, Australia, 2001.

Tsuji JS, Schoof RA, Robinson S, Seidel P. Dietary arsenic in subsistence populations from Indonesia. Invited presentation at the 4th International Conference on Arsenic Exposure and Health Effects, San Diego, CA, 2000.

Tsuji JS, Garry MR. Metals exposure from homegrown produce at mining and smelting sites. Toxicol Sci 2001; 60(1-S): Abstract 95.

Garry MR, Lowney YW, Tsuji JS. A critical analysis of assumptions used when evaluating intake of metals from homegrown vegetables. Toxicol Sci 2001; 60(1-5): Abstract 2077.

Goodman M, Tsuji JS. Is sulfate in drinking water a hazard for infants? Toxicol Sci 2000; 54(1-S), Abstract 1174:250.

Schoof RA, Tsuji JS. The role of outdoor dust in exposures to chemicals in soil: Case studies for arsenic. Toxicol Sci 2000; 54(1-S), Abstract 1168:249.

Tsuji JS, Schoof RA, Hook GC. Subchronic health effect levels for childhood exposure to arsenic. Toxicol Sci 2000; 54(1-S), Abstract 346:73.

Tsuji JS, Serl KM. Multipathway exposure and risks to mercury in soil. Toxicol Sci 1998; 42(1-S), Abstract 1139:231.

Tsuji JS. Chairman and introductory speaker for a session on community health monitoring and education programs. National Environmental Policy Institute Conference on Lead in Soil and Blood Lead of Children, 1998.

Tsuji JS, Serl K, Fricke JR. Predicted versus observed blood lead levels for a smelter site. Fund Appl Toxicol 1997; 36(1):Part 2, Abstract 1706:336.

Project Experience

Product Safety

Assessed exposure, toxicology, and health risks of metals (e.g., aluminum, barium, chromium, cobalt, iron, neodymium, nickel, platinum, titanium, tungsten, and vanadium) release from alloys used in various medical devices or instruments. Projects involved potential device failures or surgical or patient-specific conditions, as well as assessments in support of FDA submissions for device approvals. Types of devices included joint replacements; structural, fixation, drug delivery, bariatric, and cardiovascular and other devices; electronic components; and surgical instruments and equipment.

Directed the development and application of a biokinetic model for internal nickel release to evaluate the representativeness of in vitro leaching tests based on clinical data on serum nickel levels. Used the model to assess health risks of medical devices based on in vitro leaching data and clinical reports. Served as the senior reviewer of a project to refine the nickel biokinetic model using additional human experimental data to inform the development of occupational biological exposure limits for nickel in urine.

Directed an assessment of the potential health risks from volatiles during use of a drug delivery device, as well as the applicability of Global Harmonization System classification and labeling requirements.

Provided senior review of toxicological assessments of the biocompatibility of various medical devices and surgical tools. Served as senior reviewer for health evaluation of silver release from medical devices involving silver coatings and for the design of an animal study of an in-dwelling catheter.

Conducted an evaluation of potential health risks for organic chemicals identified from leaching and volatilization tests of a device and control unit intended to be implanted for nerve stimulation. Commented on the implications of the test results for the intended application. Provided perspective on potential exposures and toxicity given the intended use and other known and approved exposures to these chemicals.

Directed the development and provided senior oversight of toxicology reviews and health-protective exposure limits for residual levels of impurities and excipients in pharmaceutical products, occupational health assessments of pharmaceutical manufacturing, as well as evaluation of health risks of drug-device combination products.

Served as the senior toxicologist for an assessment of trace levels of an impurity in a cosmetic product. The report responded to concerns by a regulatory agency in China.

Conducted state-of-the-science reviews of potential exposure and health effects related to nanometal oxides, carbon nanotubes and nanofibers, and other nanomaterials proposed for use in several products with widespread consumer uses. Evaluated exposure and health effects literature related to worker or consumer exposure and potential environmental effects. Directed a team of material scientists and toxicologists to assess the potential for exposure and health risks to nanoparticles from these products during manufacture and consumer use.

Served as the principal toxicologist and project director on an assessment of worker safety of nanomaterials used in semi-conductor manufacturing. The project team conducted a workplace safety audit and risk assessment using a control banding approach adapted for the specific nanomaterials. These efforts were used to guide risk management decisions for protection of workers.

Evaluated potential applications of nanotechnology and the available knowledge on health risks for home care and cleaning products.

Directed a literature review and assessment of studies of potential exposure and health effects associated with nanometal pigments used in sunscreen formulations. Provided senior review of a survey of toxicology studies on nanoscale silver and silver in general with relevance for use in personal care products.

Evaluated potential safety concerns of a sanitizing device on a water dispenser. The assessment included evaluation of the sanitizing agent as well as potential reaction byproducts depending on whether the water source was untreated water or treated (chlorinated or ozonated) water.

Provided toxicology and health risk support for assessment of chemical leaching results for various plumbing fixture parts.

Served as the senior toxicologist for several projects involving metals (e.g., lead, cadmium), phthalates, or other organic chemicals in toys or consumer products, including interpretation of the results of sampling and chemical analysis for potential exposure and health risks.

Conducted critical reviews of the literature on exposure, biomonitoring, and health effects of perfluorinated compounds per- and polyfluoroalkyl substances (PFAS), including perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorohexane sulfate (PFHxS), and others used in consumer products, fire-fighting foams, and industrial manufacturing. Assessed the potential sources, exposure, and health risks of levels of PFOS and other compounds in soil, groundwater, river sediments and fish tissue. Evaluated health risk assessments and health-based limits for PFAS perfluorinated compounds conducted by U.S. and international regulatory agencies. Contributed to public comments on the scientific-basis of proposed regulatory assessments and criteria.

Investigated levels of brominated flame retardants and other chemicals in fabric used in children's products that might potentially be associated with reported skin reactions. Assessed potential exposures and health effects of brominated flame retardants in plastic housing of consumer electronics. Evaluated health risks of formaldehyde, 1,4-dioxane, parabens, and other chemicals reported in children's bath products and other personal care products.

Assessed the results of chemical testing of clothing and bedding materials for consumer exposure, health risk, and compliance with international regulatory guidance levels. Products included formaldehyde in bedding products (and the effects of laundering and different drying methods), and multiple types of uniforms and worker outerwear. Provided recommendations on assessment of residential exposure to formaldehyde from cabinets and evaluated potential health risks associated with exposure levels.

Evaluated the toxicology of cleaning and sanitizing agents for a Fortune 500 consumer product company negotiating backflow device requirements with health authorities. Communicated the nature of the toxicity of the ingredients and compared exposure during a backflow event with other dietary or cosmetic exposures to these chemicals.

Researched the toxicology of the more than 22 ingredients in carpet glue for a glue manufacturer who was sued along with the carpet manufacturer, carpet installers, and landlord of a retail space in which tenants claimed multiple chemical sensitivity and other long-term health effects from short-term exposure to a newly installed carpet.

