



From left to right: Dartmouth undergraduate Stephanie Rivera-Ithier D '21 and Geisel medical student Rajiv Raghavan D '13, Thayer '14, MED '18 learn in the lab with Margaret Karagas, PhD, chair of epidemiology and the James W. Squires Professor, and Brock Christensen, PhD, associate professor of epidemiology.

## MARGARET KARAGAS, PHD

# Stopping Diseases Before They Start

**N**UMEROUS SERIOUS AFFLICTIONS THAT STRIKE US IN ADULTHOOD—such as cancer, diabetes, heart disease, high blood pressure, and immune system disorders—have roots that stretch back to childhood. These roots are anchored in genetics and fed by the environment. But how do genetics and environment combine to impact health? And exactly how early do environmental exposures begin to affect lifelong well-being?

Margaret Karagas, PhD, the James W. Squires Professor and chair of the Department of Epidemiology at the Geisel School of Medicine, is working to answer these questions. “Dartmouth has the flexibility to leverage talent and initiate bold ideas in ways that may not be possible at other institutions, where the work is more siloed,” Karagas says. As director of both the Children’s Environmental Health and Disease Prevention Research Center and the Center for Molecular Epidemiology, Karagas leads, mentors, and collaborates with researchers across the College to find the causes of diseases and stop them before they start.

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### Pursue Bold Ideas

We will make transformative discoveries that reveal the scientific underpinnings of health and catalyze the development of effective, personalized, and patient-centered approaches to disease treatment and prevention. We will approach complex challenges from fresh angles, dare to ask big questions, and accelerate the pace of innovation.

**New philanthropic support totaling \$155 million** will fuel greater interdisciplinary collaboration and more rapid translation of bold ideas into real health outcomes.

“The importance of early-life environment to lifelong health is becoming increasingly recognized,” Karagas explains. “And at Geisel we’re finding answers to what causes cancer and what causes adverse child health outcomes.”

## IMPACT AND OUTREACH

Karagas’ work in child health stemmed from her research into bladder and skin cancers, and the effects of exposure to toxic metals in drinking water. Rates of these cancers are high in areas where water supplies from private wells contain arsenic, including in nearby parts of New Hampshire, Vermont, and Maine. “And that made me concerned about whether pregnant women should be drinking that water,” Karagas says.

In 2009, as part of the Dartmouth Toxic Metals Superfund Research Program, Karagas, Emily Baker, MD, a Dartmouth-Hitchcock obstetrician, and a student at The Dartmouth Institute for Health Policy and Clinical Practice began a registry of pregnant women who may have been exposed to low levels of arsenic. That registry became the basis for the establishment of the Children’s Environmental Health and Disease Prevention Research Center, a multidisciplinary effort to study environmental exposures to common contaminants during fetal development and childhood.

The Center’s research revealed that dietary exposure to arsenic—in utero and after birth, from foods like rice and apple juice—is associated with adverse effects on fetal growth, immune system function, and changes in gene expression. These discoveries informed the U.S. Food and Drug Administration’s 2016 action limiting the amount of arsenic allowed in infant rice cereal. The Center also works with primary care physicians and pediatricians to help educate families about testing water in private wells and diversifying children’s diets, and Carolyn Murray, MD, MPH, director of the Center’s Community Outreach and Translation Core, led the development of an interactive web tool that includes tips for reducing arsenic exposure ([www.dartmouth.edu/~childrenshealth/arsenic/](http://www.dartmouth.edu/~childrenshealth/arsenic/)).

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—Margaret Karagas, PhD

## LOOKING TOWARD THE FUTURE

Another benefit of the pregnancy cohort is that it enables other investigators to ask important research questions. Using the data and samples already collected from participating mothers and their children, Geisel Associate Professor Brock Christensen, PhD, is analyzing breast milk for early indicators of breast cancer risk; and Associate Professor Diane Gilbert-Diamond, ScD, is connecting certain environmental exposures with childhood obesity. These are just two examples of the ways in which Karagas and her colleagues are utilizing the trove of epidemiologic data they have gathered over almost a decade to answer new questions about disease origins and children’s health.

In fact, researchers across Dartmouth use the pregnancy cohort. “We have collaborators in biology, Earth sciences, Geisel, The Dartmouth Institute, Dartmouth-Hitchcock, the Cancer Center,” Karagas says. “By nature our work is very interdisciplinary.”

Karagas strongly believes this interdisciplinary approach is essential to becoming a successful researcher, and she’s committed to training the innovators of the future. She was one of the founders of Geisel’s graduate program in Quantitative Biomedical Sciences, which encompasses a team of Dartmouth faculty with expertise in subjects such as genomics, engineering, computational structural biology, neuroimaging, data science, and population health. PhD students in the program cross-train in epidemiology, biostatistics, and bioinformatics. “The next generation of scientists cannot know just one discipline. That is not the way to solve the complex problems our world faces. This is where Dartmouth stands apart—not only in its interdisciplinary research but also in its interdisciplinary training,” Karagas says.

It’s this flexibility at Dartmouth, Karagas believes, that allows her and fellow researchers to launch bold ideas that receive national attention. The Center for Molecular Epidemiology was recently refunded by the Centers of Biomedical Research Excellence (COBRE) for a second five-year phase, and building off of the Children’s Environmental Health and Disease Prevention Research Center, Karagas and colleagues were just awarded a grant from the Environmental Influences on Child Health Outcomes (ECHO) program to participate as one of 84 cohorts in a seven-year nationwide initiative.

“Our next big step is to look beyond one exposure at a time to the totality of people’s exposures—their home environment, their school—and their genetics. And to see how all those pieces fit together to create a healthy child. Our goal,” says Karagas, “is to sustain health.”

LAUREN SEIDMAN