

By Steven Higgs  
Illustration by Jacqui Oakley

# Mama, Dada, and Nano? *Subparticles May Be Toxic for Kids*



**A**LL MOMS WANT THE BEST FOR THEIR BABIES. They seek the newest pacifiers and milk bottles for their newborns and give them plushy stuffed animals to play and sleep with. They look for the most protective sunscreen. And they're sure to be tempted by products like Nanover Wet Wipes, which boasts an ingredient that "inhibits multiplication and growth of those bacteria and fungi which cause infection, odor, itchiness, and sores."

But what mothers probably do not know is that many of those products contain materials made from nanotechnology, the process of manipulating and manufacturing matter at the tiniest of levels. (Three to six atoms can fit inside one nanometer.) And what they almost certainly do not know is that nanomaterials may be toxic.

In fact, scientists cannot say for sure just what happens when humans, especially developing children,

breathe, absorb, or ingest engineered nanomaterials. They don't know where they go in the body, what they do when they're in there, or what their health impacts are. But some of what is known is ominous.

*Steven Higgs is a freelance writer and lecturer at the Indiana University School of Journalism in Bloomington, Indiana. He is editor of The Bloomington Alternative and can be reached at [editor@BloomingtonAlternative.com](mailto:editor@BloomingtonAlternative.com).*

One early study, for example, showed that nanomaterials can cross the blood-brain barrier between the olfactory bulb and the brain. No one knows if they can cross the placental-blood barrier that protects a developing fetus's blood from its mother's.

In an essay in an upcoming edition of the *Handbook on Children's Environmental Health*, published by the American Academy of Pediatrics, Dr. Philip Landrigan distills the potential health threats. "Nanoparticles may be able to produce toxic effects as a consequence of their ability to enter cells," the director of the Children's Environmental Health Center at Mount Sinai School of Medicine writes. "Small size enhances cell entry and appears to be a major determinant of toxicity."

In a 2008 issue of the journal *Nature Nanotechnology*, two researchers from Brown University noted that carbon nanotubes injected into mice in separate studies in England and Japan produced biological parallels to asbestos. The Japanese study found that a greater percentage of mice injected with carbon nanotubes developed tumors and lesions and scarring in the mesothelial lining than did mice injected with a particularly potent form of asbestos.

"These two studies provide scientific evidence for an asbestos-like pathologic response to carbon nanotubes, at least in certain cases," wrote researchers Agnes B. Kane and Robert H. Hurt.

**D**avid Rejeski runs the Project on Emerging Nanotechnologies in Washington, D.C. A partnership between the Woodrow Wilson International Center for Scholars and the Pew Charitable Trusts, his organization maintains an online inventory of nanotech products. His "Goods for Children" category includes toothbrushes, wet wipes, pacifiers, milk bottles, and stuffed animals.

Rejeski says the first inventory released in March 2006 listed 212

products that claimed to have nanomaterials in them. By 2008 the total climbed to 803. Data just released in August puts it at 1,015. Inventoried products include cosmetics, sunscreens, food supplements, tennis racquets, eyeglasses, batteries, and medical devices produced in twenty-four countries.

The 2006 list reported no products under "Goods for Children"; last year's update included nearly

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two dozen (with 2009 remaining at the same level), most of which are produced in China, Korea, Japan, and Taiwan.

Driving the growth in nano children's goods has been a surge in products containing nano-scale silver, which is engineered for its anti-bacterial properties. In the Project on Emerging Technologies' inventory, silver, a potentially dangerous toxin for humans and ecosystems, is now number one, accounting for 26 percent of all nano products.

Indeed, many of the nearly two dozen goods for children on the pro-

ject's inventory make claims similar to the Silver Nano Baby Milk Bottle: "Through silver nano poly system, 99.9 percent of germs are prevented, and it maintains anti-bacteria, deodorizing function, as well as freshness." The inventory's "general clothing" category includes socks, shirts, pants, swimsuits, shoe inserts, ties, and gloves. One manufacturer of "luxury base-layer apparel" (upscale underwear) says consumers can "sweat in style" thanks to the nanosilver blended into its garments' fibers.

But using water-soluble nanosilver as a disinfectant carries with it environmental threats beyond human health. Since 2003, when Samsung introduced a washing machine that injects nanosilver into the wash cycle, wastewater treatment plant operators have warned that their systems could be destabilized as a result. In a March letter to the EPA, the Bay Area Clean Water Agencies, which represents fifty-five public utilities, warned that while "nitrification" is critical to biological nutrient removal, two related studies "found that nanosilver particles less than 5 nanometers in diameter are uniquely toxic to nitrifying bacteria."

In June, the Friends of the Earth, along with Health Care Without Harm Europe, released a report calling for a total moratorium on all products containing nano-engineered silver.