Directed an assessment of exposure and health risks for chemicals associated with fragrances used in various consumer products. Evaluated the potential for certain compounds to react with ozone and assessed the toxicity of the reaction by-products. Compiled comprehensive literature summaries and identified data gaps and areas for additional research and investigation.

Provided senior direction for development of a framework to assess arsenic and chromium exposure and toxicity to children from chromated copper arsenic (CCA)-treated wood used for play equipment and residential decks. This project involved analysis of the available scientific data and identification of critical uncertainties for exposure parameters that would benefit most from additional research. Presented the analysis to the Agency for Toxic Substances and Disease Registry and EPA. Commented on EPA's deterministic risk assessment of CCA-treated wood and on the agency's probabilistic exposure model for assessing exposures to wood treatment chemicals. Testified at EPA's FIFRA Science Advisory Panel meetings and before the Consumer Product Safety Commission regarding background exposures to inorganic arsenic via diet and water in comparison to CCA exposures.

Retained by the U.S. Department of Justice and the U.S. EPA to evaluate claims that EPA under the Toxic Substances Control Act inadequately considered neurotoxicity and specifically developmental neurotoxicity of drinking water fluoridation, based on experimental animal neurotoxicology studies. Conducted a systematic review and assessment of the overall evidence from animal studies and testified on the findings.

Metals

Served as a senior advisor for human health investigations of environmental and dietary exposures associated with a zinc-lead mine, haul road, and concentrate loading facility in northern Alaska. Native American concerns included deposition or uptake of metals into berries, caribou muscle and organs, and fish. Reviewed data collection work plans and risk evaluations of environmental data. Provided expert testimony regarding potential health effects to downstream native populations based on levels of metals and other constituents in discharge monitoring reports from the mine.

Assessed risks to cattle and horses from metals in alluvial sediments deposited in pastures. Developed toxicity values and soil intake rates to assess potential exposures and risks to arsenic, cadmium, copper, lead, manganese, mercury, molybdenum, selenium, zinc. The assessment considered the differences in

potential toxicity for ruminants versus non-ruminants and young versus adult animals, and the bioavailability of certain metals in soil based on in vitro bioaccessibility results, mineralogy, and possible interactions among metals.

Participated as the senior toxicologist in the development of technical guidance for conducting hazard and risk assessment of alloys suitable for meeting emerging international regulatory requirements for chemical risk assessment and classification schemes to protect human health. A key issue was the difference in bioavailability of metals in alloys compared to simple mixtures of metals. Example metals in alloys included aluminum, chromium, cobalt, copper, iron, lead, manganese, nickel, and zinc.

Directed a team of scientists in conducting a quantitative analysis of the health benefits of consumption of rice and rice-related nutrients based on the epidemiological literature as well as in dietary studies of exposure to arsenic compounds from consumption of rice and rice products.

Assessed exposure and health risks of various metals in steel slag (e.g., chromium, manganese, cadmium) when reused as fill, railroad ballast, concrete aggregate, asphalt production, and road base. Specific considerations including particle size and durability of the material, as well as leaching and bioassessibility of the metals.

Assessed potential health risks of metals in soil and in a river system, as well as airborne exposures during cleanup after a coal fly ash impoundment failure at an electric power generation plant.

Submitted comments to EPA regarding their derivation of a revised provisional peer-reviewed toxicity value for cobalt. Discussed the toxicology, medical, and dietary literature for cobalt with EPA scientists.

Worked with a team of epidemiologists on a meta-analysis of low-level arsenic exposures and cancer. The results of the meta-analysis were submitted to the EPA Science Advisory Board (SAB) reviewing the cancer slope factor for arsenic and were published. Also provided technical comments to the SAB regarding arsenic toxicology and importance of nutrition, perspective on background exposure via diet and water, and information from health studies from a number of smelting sites.

As a part of an inter-disciplinary, international team, evaluated the health effects of metals and other constituents in tailings discharged into a river system from a copper mine in Irian Jaya. Served as the senior toxicologist for the human health risk assessment. This risk assessment entailed designing a dietary, human exposure, and biomarker survey of subsistence populations in the area and overseeing the implementation of the survey at the site. The survey information was used in both screening-level and detailed probabilistic assessments of risks to these populations. Trained local scientists in conducting risk assessments and presented preliminary results to a government scientific review panel.

Provided comments on EPA's assessment of health risks and potential cleanup levels associated with arsenic, cobalt, and other metals in soil from a mining site near Salmon, Idaho. This remote site included an inn and primitive campgrounds, and was located near two creeks. Stream-side tailings deposited on properties downstream of the site were also a concern. Site-specific issues included the bioavailability of the ore and the amount of exposure associated with residential, recreational, or livestock use of the area. Worked with EPA scientists in developing risk assessment assumptions.

Retained by the U.S. Department of Justice as a toxicology expert to assess enforcement actions by EPA regarding release of chromium in groundwater from mining activities that was potentially affecting domestic wells, and arsenic in a domestic water supply.

Analyzed news reports of health effects on dock workers from exposure to an arsenical wood-treating solution that leaked from shipping containers at an African port. Separated symptoms associated with arsenic poisoning from those possibly due to hemorrhagic fevers or other local health problems.

Served as the senior toxicologist for a probabilistic risk assessment of arsenic in soil in a community in Arizona that received historical flooding from a tailings impoundment. Provided arsenic toxicology expertise and scientific input on distributions of values for arsenic bioavailability and other inputs to the Monte Carlo risk assessment.

Participated in an EPA working group involving the Agency for Toxic Substances and Disease Registry, state and local health agencies, interested parties, and concerned residents of a Superfund and Environmental Justice site in Denver with elevated levels of arsenic and lead over a large residential area. A primary source of the elevated arsenic levels was found to be historic use of an herbicide for lawns. Attended monthly meetings over a 2.5 year period and provided comments on data collection, bioavailability of metals, biomonitoring, risk assessment, and the toxicology of arsenic and lead.

Participated in focused technical meetings on the short-term toxicology of arsenic in children and pica soil ingestion by children.

Served as senior toxicologist on a case involving lead-containing brass in water meter parts for a water department of a large municipality in California. The water department was seeking cost recovery from a supplier that provided water meters and valves containing more lead than specified in the order. The water department also had concerns for public exposures. Our work involved evaluation of the leach test information and conducting various exposure simulations of the potential effect on blood lead levels of children.

Directed human health and ecological efforts to evaluate risks before and after reclamation of an abandoned mine site in a wildlife refuge in Northern California. These assessments were performed for the State Department of Fish and Wildlife. Features of the site included an acidic pit lake, tailings and waste rock piles, and mine drainage and mineralization of groundwater and a nearby creek.

Appointed as an expert for a U.S. district court on health risks related to lead, arsenic, and other inorganic and organic chemicals for an 11-mile2 area of the city of Dallas, Texas. The study area included a former secondary lead smelter, several battery and metals reclamation facilities, numerous other industries, a large public housing project, single and multi-family private residents, and schools.

