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Nanotechnology Offers Potentially Great Rewards But at What Price?

Environmentalists worry that revolutionary products could cause harm

By Thomas W. Krause

Nanoparticles are tiny particles – very tiny particles – that help to construct packaging that keeps food fresher for longer, help to keep pests off agriculture, and use less chemical spray to do it. They help to keep microbes from growing on children's toys and one day, they may be able to seek out and destroy cancer cells without harming healthy ones.

Scientific engineers prove daily that what we know about these nanoparticles is amazing and revolutionary. Yet, some environmentalists worry that what we don't know about these tiny giants just might kill us.

The development of nanotechnology has pitted manufacturers and engineers against environmental watchdogs in an age-old debate: How much study is required before scientific advancements can be released for public consumption? Environmentalists say we still don't know near enough about the risks of nanoparticles and should halt all production until we know more. Manufacturers of products that utilize nanomaterials agree we don't know the risks that some nanoparticles may pose. But other nanotechnology products, they argue, are perfectly safe and should not be abandoned for irrational reasons.

So what exactly is nanotechnology?

In recent years, practical application of the quantum physics theory has allowed the development of particles on the "nano" scale. A nanometer is one-billionth of a meter, which is one-100,000th the width of a human hair. When particles become that small, their physical makeup changes. For example, gold at the nano level turns purple and becomes more reactive.

"It very much becomes a new chemical," said Ian Illuminato, an environmentalist and nanotechnology expert with Friends of the Earth. "That's very exciting but, at the same time, very new."

Silver, when engineered down to the nano level, becomes an excellent anti-microbial agent. Several products on shelves now contain nanosilver particles. When injected into sports-sock fabric, the nanoparticles keep socks from smelling bad after a long workout. The same particles prevent mold from growing on teddy bears. Many sunscreens use other nanoparticles, including nanotitanium for better sun-blocking capability with less grease or whiteness in the cream.



"Technological progress is like an axe in the hands of a pathological criminal."

— Albert Einstein,
theoretical physicist, 1879-1955

Illuminato points out, no one really knows what happens to these atomic-sized particles if they enter the body – or when they are washed down the drain. "It's the not knowing, the walking in the dark" Illuminato said. "But it's also the red flags that current studies have found so far. There's a lot to look at here."

Nanotechnology has helped to produce micro-sized carbon tubes called fullerenes that have made stronger and lighter bicycle frames and tennis rackets. Advocates suggest that fullerenes may be used to produce lighter and more efficient cars.

Some studies, however, suggest that these molecular-sized tubes are similar to asbestos fibers. Asbestos was once considered a miracle insulation and anti-fire product. Later, it was discovered that the fibers, if inhaled, are too small for the lungs to cough out. Therefore, they cause a rare and incurable cancer called Mesothelioma.

Scientists are not sure if the ultra-small fullerenes might cause a similar reaction. Current studies are contradictory and inconclusive because determining whether a product is a carcinogen is a slow process that could take decades.

About 1,000 products on the U.S. market acknowledge nanoparticles among the ingredients. Countless more contain nanoparticles but do not say so. Friends of the Earth, therefore, is calling for a moratorium on the development of more products containing nanoparticles until scientists and public policy makers can determine the risks. At the very least, the group asks for government regulation that would include mandatory labeling.

Engineers and manufacturers, however, say a moratorium is impractical and unnecessary.

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Deborah Duffey, president of Dermazone Solutions, a Florida-based skin-care company, said studies have shown the benefits of several medicinal products that utilize nanotechnology. Dermazone products use a natural soy lecithin, engineered to the nano level, to create beauty products including anti-aging creams and acne medication. The company's products also utilize nanotechnology to help treat burns, help reduce skin ulcers in diabetics and help relieve the pain caused by skin conditions such as eczema and psoriasis.

Independent studies have shown that nanoengineered soy is perfectly safe for people and for the environment, Duffey said. And all Dermazone products that contain nanoparticles are labeled as such.

Like Duffey, Georgia Tech civil engineering professor Joe Hughes worries when people talk about moratoriums on science. "I think a moratorium on nanotechnology development would be a mistake," he said. "We stand a chance of gaining the rewards and minimizing the risk." Hughes, who holds a Ph.D. in environmental engineering, points to the development of "quantum dots" that are under development now. These particles very specifically attach to cancer cells and can absorb light in a spectrum that passes right through the human body. Therefore, doctors can focus light directly on cancerous cells without harming healthy ones.

"These materials are so unique compared to the world of chemistry that we're used to," Hughes said. "They pose amazing advances for curing cancer, for harnessing energy, for creating amazingly efficient mechanical devices, for improving human health. There are some amazing, amazing benefits from these particles for the human species."

Still, Hughes does not discount Illuminato's contention that with advancements come risks. Those risks must be analyzed, Hughes said. "We've been through this before," Hughes said. "We've developed chemicals that helped before we knew how they hurt. DDT was a bad one." DDT, once a revolutionary pesticide, was found to have catastrophic environmental repercussions.

Hughes said much of his work at Georgia Tech is to investigate the environmental implications of nanoparticles. Some medicinal nanoparticles are engineered to seek out specific diseases or to target bacteria. When the product is flushed from the body – or washed from the skin – where do these particles go? "It's a very significant question and one that we do not have an answer to," Hughes said. "We don't know if it's breaking down in the wastewater treatment plants, which would be good

I guess, or if they are going right through to the rivers."

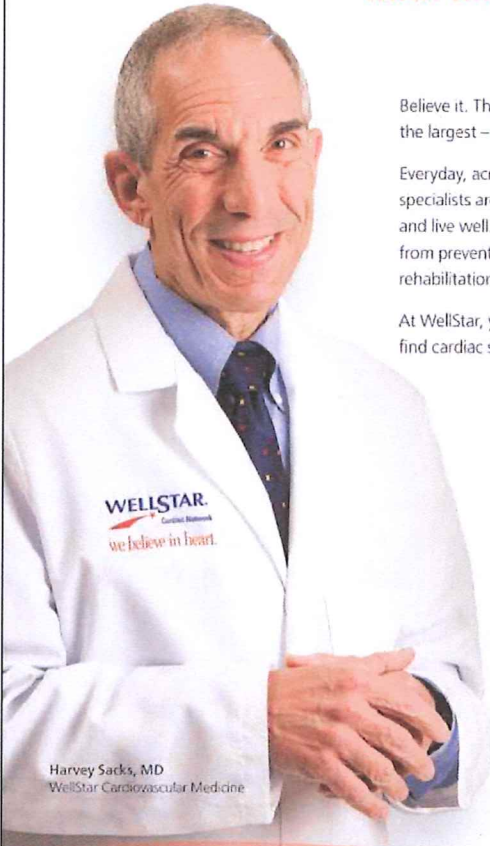
If nanosilver, which inhibits bacterial growth, enters a water stream, it has the potential to attack the good bacteria needed to keep an ecosystem healthy.

Eight years ago, when nanotechnology was in its infancy, engineers did not know the possible environmental and health affects of the products. Now, Hughes said, we only know a little more.

"We have progressed from: 'We don't know, so we better study it' to: 'What we do know shows that we better study more,'" Hughes said. "I do agree, there should be some level of concern." ♦

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