Research Garners International Recognition

When I went to several local stores in April 2006 to buy some inexpensive jewelry items for one of my classes to analyze, I had no idea that I was about to come face to face with the realities of global trade in a way that would lead me into some entirely new directions of research.

And I certainly had no idea that I would soon be picking up my phone to find reporters from Consumer Reports, the New York Times and other major news outlets on the other end, all with questions about the results of studies that grew from this initial class project.

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– Dr. Jeffrey Weidenhamer '79, Professor of Chemistry

The class, Lead and Civilization, is one of several new classes developed by my department for the AU Core Curriculum. We focus on the chemistry and toxicity of lead, and work to engage student interest by doing labs that are relevant to them, such as testing paint and soil from around older homes.

Lead is a highly toxic metal that can cause a range of health effects, from behavioral problems and learning disabilities, to seizures and death. Young children are most at risk, because their brains and nervous systems are more sensitive to the effects of lead than adults. Recent research indicates that even small quan-

tities of lead can cause significant neurological injury such as decreased IQ. The effects of lead are cumulative, and the only way to prevent harm is to prevent exposure. Because of the link to children and learning, the Lead and Civilization course has been of particular interest to teacher education students, and the regulatory and business liability dimensions of the historical uses of lead in gasoline and in paint provide many other opportunities to tie science to issues of concern to students.

In February 2006, Jarnell Brown, a 4-year-old Minnesota boy, died of lead poisoning after swallowing a heart-shaped charm from a bracelet given away with the purchase of Reebok tennis shoes. The charm was found to contain 99 percent lead by weight after it was removed from his stomach. The bracelets involved were subsequently recalled by Reebok and the U.S. Consumer Product Safety Commission (CPSC). The analysis of metal samples for lead is not too involved, so the question of whether similar items might be on the shelves of Ashland area stores seemed to be a good one to ask of our students.

I was not prepared for what my students found. In the first set of 20 inexpensive jewelry items, 14 were heavily leaded, in two cases as high as 100 percent lead by weight. The CPSC guidelines for lead in children's metal jewelry items establish a maximum of 0.06 percent lead by weight, along with an additional test for the accessibility of lead that measures how much lead a child might be exposed to if the item were ingested. This second test is much more involved, and because items with high total lead also generally have high accessible lead, the CPSC has proposed doing away with this test and setting the standard at 0.06 percent lead by weight. A lead content of 60 percent lead by weight is 1,000 times 0.06 percent, so many of these items have extraordinarily high lead content.

With the help of the Chemistry Department's Laboratory Manager Michael Clement, I repeated the student work and extended the study to examine the lead content of 139 inexpensive jewelry items – including charm bracelets, key chains, necklaces, pins and earrings – purchased from a number of locations around the country by friends and family members. While not all of these items were clearly targeted toward children, the low prices (all items cost less than $5, and most less than $2) put them in a price range that would be attractive to young children. While 41 percent of the items tested contained less than the 0.06 percent standard for children's metal jewelry, even more of the items (43 percent) were very heavily leaded, exceeding 80 percent lead by weight.

As with many other inexpensive products sold in the United States, a majority of the items that we purchased were imported from China. When we have analyzed multiple samples of the same jewelry item, we often find that the lead content is variable, suggesting that the source material used to produce this jewelry is scrap metal of varying composition. Earlier in the semester, my class and I had watched a video documentary on the global e-waste trade produced by the Basel Action Network showing women in the Guiyu region of China cooking lead-tin soldered circuit boards in order to recover the circuit board chips and solder. E-waste is the term given to the dead TVs, DVD players, computers, cell phones, iPods and innumerable other electronic devices that are now a ubiquitous part of modern life, but have to be disposed of in some way once they wear out or become obsolete. The U.S. currently exports much of its e-waste to countries on the Pacific Rim, including China, where it is "recycled" in primitive conditions that result in considerable environmental degradation. Having been trained as an ecologist, it seemed a natural question whether any of the lead from these leaded hazardous wastes might be recycled into leaded products such as inexpensive costume and children's jewelry.

I tried to address this question by analyzing some of the other metals present in the jewelry items. We had 39 samples in our original set that contained more than 90 percent lead by weight. The content of lead and antimony in these samples is almost identical to the lead alloy used in lead-acid batteries in automobiles. Lead-acid batteries can contain more than 20 pounds of lead. Lead mining generates huge quantities of waste and has enormous negative environmental impacts, so it is important that this lead be recycled, but the use of lead recovered from these batteries to make jewelry is clearly an inappropriate way to recycle this lead.