Conducted multiple risk assessments and health risk reviews and worked with federal and state regulators to evaluate various health issues in areas near a large open pit copper mine and smelter in Utah. The areas included residential and recreational area soils affected by past air emissions or by deposition of metals in tailings during flooding from a stream channel. Evaluated the results of an environmental exposure and biomonitoring program for lead and arsenic in children for use in assessing health risks and cleanup levels. Assessed drinking water exposure to sulfate and other inorganic constituents in groundwater. Provided a scientific review of the toxicity of sulfate to humans that U.S. EPA Region 8 relied on to set a site-specific action level for sulfate in groundwater used for drinking water. Assessed health risk and cleanup levels for arsenic and lead associated with tailings and waste rock drainage and flood events in offsite areas.

Directed the human health and ecological risk assessments for tailings and naturally mineralized soil at a former mill site in New Mexico. The primary site constituents were manganese and zinc in groundwater and lead, manganese, and arsenic in soil. Lead in soil was evaluated using EPA's adult and child lead models with site-specific assumptions when justified. Detailed site geochemistry studies and simulated gastrointestinal leaching tests indicated very low bioavailability of lead in soil. This work was conducted as a part of a voluntary removal action.

Evaluated claims by a couple in New Mexico that past weekend exposures at a cabin to elevated levels of metals and fluoride in their drinking water put them at risk of future disease.

Retained as an expert in separate legal suits at mining sites in Washington. One suit involved releases of acrylamide in drilling muds to groundwater; the other, cyanide and metals concentrations in surface water

and groundwater near a gold mine. Assessed the potential health risks of chemical concentrations to populations in the vicinity. Testified before a jury in the latter case.

Provided toxicology and exposure assessment support for a litigation case involving a competitive shooter who alleged that his health effects and elevated blood lead level were caused by the conditions of an indoor firing range. Assessed lead data from range samples and designed an exposure study at an outdoor range to distinguish lead exposure from the shooting equipment and style of firing versus ventilation conditions of the range. Also evaluated whether the alleged health effects were related to the chelation therapy and whether this treatment was applied appropriately.

Retained by a county in Oregon to direct a risk assessment of elemental mercury and cinnabar ore in soil at the site of a former small-scale refining operation. The RI/FS was conducted under the state voluntary cleanup program and involved close coordination with state toxicologists. The risk assessment evaluated direct exposures to soil as well as mercury vapor emissions and potential effects on groundwater and migration to nearby rivers.

Conducted risk assessments for a former copper smelter in Tacoma, Washington. Risks were assessed for arsenic and lead in soil and slag in nearby residential areas and for more than eight metals, PAHs, PCBs, and aniline compounds in soil, slag, demolition debris, groundwater, and surface water on the smelter site. Risks of the site to aquatic life and fishermen were also considered. Participated in discussions of health issues with EPA; in risk communication at public meetings and with citizen groups; and in a technical work group with EPA, the state, NOAA, and other trustees to design and implement toxicity testing and assessment of sediment impacts.

Directed a risk assessment of metal concentrations under baseline and post-mine-development conditions as a part of the permitting process for a gold mine in Montana. Because the mine site is located near the confluence of two rivers, fish consumption was a major pathway of exposure in addition to potential effects on groundwater. Assisted in risk communication.

Directed health risk assessments of lead smelter sites in Montana, Utah, and Washington. Reviewed and commented on the health risks of smelter sites in Kansas City, Idaho, Illinois, and Texas. Chemicals of concern included lead, arsenic, and cadmium. Evaluated blood lead and urinary arsenic concentrations of residents and environmental sampling data. Assessed impacts from air, water, soil, and dust using EPA's integrated exposure/uptake biokinetic (IEUBK) lead model for the Montana site.

Conducted a health risk assessment of a lead smelter site on the Missouri River in Omaha, Nebraska, that was proposed for brownfield redevelopment as a park. Assessed health risks during demolition and construction as well as afterwards to visitors and maintenance workers of the park. Also considered the potential impacts resulting from flooding of the site. Discussed health risk issues with the state regulators, and participated in public meetings. This work facilitated the cleanup and redevelopment of the site by addressing health risk concerns.

Served as project manager under a contract with EPA for conducting a risk assessment of a reservoir in Montana filled with sediments from upstream mining and smelting activities. The site covers hundreds of acres involving potential impacts to aquatic life, wetlands, bird life, and local drinking water wells. The risk assessment involved coordination among various agencies (EPA, the State of Montana, the U.S. Fish and Wildlife Service, the Montana State Department of Fish and Game), the public, and the principal responsible party.

Calculated health-based soil remediation goals in support of risk-based closure and commercial redevelopment of a zinc plant site in Oklahoma. Lead, arsenic, and cadmium in soil and smelter debris used as fill material were the primary health concerns.

Provided technical review and comments on an engineering evaluation/cost assessment for a zinc plant site in southern Illinois. Evaluated site-specific uses of EPA's IEUBK lead model for estimating lead risk

for residential soil with isolated areas of lead-containing smelter debris for both sites. Also calculated lead risks to workers using an adult lead model.

At another zinc plant site in Oklahoma, directed screening-level assessments of exposure and risk and made recommendations for communicating the necessity of closing private wells because of potential risks associated with cadmium in groundwater.

Conducted focused health evaluations for zinc plants in Texas and Tasmania. Presented findings for the Texas site to the regulators and in a brief televised news interview.

Assessed the toxicity of mine tailings to cattle and food chain transfer of metals in tailings to humans consuming beef or beef liver. This study was a part of a successful project in Arizona to use cattle to revegetate and stabilize mine tailings slopes.

Reviewed the scoring of arsenic by the Canadian Government's Substance Selection Committee, which implemented the Ontario Ministry of the Environment Scoring System for Assessing Environmental Contaminants. Provided technical comments on the environmental fate and persistence, aquatic toxicity, and carcinogenicity of different forms of arsenic. Reviewed a draft Environment Canada report on the long-range transport of metals in the environment with specific focus on the sources and migration of mercury.

Provided health risk and toxicology expertise for an active cadmium refinery in Denver, Colorado. Reviewed risk assessments, evaluated air emissions, interpreted health data of residents, discussed technical issues with the state agencies, and communicated risk to the public. This site required environmental cleanup for cadmium, lead, and arsenic.

As an expert for the Environmental Protection Authority of Victoria, conducted a focused risk assessment of lead in soil from a past battery recycling plant in Melbourne, Australia. Residential development had already commenced at the site without prior remediation. This assessment was instrumental in justifying that health protective actions were necessary.

Reviewed the NPL ranking of a mine waste site in Idaho that received one of the highest scores. Comments primarily focused on the lack of consideration of the bioavailability of arsenic and lead in the mine waste. Provided senior toxicology input to the assessment of both human health and ecological impacts, wetland areas, and a nearby river. Worked on behalf of the responsible parties to help ensure that up-to-date scientific methods and site-specific assumptions were considered. Provided oversight on bioavailability and geochemical studies of the soils and waste rock.

