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A Look at Green Chemistry's Efforts to Reinvent How We Make Products

By [Lisa Lillelund](#)

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Nowadays, just about everything we put on us, or in us or is around us has been touched by advanced chemistry applications in some way. Just 60 years ago, the clothes we wore, medicine we took, cosmetics we put on our face, food we ate and products we used did not rely so heavily on man-made chemicals and petroleum-based materials.

Advances in engineering and the manufacturing of plastics, medicines, and textiles have given us many products that were inconceivable a few decades ago. Mobile phones, high performance

athletic gear, antibiotics, new cancer treatments, and jumbo airplanes are just a few examples of the uses of these new materials.

Unfortunately, along with the convenience and benefits of these new chemicals, there are some potentially very harmful effects on human health. According to Elisabeth Grossman in her enlightening book, [Chasing Molecules](#):

"95 percent of Americans tested by the Centers for Disease Control had chemicals used to make common plastics and cosmetics in their blood. Among these effects are reproductive, metabolic, immune systems and neurological disorders, effects that can lead to such chronic conditions as diabetes, obesity and learning difficulties. Many of these chemicals have been identified as endocrine disruptors for their ability to interfere with the workings of the hormones that regulate and maintain a number of the body's reproductive, metabolic, and other vital systems. Overall, these compounds are so pervasive that nearly all babies in the U.S. are now born with synthetic chemicals already in their bloodstream."

It turns out that many of these new molecules are traveling around the world, many are not biodegradable and in some cases they can even detach themselves from their products. These molecules are showing up in the wind, groundwater, seas, water, soil, plants, animals, and dust. This would help explain why sea turtles can be found with chemicals for polyester flame retardants inside them. When the chemicals get into our bloodstream, some of these synthetic chemicals can disrupt the healthy functions of many of our normal biological mechanisms.

This is concerning news. But to be honest, I never really thought much about chemistry and how it affects our lives until mid August 2010, when I attended a Green Chemistry lecture by Dr. John Warner at the [Clean Tech InnoVenture Center](#) in Lynn, Mass.

Most of us involved with the center are familiar with the topics of renewable energy, waste reduction and energy efficiency, but green chemistry was a new one for us. In order to learn more about green chemistry and its promise for a more sustainable future, I went to visit Warner at the [Warner Babcock Institute for Green Chemistry](#) (WBI) and Amy Cannon at the [Beyond Benign Foundation](#) located next door. Cannon is devoted to promoting awareness and understanding about green chemistry among young students, communities and the workforce. She and her team work to inspire young people to enter the field of chemistry and science where they may be able to have a positive impact on a more sustainable future.

To help get a better understanding of the prevalence of synthetic chemicals in our lives, Warner pointed out to me: "Walk into a Home Depot store today and you will be surrounded by thousands of man-made molecules making up product materials that might not have existed fifty years ago. At any given time you may have nearly 100 synthetic chemicals in your body. Over 75,000 compounds are in commerce today and only around 600 have been tested for toxicity."

Something is truly wrong with this picture when less than 1 percent of synthetic made molecules have been tested for hazards. Scientists can go and create any molecule they want to and no one is testing these for safety? Chemists can get a PhD in chemistry and are not required to take even one course in toxicity or

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environmental science? What could help us get out of this dangerous situation and reduce chemical pollution?

One solution is Green Chemistry. Warner is on a mission to transform the way products are made into a new way that is more benign, less wasteful and less polluting. According to the WBI website, "Green Chemistry is a revolutionary approach to the way that products are made: It is a science that aims to reduce or eliminate the use and/or generation of hazardous substances in the design phase of materials development. Green Chemistry follows the principle that it is better to consider waste prevention options during the design and development phase than to dispose or treat waste after a process or material has been developed."

The Warner-Babcock Institute combines academic research capabilities with the urgency and agility of successful start-ups. In the three years since its, WBI is already cash-positive and filed 130 patents for itself and its clients, along with creating five products ready to go to market.

Warner-Babcock uses green chemistry to create products for companies that accomplish three very important things for their clients:

- 1) It must be more environmentally benign than existing alternatives.
- 2) It must be more economically viable than existing alternatives.
- 3) It must be functionally equivalent to or outperform existing alternatives.

According to Warner, only 10 percent of current technologies are environmentally benign and 35 percent could be made benign relatively easy. The remaining 65 percent will need to be reinvented in more environmentally benign ways.

In addition to the health and environmental safety of these greener chemicals, green chemistry brings a competitive advantage to companies:

- Less risk of product recalls and potential damage to company reputation;
- Cost savings gained when hazardous materials are removed to reduce the costs associated with handling, transportation, disposal and compliance of hazardous materials;
- Improved chances of greater stakeholder engagement from customers, employees, managers, and investors are achieved when a company demonstrates initiatives to reduce their negative impact on the environment;
- Cost savings from greater efficiencies in manufacturing process.

The federal government is also taking steps to encourage the growth of green chemistry. President Obama appointed green chemistry leader Paul Anastas to head up the EPA Office of Research and Development.

And each year since 1996, the EPA has given recognition to corporations, small businesses, and universities employing green chemistry by honoring them with the Presidential Green Chemistry Challenge awards. A sample of the award winners for various projects includes Dow Chemical, Proctor and Gamble, Merck, Virent Energy Systems, BASF, University of Massachusetts, Michigan State University, Clarke, and Cook Composites and Polymers.

Incorporating green chemistry into traditional manufacturing processes is not an easy job. But Warner and Anastas developed [The 12 Principles of Green Chemistry](#) to serve as guideposts along the way. The principles and framework for design listed on the WBI website include concepts such as using benign substances instead of toxic ones, using fewer materials and natural resources whenever possible, using renewable feedstocks, designing for energy efficiency and planning for end of product life by using recyclable or biodegradable materials.

Green chemistry concepts offer an exciting and beneficial new way of designing products. For the benefit of our planet, let's hope that someday green chemistry becomes the standard for chemistry.



Lisa Lillelund is a sustainability advisor and environmental advocate. She has a passion and respect for organizations and companies doing well by doing good.

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Great article! I think we

AAA (not verified), November 29, 2010 - 09:57

Great article! I think we must distinguish between "green chemistry" and "green chemicals". Generally, the term "green chemistry" describes reactions to produce conventional chemicals by green processes e.g. non-toxic solvents, low energy consumption... "Green chemicals" are supposed to derive from green/sustainable resources and to substitute conventional chemicals of fossil origin.

With respect to the "12 Principles" the chemical industry will change to sustainability - it might take some time but the change will come!

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