

Contributions to Environmental Health through Research and Training

Professor Pamela J. Lein



CONTRIBUTIONS TO ENVIRONMENTAL HEALTH THROUGH RESEARCH AND TRAINING

Professor Pamela J. Lein is a neurotoxicologist and current Program Director for the Advanced Training in Environmental Health program at UC Davis. She investigates the potential roles of environmental contaminants as risk factors for neurodevelopmental disorders.

Your contribution to environmental research is impressive. What initially peaked your interests in toxicology and environmental health?

My interest in toxicology and environmental health was initially sparked by three phenomenal researchers and teachers at Cornell University: Paul Feeny, who taught an introductory course in Ecology and Evolutionary Biology; Tom Eisner, who taught a course in chemical ecology that focused on how insects use chemicals to protect themselves from predators and to entrap prey; and John Kingsbury in the School of Veterinary Medicine, who taught a course on poisonous plants. These three courses really solidified my interest in merging the two fields of biology and chemistry to study how chemicals interact with biological systems. I also loved these courses because they involved field studies – I have always loved being outdoors.

How crucial is it to discover environmental toxins and make the appropriate public health recommendations regarding their use?

There is now credible evidence that environmental contaminants, including chemical contaminants, interact with genetic susceptibility factors to determine individual risk and/or severity for a number of neurodevelopmental disorders and neurodegenerative diseases, ranging from autism and ADHD to Parkinson's disease and Alzheimer's disease. Collectively, these diseases exact a huge toll on individuals, their families and society. Currently we do not have pharmacological interventions that prevent or cure these diseases – the best we can do is slow the progression of the disease. So, our best bet is prevent

or minimize the severity of disease by identifying the environmental chemicals that influence risk because, in contrast to genetic risk factors, which are currently irreversible, environmental factors are a modifiable risk variable.

In addition to your role as a researcher, you are also the Program Director for an environmental health training program. Why did you pursue this role?

I have always enjoyed teaching – it is really gratifying to see the students you are working with grow and succeed as academicians and researchers – and I have always believed in giving back. I was extremely fortunate to have had some truly amazing teachers and mentors who provided support and encouragement for me at every stage of my career, and I really wanted to return that favor to the generations following me. I also felt that taking on the role of Program Director for the Advanced Training in Environmental Health Science at UC Davis would enable me to reach more students than I would be able to in just my own lab, and it would allow me to provide tangible support in the form of fellowships. Training research scientists in today's world is an expensive endeavor, and these training programs are a very important piece in the network of support available for graduate students and their faculty mentors.

As the demand for environmental health experts is growing, so is the need for training. What are some of the highlights of your program?

The highlights include financial support for graduate students performing research in environmental health sciences, mentored research training laboratories performing

cutting-edge research, access to world-class research facilities, and a unique course developed for trainees focused on emerging concepts in environmental health that engages trainees in critical thinking about complex issues in a modern society.

Can you elaborate on the impact of the faculty on training?

The faculty are at the core of the training program – they are the ones who oversee the research progress of the trainees. Each trainee is affiliated with the laboratory of one of the training faculty members, and this faculty member will work with the trainee to teach them the skills needed to perform their predoctoral research as well as develop the conceptual and technical aspects of their research project.

As Program Director and a scientist, what are your goals for the improvement of environmental health overall?

Our goals are to develop better methods for identifying the “bad actors” and the “neutral or good players” in the environment so we can more efficiently utilize resources to protect the public; to understand the mechanisms by which genetic susceptibility factors interact with environmental risk factors to determine the risk and/or severity of disease, which will hopefully improve approaches for identifying specific environmental risk factors, and possibly provide insight on novel preventive and therapeutic approaches; and to develop more effective approaches for communicating to the public the value and importance of environmental health research in public health.



TRAINING FUTURE ENVIRONMENTAL HEALTH EXPERTS

The Advanced Training in Environmental Health Sciences program provides a didactic and student oriented curriculum, collaborative research opportunities, faculty mentorship, and career development. It prepares future scientists with critical thinking skills, multidisciplinary expertise, and the ability to apply scientific knowledge to complex environmental health problems.

The Commitment to Environmental Health

There is increasing concern regarding the potential role of the environment in the development and progression of human diseases. This has consequently increased the universal demand for environmental health experts. To meet these critical demands, it is necessary to train scientists to identify and study environmental factors that are contributing to disease. These complex factors require scientists to be equipped with sharp critical skills and intellect in a comprehensive range of scientific disciplines.

The UC Davis Advanced Training in Environmental Health Sciences program is the field's second oldest training program in United States and has been operating since 1968. The National Institute of Environmental Health Sciences (NIEHS) grant, which sponsors 6 graduate level trainees per year, has been a key funding source in the training

of aspiring environmental health experts. Approximately 150 trainees, which come from a diverse spectrum of scientific backgrounds, have been supported by the NIEHS funded program. Graduates have gone on to utilize their expertise in the environmental health field. The program remains highly dedicated and motivated to continue this long tradition of training.

A Curriculum Geared Towards Training

The two year Advanced Training in Environmental Health Sciences program incorporates didactic teaching and research training in the core principles of toxicology and methods of quantitative analysis. The curriculum is comprised of key requirements which includes didactic coursework, student centered learning activities, and research. A fundamental course called Emerging Concepts in Environmental Health offers a solid foundation for trainees in their first



year. Students are expected to complete laboratory rotations and elective coursework designed to support their research interests. In addition, trainees gain teaching experience in their roles as teaching assistants.