Retained as the senior toxicologist for a risk evaluation of mine tailings in Coeur d'Alene River and Lake in Idaho. Provided technical input and risk communication regarding the likelihood of adverse effects associated with exposure to metals in surface water, fish, and beach sediments resulting from tailings releases from upstream mining. Communicated the findings of the risk evaluation at a press conference. Later retained as an expert on human health issues in the natural resource damage suit. Evaluated the available data relating various sources of environmental lead in the Coeur d'Alene basin to blood lead levels of children.

Assessed the bioavailability and adverse health effects of arsenic-containing ore and mercury contamination of an old gold mining site in Alaska that was turned into a children's playground. Negotiated a site-specific approach for setting cleanup levels with the Alaska Department of Environmental Conservation. This study developed a cleanup level for arsenic based on a health risk assessment that incorporated the low bioavailability of the ore form of arsenic.

Provided senior direction and review of an evaluation of thallium levels in cement kiln dust and exposures to workers at a cement plant in Florida. Recommendations were made for reducing thallium levels to protect the health of workers.

Assessed exposure to lead and arsenic in soil from historic sandblasting and repainting of water tanks in residential neighborhoods in Seattle, Washington.

Medical/Biological Monitoring

Assessed PFAS exposures based on serum biomonitoring data of communities in the United States and Sweden with environmental exposures from drinking water, crops, fish, air emissions, or consumer product uses. Conducted exposure assessments of PFOS and other PFAS compounds in fish tissue at multiple sites with numerous potential industrial and municipal sources.

Designed and directed an arsenic exposure investigation and biomonitoring study of more than 400 residents living near a pesticide manufacturing plant. The study included a detailed census of the community, public communications, administration of a survey of individual characteristics affecting exposure, and collection and reporting of biological samples (urine and toenails) and environmental samples (house dust, soil, vegetables) for arsenic analysis. The data collected were used in a cross-sectional statistical evaluation of soil arsenic exposure in the community.

Served as a toxicology and risk assessment expert in assessing claims that arsenic exposure, based on urinary biomonitoring data in a community, resulted in increased health effects in a coastal town in northern Chile. Arsenic exposure was alleged to have resulted from smelter process material from Sweden that was sent to Chile in the mid-1980s for extraction of metals for resale. Assessed the timing of exposure relative to biomonitoring, likely sources of inorganic arsenic and organic arsenic (from diet) that would have affected the test results, whether the patterns of elevated urinary arsenic were consistent with site exposure and windblown dispersion, and the validity of the health survey.

Evaluated potential for health effects and provided technical consulting pro bono to a homeowner who drank well water with elevated arsenic levels, including review of well water data, medical records and biomonitoring results.

Served as the senior toxicologist of a team that designed and conducted biomonitoring for potential metals exposure of highland, lowland, and estuarine populations living along a river that carried tailings from a mine and mill in Irian Jaya. Biomonitoring of inorganic substances in blood, urine, and hair in the different villages was evaluated for consistency with external measures of exposure based on dietary intakes and daily activities.

Assessed past exposures and potential health risks for arsenic and cobalt based on biomonitoring data in residents of a mining area with elevated metals concentrations in soil, dust, and well water.

Developed work plans for community protection measure programs to address residual risks to lead and arsenic in residential soil at a former smelting area in Utah and for several communities in the tri-state mining district in Oklahoma. The programs involved health education, blood lead and urinary arsenic monitoring, health intervention, and environmental abatement, if warranted. These programs were developed cooperatively with federal, state, and local health agencies. Worked with EPA and state and local health departments in interpreting blood lead and environmental lead data for risk management decisions at the Leadville, Colorado, mining and smelting site.

Served as a toxicology expert in legal cases involving children in Oklahoma. The families alleged that their children's prior blood lead levels resulted from wind-blown dust from mine waste piles and had caused behavioral and academic problems in school. Evaluated sources of exposure for each child and the potential effects associated with their blood lead levels.

For two residential areas in the Midwest involving releases of elemental mercury from gas meter regulators in homes, provided information on the toxicity of elemental mercury, biomonitoring of individuals for exposure, and background sources of elemental mercury. Provided risk communication and technical support in developing strategy for working with EPA Region 5 on what levels might

constitute a concern in homes. Conducted a pooled analysis of studies examining the relationship between mercury levels in air and in urine. Based on this analysis, recommended limits to the usefulness of biomonitoring for mercury vapor.

Directed an evaluation of beryllium exposure in workers manufacturing aluminum alloy products. Reviewed air and wipe sample data and provided a review of the available scientific and medical information regarding the likelihood of disease and strengths and limitations of medical monitoring tests.

Retained as an expert on the toxicology and health risk of metals associated with contamination of private wells by acid mine drainage in Arizona. Served as the senior lead of the human health risk assessment team and worked with county and state health officials to assess and communicate to residents the potential health effects indicated by well water sampling results. Manganese was the primary chemical of concern. As a part of a settlement for a class action lawsuit, proposed an approach to exposure screening and medical monitoring and worked with plaintiffs' expert from a local university to develop a medical monitoring program for residents.

Provided testimony in a class action lawsuit in Washington State regarding the alleged need for medical monitoring for all residents in the vicinity of a smelter living on soil with arsenic and lead levels above background levels. Key issues included the lack of sensitivity of tests at these low exposure levels and the low risk of adverse effects.

Risk Communication

Evaluated residual lead levels in dust and cleanup efforts for a former printing facility building in Colorado that was converted for use as a charter school. Explained lead exposure and health issues at two town hall meetings for parents, teachers, and students.

Provided toxicological expertise and risk communication for a school district dealing with the issue of lead in drinking water of schools. Assessed the sampling data, recommended further testing and controls, and discussed the nature of the risks and solutions with school officials. Contributed to press releases and communication to parents.

Met with a daycare owner and concerned parents in a residential area near a former smelter to discuss their potential health concerns associated with soil sampling results for arsenic and lead on the property.

Participated in public meetings and news conferences as a health risk expert. Explained health issues to concerned parents at a daycare facility near a Superfund site. Evaluated and communicated potential health risks of a nearby hazardous waste site cleanup to the cast and crew of a television studio in California.

Air Toxics (see also Volatile Organic Compounds and Petroleum)

Worked with air quality scientists and epidemiologists to conduct an evaluation of trends in exposures to fine particulate matter (PM10, PM2.5) and PM precursors in a western greater metropolitan area, along with a state-of-the-science review of the association of PM with various health effects. These efforts were conducted to examine the contribution of an industrial facility to local air pollution and health outcomes.

On behalf of the State of Washington and Labor Organizations in a legal action regarding worker safety, assessed health risks of worker exposures from releases of mixtures of volatile organic and inorganic chemicals from tank farms at the Hanford Nuclear Reservation.

Testified at a preliminary injunction hearing regarding claims of imminent and substantial endangerment based on PM levels alleged to be emitted by a coke plant, as measured by nearby residents using hand-held instruments.

