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Integrating Sustainability into Environmental Research and Development

Today's environmental challenges appear more complex and ever more challenging. As science advances, the U.S. Environmental Protection Agency (EPA) continues to play an integral role in addressing these challenges. Through its research and development efforts, EPA seeks to identify effective, efficient, and sustainable solutions that are science-based and designed to meet current needs while minimizing potential human health and environmental risks. "There's a 40-year history at EPA of deeply understanding the nature of the environmental problems we face," explains Dr. Paul Anastas, assistant administrator of EPA's Office of Research and Development (ORD) and EPA's science advisor, "whether it is the contaminants in our water, the pollution in our air, or the toxicity of chemicals. We are the best in the world in understanding the nature of these problems."

Anastas leads the agency's efforts in this area, overseeing a wide range of research programs from basic studies on the toxicity of chemicals to technology development for purifying water. ORD began with the inception of EPA, ensuring that science was at the table on every question and issue the agency addressed. "It was the recognition," Anastas admits, "that everything that we do needs to be science-based. We're looking at how we get the right scientific foundation for all of the decisions we make and the actions we take." He meets this critical agency mission with a budget of about $580 million and a staff of 2000.

Since taking the reins of ORD, Dr. Anastas has set a path forward, providing the scientific and technological basis for advancing EPA's mission. "How do we use our deep knowledge and understanding," posits Anastas, "of the environmental problems we confront in order to inform and empower solutions? It is one thing to say X is bad or that we need to do things better by Y percent. It's quite another to meet these challenges synergistically, so that we achieve environmental, economic, and societal benefits simultaneously." Doing this also involves forging a new level of awareness. His perspective has its roots in Albert Einstein's insight that "problems can't be solved at the same level of awareness that created them." It's going beyond reductionist approaches that tend to define problems and solutions too narrowly. "Many times when we take a reductionist approach," Anastas says, "we wind up with unintended consequences. For example, we may find new ways to generate energy, but wind up causing various types of pollution as a result. What I'm saying is step back, look at the narrow focus we're intending to accomplish, but also see how it interacts with the broader world—always asking: what are the consequences to human life and the environment?"

With such a perspective, Anastas has sought to incorporate the goal of sustainability into his agency's decision-making. For him this goal is ORD's "true north." He acknowledges that scientific and technological innovation are essential to the success of EPA's mission, but it also needs to couple excellence in problem assessment with excellence in solving problems. "Very seldom do the environmental challenges divide themselves neatly into an air project or a water project, so we asked ourselves: Are we getting the synergisms we could be getting if we looked at things from a more systematic and systems approach? That's really at the heart of sustainability. We reoriented and realigned the entirety of our research portfolio, defining problems in terms of sustainable systems," explains Anastas. This means that the work at EPA must not merely be to review, assess, and quantify problems; it must be to inform

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the design of innovative new products, processes, and systems that incorporate sustainability as a design criterion.

For Dr. Anastas, one way to do this is by pursuing research in green chemistry (also known as sustainable chemistry); a high-priority goal for his office. "Green chemistry," says Anastas, "is defined as the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances." He has dedicated his entire professional life to this scientific topic, and in fact gave it its name. "It's a design protocol to ensure that we get all of the function, performance, and capability from products without the unintended consequences of excessive waste, toxicity, and environmental risk." Virtually every industry ranging from energy to transportation is pursuing it. Green chemistry in action has led to the development of safer solvents and substances, from paints to print toner. EPA promotes green chemistry and supports projects informing the design of chemicals throughout their life cycle.

In the meantime, tens of thousands of chemicals are currently in commerce now, with hundreds more introduced every year, but only a fraction of those chemicals have been assessed adequately for potential risk. "Computational toxicology," says Anastas, "is one of the many groundbreaking research efforts we are pursuing in this area." Technically, computational toxicology, or comptox, applies mathematical and computer models to help assess chemical hazards and risks to human health and the environment. It is revolutionizing how chemicals are assessed for potential toxicity. According to Dr. Anastas, it uses high throughput screening methods, meaning rapid testing of a wide range of bioassays in order to get information on thousands of chemicals much more quickly and cost-effectively. "We're aggressively moving forward with this research. It can change the equation on how we understand the hazards certain chemicals may pose." It is also a wonderful example of how information can be used to inform and empower the design of next-generation chemicals. "Instead of just trying to assess how bad things are," declares Anastas, "we can [use this information and proactively] design them to be as [minimally] hazardous as possible."

EPA also has the Integrated Risk Information System (IRIS), which provides information on potential human health risks from long-term exposure to over 540 chemicals present in air, water, or on land. According to Anastas, IRIS assessments are critical to the agency's programs and regulations, as they provide a scientific foundation for many of EPA's decisions. "We use it to understand all the scientific information on various chemicals. It's used in our regulatory programs, but it's also tremendously informative to industry and the public." Moreover, linking IRIS to computational toxicology information can further advance the information available to health scientists and those who assess the risks substances may have on human health and the environment.

As EPA's science advisor, Anastas makes it a core imperative to promote a culture of scientific integrity within his office and throughout the agency. "We have a wonderful foundation and a long tradition of scientific integrity. First and foremost, scientific misconduct is never tolerated. But more importantly, we pursue the assurance that our science is of the highest quality and integrity." EPA has internal and external systems in place to do exactly that. "Our Board of Scientific Counselors, Scientific Advisory Board, and the extensive peer reviews we do ensure that our scientific endeavors are of the highest quality." In the end, Anastas recognizes that none of this happens without a fully engaged, qualified, and professional workforce. "The one unifying factor we all share is a passionate dedication to the agency's mission: to protect human health and the environment. The motivation stems from showing how the work we do relates directly to accomplishing that mission. The more that connection is crystalline, the better."

To learn more about EPA's Office of Research and Development, go to www.epa.gov/ord

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