Electronic solder typically contains approximately 40 percent lead and 60 percent tin by weight. A smaller number of leaded jewelry samples (six of the original 139) contained significant amounts of tin and smaller amounts of copper that could be introduced by heating solder in the presence of the large amount of copper found in printed wiring boards. This suggests that these items might be derived from recycled solder scrap, perhaps being mixed with other sources of lead. Our evidence is circumstantial and still waiting confirmation from others investigating the issue on the ground in China. But it is a bit sobering to think that some of our own hazardous waste exports may be coming back to haunt us in some of these leaded products. This emphasizes that part of the solution to the problem of lead contamination in these products is adoption of responsible recycling practices for e-waste. For the U.S. to continue to ship this waste to various locations around

Dr. Weidenhamer acknowledges the many students who have worked on these projects. In addition to students in the Lead and Civilization course, and senior Environmental Science major **Jamie Yost** (above), students who have lent a helping hand or contributed experimental results to this work include **Alysa Frank, Beverly Goudy, Amanda Kozak, Amanda Morant, Marissa Solar** and **David Wilcox.**

the Pacific Rim where low-tech "recycling" operations threaten both the environment and worker health simply because it is the cheapest way to dispose of it is not a sustainable or ethical way to handle this waste.

Since our initial studies, my students and I have continued to explore this and a number of related lines of research. Jamie Yost, a senior environmental science major, has found lead paint contamination in several plastic jewelry items. Here the problem appears to be paints used to give a glossy sheen to plastic pearls. Only 10 percent of the items we have tested are a problem, but there is no obvious way to distinguish those with lead paint. Jamie has also tested jewelry items for both total lead content and the more difficult measure of lead accessibility that the CPSC has proposed eliminating, and found that the majority of items with high total lead also have high accessible lead. (Jewelry manufacturers and the Chinese government have argued that plating on high-lead items can render the lead inaccessible and therefore harmless to children). We continue to document high lead levels in inexpensive jewelry, and filed complaints with the CPSC in August about 30 additional jewelry items tested by this year's Lead and Civilization class and confirmed byYost.

Late September brought a call from U.S. Senator Sherrod Brown's office about the safety of painted Halloween product imports. With the help of Yost and four other student volunteers, I tested 22 Halloween items from local stores and found lead contamination in three of them. One, a Frankenstein-shaped plastic drinking cup, was found to have paint on the eyes with 3.9 percent lead content, over 65 times the legal limit. This item was recalled within a week by the CPSC. Recall of a skull candy bucket with lead concentrations of 0.28 percent in paint on the eyes and mouth took close to three weeks. Altogether, five recalls have resulted thus far from our work.

While deteriorating lead paint in older housing remains the major hazard to children in the United States, lead's high toxicity gives reason to eliminate all unnecessary exposure, especially for children. As dozens of recent recalls of leaded metal jewelry items and lead-painted toys have demonstrated, there have been far too many of these items on the market. Our work implies that there are many more items out there that have not yet been recalled.

The news media attention attracted by our work has been one of the things for which I found myself least prepared. Picking up the phone to find a reporter from a major U.S. newspaper calling from Shanghai, China; National Geographic; Radio Free Asia; and any number of other media outlets has been a learning experience. I participated in a news conference organized by Senator Brown's office to announce the problems found with Halloween items and subsequently found myself dealing with questions from a number of newspaper reporters, and interview requests from a number of TV and radio outlets. The taped interviews aren't so bad, but the live ones can be nerve-wracking. It is unfortunate that someone can become well known for drawing attention to lead contamination issues. It certainly would be far better for the kids if there were no story at all about lead contamination in these products. But as long as it is there, hopefully the media attention will help lead to some strong actions to make these products safe for children.

The hardest questions I get are from parents. A mom from Las Vegas called me because she was concerned about her son's painted Halloween mask. A news anchor with a 7-month-old infant that had given her child one of the Baby Einstein toys recently recalled expressed frustration with knowing what is safe to give her child. One precaution is to throw out painted toys and holiday items that are obviously deteriorating (with paint chipping or flaking off), as lead paint typically gets ingested when the paint deteriorates. Home test kits provide some measure of safety, but it is not economical to use $1.50 test kits to test toys and jewelry items that cost less than $1. Blood tests can also provide reassurance that a child has not been exposed to harmful levels of lead. Until the government, manufacturers and retailers can reassure the public that the contamination issues are behind us, many parents will likely choose to try to avoid suspect products altogether. Accent

by Dr. Jeff Weidenhamer '79