Evaluated health-based levels for short-term and long-term exposures to numerous inorganic and organic chemicals in air while serving on several expert committees for the National Research Council/National Academy of Sciences.

Conducted a state-of-the-science review of the toxicological basis for short-term and long-term air quality criteria for methylene chloride. Evaluate air guidelines developed by agencies in the United States, Canada, Europe, Israel, and by the World Health Organization. This project was followed by a review of the scientific basis supporting short-term and long-term exposure limits for airborne levels of 12 other chemicals.

Retained as the senior toxicologist on odor and health issues for a pulp mill in Camas, Washington, that had a release of hydrogen sulfide and mercaptans that reached a school. The strong odors at the school resulted in children feeling acutely ill with some being sent to the local hospital. Discussed the nature of the risk and latest scientific information with state and local health agencies to promote better risk communication and attended a public meeting.

Provided senior review of a health evaluation of workers exposed to hydrogen sulfide, mercaptans, and other sulfur compounds in air at a geothermal energy plant. Issues of concern also included potential toxic interactions among these compounds.

As an expert for a city in Washington State, evaluated the potential health effects of odorous chemicals (primarily hydrogen sulfide and mercaptans) associated with emissions from a wastewater treatment plant. A critical issue was the distinction of odor levels that are a public nuisance, possibly resulting in subjective effects in some individuals, but that do not cause clinically defined adverse health effects.

Retained by the U.S. Department of Justice as a toxicology expert to help assess cases involving enforcement actions by EPA for two sites with potential public exposures: one with chromium in groundwater, the other with accidental releases of hydrogen sulfide from a plant into a community. Testified on findings at an administrative hearing for the hydrogen sulfide case.

Evaluated the inhalation toxicology and health risks of criteria pollutants, metals, and silica for an application submitted to the Texas Air Board for permitting of modernized equipment at a copper smelter. The permit was approved.

Directed multipathway risk assessments of hazardous and municipal waste incinerators. Researched the health effects of incineration ash. Incineration sites included New Jersey, Kentucky, some midwestern states, and Washington. Chemicals of primary concern for potential risks were metals, dioxins, and furans, and polycyclic aromatic hydrocarbons (PAHs).

Served as senior reviewer of risk assessments and scientific reviews of the health risks associated with cement kilns burning hazardous waste. Participated in an investigation of occupational exposures and health and safety issues for cement kiln dust.

Assessed the nature of health risks associated with chemicals emitted by semiconductor industries (projects for four different companies) in Arizona. Chemicals emitted by operations were primarily acute toxicants, such as acids or bases and some solvents. Communicated risks to regulators and concerned citizens at a public hearing and assisted in preparing a corporate environmental report and other information for the public. The projects involved emissions from proposed facilities that were subsequently permitted; from operating facilities; and from a circuit-board manufacturing plant that had a fire.

Served as a toxicology and risk assessment expert in commenting on proposed hazardous air pollutant (HAP) rules for non-federal HAPs in the State of Arizona. Participated in a series of public hearings and communicated the latest scientific information to the Arizona Association of Industries (AAI), public

interest groups, and the Arizona Department of Environmental Quality (ADEQ). Commended by ADEQ, AAI, and public representatives for scientific contributions to the process and facilitation of consensus.

Subsequently, commented on the revised HAPs program proposed by the State of Arizona. In addition to comments on the overall process, specific comments were submitted on the health-based methodology and use of the toxicological literature in developing short-term and long-term air criteria for individual chemicals.

Served as the senior toxicologist as a part of a team of industrial hygiene and air quality specialists investigating possible causes and remedies for various health complaints suffered by staff working in the neonatal intensive care unit of a hospital in Nevada. Possible causes investigated included re-entrainment of boiler exhaust, other problems with the ventilation system, or indoor sources of chemicals.

Selected by a major cancer research facility and the local fire department to help settle a dispute regarding the acute inhalation toxicity of formalin and its classification according to the Uniform Fire Code. Strict interpretation would have required the facility to shut down because only a small amount of formalin would have been allowed per building. Provided the scientific interpretation on the toxicity of formalin versus formaldehyde that resolved the conflicting conclusions provided by experts for each of the parties, thereby allowing the facility to operate and the fire department to be confident that health would be protected in the event of a fire.

For a major health care organization, conducted an independent review of a risk assessment of benzene in air at a daycare facility located on petroleum-contaminated soil.

On behalf of the surviving family, provided a summary of opinion as a toxicology expert in a case involving the death of a refrigerator repairman by carbon dioxide poisoning from dry ice used in a broken freezer. The key issues considered were the physiological and toxicological effects of elevated carbon dioxide levels and whether the repairman would have been able to rescue himself from the situation.

Pesticides and Herbicides

Assessed potential exposures and health risks for workers at a flour mixing and packaging plant after fumigation for beetles using a fogging product containing Dichlorvos. Residual strong odors reported by workers were associated with the petroleum distillate carrier.

Conducted detailed toxicology evaluations of ethylene dibromide, dibromochloropropane, 1,3-dichloropropene, 1,2-dichloropropane, 1,2,3-trichloropropane, and epichlorohydrin for cases involving alleged exposures to fumigants from drift off of fields and from groundwater contamination. Specifically evaluated the scientific evidence related to whether exposure to these chemicals would cause the alleged health effects.

Evaluated health risks associated with residential exposure to pesticides and herbicide releases as a result of a fire at a nearby grain silo and a warehouse in Oregon containing more than 100 agricultural chemicals. Emergency response action levels were developed to guide remediation of residential soil contaminated by surface runoff of water used in fighting the fire.

Retained specifically to resolve risk assessment and cleanup levels issues with the state regulatory agency for persistent pesticides and herbicides in soil at an agricultural chemical site in Oregon.

Provided senior oversight on an evaluation of health and environmental effects of pesticides and herbicides used by Northwest utilities on vegetation and on utility poles.

In support of a settlement for a major retailer, evaluated the toxicity of their waste stream (mostly cardboard, although damaged packages of pesticides, herbicides, or fertilizers were also alleged to have

been contributed) relative to other wastes that were historically sent to a landfill in Washington that had accepted municipal, medical, and hazardous waste.

Conducted a risk assessment of residual levels of chlorinated organic pesticides in "clean" soil used for remediating a residential yards in California. Evaluated direct exposure via ingestion of soil and indirect exposure from eating home vegetable gardens.

Supervised expert toxicology work regarding a potential poisoning caused by an organophosphate pesticide and the use of pesticides on school buses and likely effects on children.

Volatile Organic Compounds (see also Air Toxics)

Served as an expert witness for a case involving a perchloroethylene (PCE) plume in groundwater attributed to a former laundry and dry- cleaning facility in Wyoming. Testified in court regarding the toxicology of PCE, health risks (via drinking water and volatilization in indoor air) to residents living over the plume, and effects on aquatic biota as a result of groundwater reaching a river. The court's decision regarding the lack of an imminent and substantial endangerment reflected this testimony.