There are student led experiences designed to train the students in applying and integrating basic and clinical sciences. For example, student groups are assigned complicated environmental health problems with the goal of working together to formulate proposals and solutions. The groups are expected to review relevant literature and hold weekly brainstorming sessions with faculty. Students then present their final projects to the class and submit a written proposal for publication.

First year trainees are responsible for identifying a faculty member to mentor their thesis projects. As students work on their mentored research studies, they are required to present chalk talks, in which they discuss their projects in terms of successes, challenges, and future steps. This approach allows trainees to receive feedback from faculty from various disciplines. This additionally serves as preparation for doctoral dissertation.

Another component of the training program is the annual retreat in which trainees give formal presentations to the environmental health science community. These presentations are expected to meet the high standards of professional scientific presentations. Faculty members work with trainees prior to the retreat and guide their presentation skills.

Since the curriculum is one of the main elements of the training process, the program relies on trainees themselves to deliver critical feedback and help shape the structure. The NIEHS program officer is also influential in the progression of the training program by setting guidelines and standards.



There is the External Advisory Committee composed of environmental health experts at outside institutions who review the program and offer suggestions for improvement. All of the above recommendations are taken into account to help the program evolve in a way to meet global needs.

How Research Collaboration and Mentorship Play a Vital Role in Training

The 53 distinguished training faculty members in this program are involved in five major research areas, which are 1) Cancer, 2) Endocrine and Metabolic Mechanisms of Toxicity, 3) Genotoxicity and Epigenetics, 4) Neurotoxicology, and 5) Respiratory Toxicology. Multidisciplinary research opportunities exist because many faculty members incorporate numerous focus areas into their research. Therefore, the trainees have a myriad of options when choosing and developing their thesis projects. Faculty encourages trainees in their collaborative efforts.

There are countless research projects which integrate multiple focus areas. An example of a multidisciplinary research project is a joint study between Professor Pamela J. Lein of the neurotoxicology group and researchers of the respiratory toxicology group investigating the mechanisms of how organophosphates cause hyperreactivity of airways. The cutting edge research conducted through this program demonstrates the critical role the faculty play in training graduate students.

Faculty members also participate in graduate groups and other training programs. They serve as mentors on dissertation committees guiding students through their research projects and training. Students cross train in other laboratories as well. UC Davis promotes professional and academic relationships.

The extensive research opportunities are supported by the multitude of grants that UC Davis researchers have secured. In addition to the funds from the NIEHS grant, there are funded projects by other institutions such as the Center for Children's Environmental Health, the Western Center for Agricultural Health and Safety, the Center for Nanotechnology Health Implications Research, the Superfund Basic Sciences program, the Center for Neuroscience, and UC Davis MIND Institute.

As a prominent research university, UC Davis provides trainees with the access to world class facilities including the National Primate Center, the Mouse Biology Program, the Genome Center, the Comprehensive Cancer Center, and others as well. It also hosts other centers including the USDA Western Human Nutrition Center as well as three neuroscience institutes. Main academic departments include the School of Medicine, School of Veterinary Medicine, and various colleges in the sciences. UC Davis awards more than 200 PhDs in the life sciences yearly and remains a leader education.

Career Development and Opportunities for Environmental Health Scientists

The training program is committed to mentoring trainees in their pursuit of careers. Assigned mentors are available to guide trainees through career planning. Furthermore, trainees participate in career oriented seminars in which they select and invite a leader in the environmental health industry to speak about career development. There is also emphasis on curriculum vitae writing and interviewing skills. Other parts of career training include seminar speaking, teaching, and grant writing.

Graduates of the program have been very successful in their post training careers. They heavily contribute to environmental health by using the skills and knowledge acquired at UC Davis. Approximately 60 per cent of graduates are working in regulatory positions in government and private sectors. Many graduates have appointments with the California Environmental Protection Agency (EPA). Others are working in consulting firms, pharmaceutical companies, or the manufacturing industry. In fact, Chevron and Chlorox are two well known employers of environmental health scientists. The remaining 40 per cent of graduates are in academia serving as faculty members and investigators. Some are involved as faculty for this program training.

Dedicated to excellence, the Advanced Training in Environmental Health Sciences aims to: 'Train future scientists with the tools needed to solve complex problems in environmental health', says Program Director Professor Lein. With the emergence of a new generation of experts, there is much promise for their overall impact on identifying modifiable environmental factors and their role in complex diseases. This, in turn, can make a significant difference globally.

PROFESSOR PAMELA J. LEIN



Meet the researcher

Professor Pamela J. Lein

Professor, UC Davis Department of Molecular Biosciences, School of Veterinary Medicine Chair, UC Davis Pharmacology and Toxicology Graduate Group Program Director, UC Davis Environmental Health Training Program

Professor Lein is a developmental neurobiologist and neurotoxicologist with a Masters degree in Environmental Health and a PhD in Pharmacology and Toxicology. Her research is focused on investigating the cellular and molecular mechanisms by which environmental contaminants play a role in the development and progression of neurodevelopmental disorders and neurodegenerative disorders. One of her ultimate goals is to identify these modifiable environmental factors and stressors in hopes of contributing to preventative and therapeutic approaches for diseases. Professor Lein is involved in many national and international collaborative studies which are funded by numerous grants. She also pursues her passion for teaching in her appointments as Program Director and faculty member for the Advanced Training in Environmental Health Sciences program at UC Davis. Throughout her accomplished career, Professor Lein has contributed her expertise while serving on advisory groups and regulatory panels. When not working, she enjoys the outdoors.

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FUNDING

National Institute of Environmental Health Sciences (NIEHS)

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