An Ounce of Prevention

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[Note: This op-ed ran in several Knight-Ridder newspapers in November 2005.]

It is a regular staple of science fiction movies, from *I, Robot* to *Jurassic Park*: A wondrous new technology turns ominous, teaching mankind it must carefully study the potential consequences of scientific innovation.

Today, thanks to the work of real scientists, we are witnessing the rise of an entirely new class of products with remarkable potential for society. Nanotechnology – the cutting-edge science of materials designed and built on an atomic scale – promises advances like new fuel cells to boost energy efficiency, innovative fabrics to revitalize the textile industry, and new materials that could improve the detection and treatment of diseases like cancer and Parkinson's.

All this progress has been fueled by federal spending of over a billion dollars a year to support research and development, and an additional $3 billion from state and private sources. These investments should pay off handsomely -– nanotechnology is expected to have a significant impact on $2.6 trillion of annual global economic output and on ten million jobs worldwide by 2015.

But as these marvels burst forth from the laboratory to the marketplace, we must not act like the stock characters in so many movies by ignoring their environmental and health impacts.

We've had little scientific research about the safety of nanomaterials – but the research that has been conducted gives us cause for concern. Some nanomaterials have the potential to damage skin, brain and lung tissue. "Buckyballs," one of the first nanomaterials produced, can clump together and kill microorganisms at the base of the food web. Some inhaled nanoparticles can cross into blood and reach internal organs through the circulatory system. "Buckyballs" can also be taken up by fish through the gills and into the brain, where they can damage brain tissue.

History shows us that a wise investment in research today could save a far greater cost in the future. Nearly a century ago, lead was added to gasoline because it boosted the power and performance of cars. Asbestos was installed in millions of homes, businesses, and schools because it was an effective fire retardant. But in both cases, the suffering, environmental damage, and financial cost have been unnecessarily huge because we did not invest sufficient resources into anticipating, understanding, and addressing downstream impacts. Indeed, while the chemical revolution of the past century has brought thousands of valuable products to market, the environmental and human toll has been, at times, staggering.

Our society must make the necessary investment in research to ensure that the positive benefits of nanotechnology are not overwhelmed by potential dangers. Researchers at Rice University have shown how it might be possible to reduce the toxicity of certain nanoparticles by modifying their surfaces. Further research will, no doubt, lead to many other improvements in the safety of these materials.

The federal government, as the largest single investor in nanotechnology research, must take the lead. At present, less than four percent of the National Nanotechnology Initiative budget is devoted to researching health and environmental implications. Given what's at stake, that figure is inadequate. For a technology as new, untested and potentially pervasive as this, we should be spending at least 10 percent of our research budget, or $100 million annually, to learn about the potential impact of these materials. That figure may seem high, but it is actually a relatively modest investment to help avoid future litigation expenses, health care costs, and lost productivity. To put the investment in perspective, Standard and Poor's has estimated the cost of liability for asbestos alone could reach $200 billion.

In addition to health and safety concerns, risk research will help protect the commercial viability of this promising new industry. U.S. companies are in the forefront of this revolution, leveraging our technological prowess to create a new and vibrant manufacturing sector. But, as with genetically modified foods, if the international public is not convinced that nanomaterials are being developed safely, a backlash could develop that stifles innovation. And because safe nanomaterials have the potential to improve our environment – from cleaning oil spills to creating cleaner energy – that outcome would be an environmental as well as a financial loss.

In the movies, rampaging robots and cloned dinosaurs show us the dangers of letting our impatience for progress outrun proper research and reflection. But reality needn't follow that Hollywood plotline. With proper investments in research, we can launch this new revolution the right way.

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