Directed and peer-reviewed assessments of health and environmental impacts of chemicals in groundwater as a part of landfill closures and corrective actions at multiple landfill sites in California, Montana, Washington, and Arizona. The evaluations included potential effects on drinking water wells and irrigation water, soil vapor exposure, and migration of volatile organic chemicals (e.g., trichloroethylene (TCE), PCE, vinyl chloride, chloroform) in groundwater to surface water bodies with exposure to aquatic organisms and fishermen. Detailed analysis of the human toxicology of these chemicals was also conducted to assess the limitations of the regulatory criteria, which were largely based on animal data.

Assessed sources and likely exposures to TCE and its breakdown products, 1,2-dichloroethene and vinyl chloride, in groundwater, soil gas, and indoor air samples at an industrial plant and for nearby residential properties in western Washington. Soil gas and air samples also included other volatile chemicals. Conducted a screening of health risks for the site and provided comments on a health consultation by the state department of health.

Retained as a toxicology expert by a county in Arizona for pending litigation concerning a landfill. The landfill had received multiple waste streams over time, including both hazardous, municipal, and construction debris. Evaluated the site environmental data and exposures at nearby retail stores, a restaurant, and motel that had elevated levels of volatile organic compounds in their well water.

Evaluated concentrations of volatile organic chemicals in air within a commercial building in southern California to assess whether volatile chemicals in groundwater were migrating into the building at concentrations of health concern for workers. Exposures were found to be less than California worker health criteria.

Evaluated the potential health risks of groundwater containing volatile organic chemicals in support of a legal settlement for a property owner adjacent to a major Superfund site in Washington.

Provided senior review for a facility in which workers received historical exposure to TCE in drinking water. This project included an evaluation of the scientific literature and current debates on the health risks of TCE and other volatile chlorinated compounds.

Worked with a team of epidemiology and toxicology experts to provide written comments on EPA's risk assessment of TCE.

Developed risk-based cleanup levels for acetone, methyl ethyl ketone, methylene chloride, and toluene in soil at an industrial facility in North Carolina. Modeled exposure by soil ingestion, dermal contact, and inhalation of volatile emissions.

PCBs

Assessed the adverse effects of PCBs and priority pollutants in uplands soils and river sediments on the environment (including aquatic organisms and associated terrestrial wildlife) and on public health at a former utility substation on the Willamette River in Oregon that was to be redeveloped into a museum. Designed a tissue residue study of local fish and used the results to derive more realistic bioaccumulation rates for PCBs in sediment. Presented the risk assessment to the Oregon Department of Environmental Quality (ODEQ). The cleanup based on this risk assessment was approved by ODEQ.

Assessed possible changes in cleanup levels for PCBs in sediments of an urban waterway in Commencement Bay, Washington. Evaluated the recent toxicological literature, sediment concentrations, fish consumption rate studies, and changes in regulatory guidance.

Provided senior review for a remedial investigation and ecological and health risk assessment of marine sediments in an urban harbor in southern California. Project efforts included sampling of sediment chemistry and biota, as well as implementation of aquatic and sediment bioassays. The primary chemicals of concern were PAHs from petroleum solvents, metals, PCBs, and persistent pesticides.

Assessed the relative hazards posed by PCBs compared with those posed by PAHs at a coal gasification and metal recycling NPL site in Washington. The study supported a de minimis settlement by the utility companies that had contributed transformers with residual PCB oil.

Dioxins/Furans, Pentachlorophenol

For a public housing authority, evaluated the potential for exposures to dioxin and furan compounds detected in soil of an apartment complex that was built on a site with past industrial uses. Assessed patterns of exposure over the site, subpopulations with highest potential for exposure, and the feasibility and limitations of biomonitoring for dioxins and furans.

On behalf of a city in Washington State, commented on the proposed changes in the state cleanup level regulations for dioxins and furans in soil. Provided scientific input on the toxicological basis of such criteria. Also on behalf of the city, provided comments on a remedial investigation report of a local pulp mill site with dioxins and furans in soil.

Investigated potential exposures and health risks of dioxins and furans emitted by a cement plant in Arizona. Supervised modeling and risk communication efforts.

Provided risk assessment input for a remedial investigation of a pole yard and wood products facility in Montana. Helped design sampling to collect the necessary data for a risk assessment and provided technical input on the need for interim remedial actions. The primary concern regarded pentachlorophenol and dioxins/furans released to soil and groundwater from former dip tanks for wood treatment. Groundwater releases threatened a sole-source aquifer. Reviewed and commented on the state's risk assessment work plan and risk assessment drafts. Addressed issues of particular concern to the community such as the toxicity of dioxins/furans.

Conducted a RCRA evaluation of human health and ecological risks for a wood-treating facility bordering wetlands, a wildlife refuge, and a major tributary of the Columbia River. Primary issues of concern were transport of copper, chromium, arsenic, pentachlorophenol, and PAHs to the wetlands via contaminated groundwater. Soil sampling revealed these chemicals as well as petroleum hydrocarbons and dioxins. The potential toxicity of sediment samples was also assessed.

Served as a toxicologist for EPA in evaluating effects to human health and aquatic organisms resulting from organic chemicals (pentachlorophenol, creosote, PAHs) and metals (copper, chromium, arsenic) in soil, groundwater, marine sediments, and surface water from a Pacific Northwest wood-treating facility. Dioxins and furans were also elevated in soil as a result of a retort fire.

Retained as an expert witness in support of litigation regarding the potential health effects and cleanup levels at an industrial site in northern California involving various activities, including lumber storage, wood treatment, wood products manufacturing, and railroad engine construction. Testified at two court hearings.

Provided senior oversight for risk assessment and risk communication about dioxins and PCBs in onsite and offsite residential soil at a pulp mill in Washington State.

Petroleum Sites

On behalf of a municipal water supplier, assessed health-protective levels and levels associated with adverse odor or taste for mid-range total petroleum hydrocarbons in an aquifer affected by jet fuel storage tanks associated with a Navy base. Commented on sampling data and reports by the Navy's contractors, and on revisions to health-based levels developed by the state department of health. In addition, provided consulting as requested regarding health-protective levels for non-regulated drinking water chemicals and other health issues for the drinking water supply.

Provided toxicology and health risk support to a city and affected residents following an oil spill in a river from a pipeline leak. Provided recommendations on air sampling; assessed air exposures to those living along the river from volatile emissions; met with citizens regarding health effects and potential concerns; discussed health risks with county, state and national health authorities; and participated in focus group meetings with citizens and health agency representatives.

Directed a health risk assessment of a fuel additive in sediments at an overseas offshore loading facility. The assessment evaluated the current literature on chemical toxicity and included design of site-specific data collection and analysis to quantify exposure. Assessed health risks via fish ingestion probabilistically using Monte Carlo techniques. Developed a survey of local practices related to fishing and designed experiments to quantify cooking loss of the additive. Educated scientific experts of the foreign court on health risk assessment and presented the risk assessment findings.