"What we've learned is alarming," author Ian Illuminato says in a news release. "Major corporations are putting nanosilver into a wide variety of consumer products with virtually no oversight, and there are potentially serious health consequences as a result."

**A**s in the development of any new technologies, be they manufacturing processes or synthetic chemicals, workers serve as the canaries in the mines.

"Seven young Chinese women suffered permanent lung damage and two of them later died after working

for months without proper protection in a paint factory using nanoparticles, Chinese researchers reported," a Reuters article stated in August. According to the piece, the women inhaled the particles along with fumes and smoke from the factory. "These findings are important because they provide concrete evidence that these materials are harmful and protection must be given to workers," Allen Chan, a chemical pathologist at the Chinese University of Hong Kong, told Reuters.

In the United States, workers are getting short shrift, too.

"It's usually the workers who get exposed first, long before consumers," Rejeski says. "And OSHA has been fairly dysfunctional. They just haven't been out there inspecting a lot of workplace environments for years now." In the case of nanotechnology, exposure is most prevalent in manufacturing and university research labs. Students, he added, "are just notorious for not wanting to put on face masks and protective clothing."

Women are by far the consumer group that receives the most exposure to nanomaterials in consumer products. The "Cosmetics" category is the second largest on the Project on Emerging Nanotechnologies' consumer product inventory, listing more than 130 lipsticks, moisturizers, cleansing gels, acne treatments, soaps, mists, and creams. One "skin optimizer" instructs: "The nanotechnology was chosen because it makes it possible to place the sensitive ingredients in the form of tiny crystals directly into the cell nucleus."

And many products in the inventory's largest category, "Personal Care," are also aimed at female consumers, including curling irons, makeup instruments, cuticle tenders, cleansers, and lip treatments. "More than a lip plumper," one company boasts of its product, "this 4-in-1, fast-acting formula provides lasting moisture, nourishing age correction and protection from daily stress while nanosphere-delivered peptides stimu-

late collagen production for plumper, healthier lips."

But when it comes to regulatory protection, American mothers, children, and workers are pretty much on their own, according to Jennifer Kuzma, a professor at the University of Minnesota's Humphrey Institute of Public Affairs. The EPA and the FDA have both been slow to respond to occupational and human health threats posed by nanotechnology.

In 2008, the EPA implemented the Nanoscale Materials Stewardship Program, through which companies submit safety information on a voluntary basis.

"The EPA envisioned that would help them figure out what to do about nanotechnology as they saw more and more data come in from this voluntary mechanism," Kuzma says.

An EPA interim report on its voluntary program released in January 2009 said only twenty-nine companies had submitted information on 123 types of "engineered nanoscale materials they manufacture, import, process, or use."

The FDA has said it will use existing laws, with "no special regulation for nanomaterials that come under their jurisdiction through the federal Drug and Cosmetic Act," Kuzma adds.

Steffen Foss Hansen from the Technical University of Denmark, who published his Ph.D. dissertation on the regulations and risks of nanomaterials, says that the European Union is in the forefront in regulating cosmetics with nanomaterials. All nano-containing cosmetics in Europe will have to be labeled from 2013 on, and producers will have to submit to the government various kinds of health and safety information. "It's a very progressive proposal," he says, although the legislation's definition of nanomaterials is limited in scope and only addresses nanomaterials below 100 nanometers.

But while Europe is widely seen as the trailblazer in nano-regulation, California and Canada are leading

the way in terms of mandatory reporting, Hansen says.

"They have actually asked companies that produce nanomaterials to submit health and safety information," he says. "For me, that indicates that they're actively doing a lot more on getting information about what these materials can do, where they're used, and how much is produced."

Rejeski notes that Berkeley, California, and Cambridge, Massachusetts, have local ordinances that address nanotechnology. Berkeley requires mandatory reporting; Cambridge's is voluntary. And, he adds, "EPA fined a company selling computer keyboards coated with nanosilver (a fine of \$208,000) for making unsubstantiated claims about the product."

So what's a mother to do? Protecting her baby's skin from damaging sunrays is a concern. But so is protecting her child from unknown environmental threats. A July 2007 study on sunscreens in *Consumer Reports* found that eight of nineteen products tested "listed zinc oxide or titanium dioxide on the label, which could indicate the presence of nanoparticles. A test of those eight sunscreens found that all contained nanoparticles, but only one disclosed the presence of nano-zinc oxide."

Rejeski says mothers should be cautious. They "can use our inventory to get a better idea of what kids' products might contain nanotechnology," he said. "I would say that the basic principle that applies here is *caveat emptor*—let the buyer beware."

In his essay, Dr. Landrigan warns that knowledge of nanomaterials' potential toxicity is "scant," and what is known about possible toxicity to early human development is "virtually nil."

Mothers should exercise "prudent avoidance," he says in an e-mail. "Nanotechnology is so new and so untested for potential effects on human health that we do not even know what we don't know." ♦