Conducted an evaluation of health and environmental effects at the site of a former Pacific Northwest boat repair and cannery site that was to be redeveloped into a resort. Issues of primary concern included petroleum hydrocarbons in soil and the aquatic toxicity of tributyltin in marine sediments and in groundwater that discharges to the surface water in the harbor. Evaluated the toxicity of tributyltin in sediments specifically to mussels and oysters. PAHs and lead were also elevated in subsurface soils and in groundwater. Potential human exposures included those of children playing on the beach and people eating seafood collected at the site.

Retained as a toxicology expert for property owners and tenants potentially affected by a groundwater plume of heating oil from a utility site in Spokane, Washington. Provided technical comments on site investigation plans and a risk assessment and assisted the citizens in understanding the health risks and state RI/FS process.

Reviewed and directed multiple risk assessments of petroleum hydrocarbons in soil and groundwater in Washington, Oregon, California, and Arizona. Most of these assessments were risk-based closures of UST sites in support of voluntary actions of two major oil companies or the U.S. Department of Defense. Also provided senior review of a risk-based remediation at a petroleum terminal site in Oregon.

Directed a risk assessment of petroleum compounds in soil and groundwater at a state Superfund site in Washington. Risks were considered for commercial use of the site as well as for potential exposure to

nearby users of private wells. The assessment included a detailed toxicity evaluation of volatile and semi-volatile chemicals in gasoline and diesel. Site-specific cleanup action levels were recommended depending on various engineering controls.

Assessed risks associated with PAHs and petroleum hydrocarbons in soil from underground storage tanks at an industrial site in Massachusetts. This risk assessment provided the state regulatory agency with sufficient scientific justification to approve a limited cleanup for the protection of workers.

For the City of Seattle, directed a review and assessment of risks to public health and aquatic life due to urban storm water discharges in the Seattle area. Lead and petroleum hydrocarbon compounds such as PAHs were the main concerns.

Provided senior direction and review of a contingency plan for incineration of oil-soaked waste and debris associated with oil spill cleanup in Alaska. This work was performed for a major petroleum consortium in response to regulatory requirements.

Multiple Chemical Sites/Issues

Testified on behalf of worker claimants before the Washington State Board of Industrial Appeals regarding whether experts for the U.S. Department of Energy had met the criteria from a scientific standpoint to challenge the Washington State disease presumption law for Hanford Nuclear Reservation workers. Workplace exposures involved a wide variety of inorganic and organic chemicals and radioactive substances

Project manager for a contract with Oak Ridge National Laboratory to write toxicity review documents for chemicals in support of U.S. EPA Integrated Risk Information System database of toxicity criteria for risk assessment.

Directed a health risk assessment for the Queensland government in Queensland, Australia (of a high-profile site known as Australia's Love Canal), involving a residential area built over an area with previous mining and industrial and municipal disposal activities. The most visible source of concern was the appearance of acid oil sludge at the surface of yards built over mining pits filled with refinery wastes. Chemicals of concern included lead, PAHs, PCBs, cyanide, and chlorinated benzenes in groundwater, surface water, soil, and air.

Examined the nature and extent of underground contamination at an abandoned naval shipyard in northern California converted for residential use. Evaluated the potential for adverse health effects to future residents from long-term exposure to petroleum hydrocarbons, lead, and other metals. Developed and implemented surface flux chamber sampling to measure volatile chemical emissions from soil. Derived cost-effective, risk-based cleanup levels, which were approved by the California Department of Health Services.

Served as an expert for the State of New Jersey regarding health risks associated with a major urban park. Evaluated health risks associated with residual levels of chromium from chromite ore processing, petroleum-related chemicals, lead and other metals, PCBs, and pesticides. Effectively demonstrated the lack of a scientific basis for the opposing expert's report.

Directed human health and ecological risk assessment of lead, PAHs, and explosive chemicals at a former industrial munitions facility. The site encompassed a large woodland area, including small lakes and a salmon stream, and bordered a wildlife refuge and river delta. Ecological concerns included both potential aquatic effects and risks to burrowing animals in the upland areas.

Retained as an environmental toxicology expert by Whatcom County, Washington, in a legal action filed by the county to cease storage of hazardous and solid waste on a property located within a primary watershed. Evaluated the potential chemical hazards at the property that might threaten the watershed.

Directed projects for EPA's Technical Enforcement Support program. Responsibilities included direction of risk assessments for EPA and oversight of potentially responsible parties conducting risk assessments at various sites.

Advisory Appointments

Science Advisory Boards/Panels

National Academies of Science, Engineering, and Medicine, Ad Hoc Workshop Planning Committee to Support the U.S. Environmental Protection Agency's Development of Human Health Effects Assessments. Participated in two workshops: Triangulation of Evidence in Environmental Epidemiology (May 9, 11, 2022) and Artificial Intelligence and Open Data Practices in Chemical Hazard Assessment (May 25-26, 2022) Sponsored by the U.S. EPA.

National Academies of Science, Engineering, and Medicine, Health and Medicine Division. Standing Committee on Medical and Epidemiological Aspects of Air Pollution on U.S. Government Employees and their Families. Sponsored by the U.S. Department of State (2017-2022).

National Academies of Science, Engineering, and Medicine, Health and Medicine Division Committee on Assessment of the Available Scientific Data Regarding the Safety and Effectiveness of Ingredients Used in Compounded Topical Pain Creams. Sponsored by the U.S. Food and Drug Administration (2019–2020).

Peer reviewer of the National Academies of Science, Engineering, and Medicine report, Review of EPA's Updated Problem Formulation and Protocol for the Inorganic Arsenic IRIS Assessment. Sponsored by the U.S. EPA (2019).

National Academies of Science, Engineering, and Medicine, Board on Environmental Studies and Toxicology. Organizing/planning committee and session moderator for workshops to support development of toxicological reviews of chemicals by the U.S. Environmental Protection Agency's (EPA) Integrated Risk Information System (IRIS) program. Sponsored by the U.S. EPA (2018-2019).

National Academies of Science, Engineering, and Medicine, Board on Environmental Studies and Toxicology. Chair of the organizing/planning committee, session moderator, and speaker for the Workshop on the Feasibility of Addressing Environmental and Occupational Health Exposure Questions Using Department of Defense Biorepositories. Sponsored by the U.S. Department of Defense. (June 14-15, 2018). Washington, DC.

Peer reviewer of the National Academies of Science, Engineering, and Medicine report, Progress Toward Transforming the IRIS Program: A 2018 Evaluation. Sponsored by the U.S. EPA (2018).

National Ash Management Advisory Board, University of North Carolina, Charlotte. Directed by UNC, Charlotte, Lee College of Engineering to advise Duke Energy on coal ash impoundment closure. Sponsored by Duke Energy as mandated by court order (2014-2018).

Peer reviewer of the National Academies of Science, Engineering, and Medicine consensus study report, Environmental Chemicals, the Human Microbiome, and Health Risk — A Research Strategy. Sponsored by the U.S. EPA and the National Institute of Environmental Health Sciences (NIEHS) (2017).

National Research Council, Committee on Spacecraft Exposure Guidelines, sponsored by the National Aeronautics and Space Administration (NASA)(2015—2016)

Institute of Medicine, Committee on the Assessment of the Department of Veterans Affairs Airborne Hazards and Open Burn Pit Registry. Sponsored by the U.S. Department of Veterans Affairs. (2015—2016).

National Research Council, Committee on Spacecraft Exposure Guidelines, sponsored by NASA (2015—2016)

National Research Council, Board on Environmental Studies and Toxicology (2010—2016).

National Academies Standing Committee on the Use of Emerging Science in Environmental Health Decisions, sponsored by the NIEHS (2011—2015). Served on the organizing committee and as a panel member for workshops on the potential use of microbiological platforms in health studies and on systems biology-informed risk assessment. Participated in workshops on individual susceptibility to environmental stressors, health risks of climate change, human genome plasticity to environmental stressors, and integration of health data to advance discovery.

National Research Council Standing Committee on Toxicology (2008—2014).

Peer reviewer of the National Research Council report, Review of the EPA Integrated Risk Information System Process. Sponsored by the U.S EPA (2014).

Peer reviewer of the National Research Council report, Exposure Science in the Twenty First Century. Sponsored by the U.S. EPA and NIEHS (2012).

Peer reviewer of the report of the National Academies Committee to Review EPA's Draft IRIS Assessment of Formaldehyde. Sponsored by the U.S. EPA (2011).

Institute of Medicine of the National Academies, Committee on Breast Cancer and the Environment: The Scientific Evidence, Research Methodology, and Future Directions. Sponsored by Susan G. Komen for the Cure (2010-2011).

Peer reviewer of the National Research Council report, Eighteenth Interim Report of the Committee on Acute Exposure Guideline Levels. Sponsored by U.S. EPA (2010).

National Research Council Standing Committee on Risk Analysis Issues and Reviews. Sponsored by the U.S. EPA (2007-2010). Served on the organizing committee and/or as a panel member for workshops on various toxicological and risk assessment issues, including effects of receptor-mediated events on dose-response assessment, relevance of mouse liver tumors, exposure measurement error in epidemiological studies, interpretation of bioassay and human biomonitoring data for thyroid active chemicals, and exposure science in the 21st century. Chaired the organizing committee and moderated two workshops for EPA:

- Quantitative Approaches to Characterizing Uncertainty in Human Cancer Risk Assessment Based on Bioassay Results, June 2007.
- Characterizing the Potential Human Toxicity from Low Doses of Pharmaceuticals in Drinking Water: Are New Risk Assessment Methods or Approaches Required? December 2008.

National Research Council subcommittee for review and comment on Spacecraft Water and Air Exposure Guidelines for various organic and inorganic chemicals in spacecraft and space stations. Assisted the NASA contractor in modeling increases in blood lead levels due to bone loss in space. Sponsored by NASA (2001-2008).

National Research Council Ad hoc organizing committee member and panel participant in EPA's symposium, Toxicity Pathway-Based Risk Assessment: Preparing for Paradigm Change, Sponsored by U.S. EPA. May 11-13, 2009, Washington, DC.

Independent expert review panel for the Flin Flon, Manitoba, and Creighton, Saskatchewan Human Health Risk Assessment. Coordinated by Toxicology Excellence for Risk Assessment. Sponsored by

Hudson Bay Mining and Smelting Co., Limited (2009).

National Research Council Subcommittee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants (development of health-protective short-term and long-term airborne levels for acetaldehyde, hydrogen chloride, hydrogen fluoride, hydrogen sulfide, and propylene glycol dinitrate). Wrote chapter on acetaldehyde for published report. Sponsored by the U.S. Navy (2008-2009).

Independent expert review panel for the Sudbury Soils Study Ecological Risk Assessment. Sudbury Mining District, Ontario. Coordinated by Toxicology Excellence for Risk Assessment. Sponsored by Xstrata Nickel and CVRD Inco Limited. (2007).

Peer review of two National Institute for Occupational Safety and Health (NIOSH) research protocols designed to gather data for evaluating inhalation risks to workers posed by nanoparticles and nanotubes. Coordinated by Toxicology Excellence for Risk Assessment. Sponsored by NIOSH (2007).

Independent expert review panel for the Sudbury Soils Study Human Health Risk Assessment. Sudbury Mining District, Ontario. Coordinated by Toxicology Excellence for Risk Assessment. Sponsored by Xstrata Nickel and CVRD Inco Limited (2006).

National Research Council Subcommittee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants (development of health-protective short-term and long-term airborne levels for acrolein, carbon dioxide, carbon monoxide, formaldehyde, hydrazine, methanol, monoethanolamine, nitric oxide, nitrogen dioxide, oxygen, ammonia, benzene, 2,6-di-tert-butyl-4-nitrophenol, Freon 12, Freon 114, hydrogen, 2190 oil mist, ozone, toluene, xylene). Wrote chapters on formaldehyde and Freon 12 for published reports. Sponsored by the U.S. Navy (2003-2007).

Peer reviewer of the National Research Council subcommittee report that commented on the U.S. EPA Risk Assessment of the Coeur d' Alene Basin. Sponsored by the U.S. EPA (2005).

Scientific panel to evaluate protective measures and remedies for area-wide soil contamination of arsenic and lead in the state resulting from past pesticide use, mining and smelting, and other sources. This panel was advisory to the Washington State task force convened to reach practical and protective solutions for widespread areas of the state that exceed state standards for lead and arsenic in soil. Sponsored by the Washington Department of Ecology (2002).

National Research Council subcommittee to evaluate the health protectiveness of the Navy's proposed submarine escape action levels for carbon monoxide, hydrogen chloride, hydrogen cyanide, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, chlorine, and ammonia. Toxic levels of these gases may be expected from fires associated with a disabled submarine. Wrote chapter on hydrogen sulfide for the published report. Sponsored by the U.S. Navy (2001).

Expert review panel commissioned by the U.S. Army to review a risk assessment of closure of the Jefferson Proving Grounds in Indiana and reuse as a wildlife refuge. Metals and radionuclides were a primary concern. Sponsored by the U.S. Army (2001).

National Academy of Sciences subcommittee to evaluate the EPA drinking water level for copper. Coauthored the report Copper in Drinking Water, published by the National Research Council. Sponsored by the U.S. EPA (1999-2000).

National Academy of Sciences peer reviewer of the National Research Council's drinking water document for arsenic. Sponsored by the U.S. EPA (1998).

Technical committee on the human health-based surface water quality criteria for arsenic. The purpose of the committee was to determine whether new data existed of sufficient quantity and quality to merit changing the state human health-based surface water criteria for arsenic. Sponsored by the Washington State Department of Ecology (1997-1998).

External expert panel to assess the relative importance of environmentally related human health problems in the State of Washington. Pilot Comparative Risk Project. Sponsored by U.S. EPA, Region 10 (1997).

Research Grants

National Science Foundation Dissertation Improvement Grant

National Science Foundation Graduate Student Fellowship