UCSC Mercury Thermometer Exchange Program

Juniper Rosen

Undeclared Sophomore

jusrosen@ucsc.edu

Environmental Health and Safety Department of UCSC

April Anesty: aprilc@ucsc.edu

May 30th, 2014

Abstract

I am working with University of California Santa Cruz's Enivornmental Health and Safety department to develop and implement a Mercury Thermometer Exchange Program. This is a program that has been implemented successfully at Universities, Hospitals, and even cities across the United States. And although the dangers of mercury have been known for years, of the ten UC's, UCSC will be the fifth to implement a Mercury Thermometer Exchange.

Elemental Mercury has a very low vaporization temperature, creating mercury levels up to 100 times the safe amount at room temperature. Spilled mercury can rarely be completely cleaned; it will often sit in the cracks of tiling vaporizing invisibly for years. In addition to this, improper disposal of a mercury thermometer can contaminate our soil and water, and the mercury will accumulate in the bodies of fish and wildlife. Natural processes can convert mercury in sediments into methylmercury, which is incredibly harmful if ingested—this is the type of mercury which is plaguing our tuna and other top-chain predatory fish through bioaccumulation.

The idea of the Mercury Thermometer Exchange is simple: EH&S will be using its own funds to purchase spirit-filled thermometers at the request of Laboratory Representatives, who in turn will give us their mercury thermometers for proper disposal. This will be beneficial to the health of students and faculty as well as our surrounding ecosystems.

Problem Definition, Context & Background

Mercury is a naturally found element, and is found in volcanoes, geologic deposits, and volatilization from the ocean. However, when high levels enter the mercury cycle from non-natural sources, (Alkali and metal processing, incineration of coal, medical waste, and mining of

gold and mercury), conversion of inorganic mercury increase via bacteria, which are then eaten by plankton, and so on and so forth through the food chain. Animals accumulate Methylmercury faster than they can dispel it, and consumer higher concentrations at each level of the food chain. This is known as bioaccumulation, and can lead to neurodevelopment defects, reproductive, and behavioral defects especially in humans and water birds. (U.S. Geological Survey)

As it pertains to thermometers, the above process is not the main danger involved. The most serious threat of the mercury thermometers on campus is to the well-being of students, staff, and faculty. Laboratories have many harmful chemicals involved in research; however, a mercury thermometer can be replaced with a non-harmful counterpart with just as accurate measurements. When a mercury thermometer is broken, it's vapors are released into the surrounding air immediately. This can be seen clearly in Bowling Green State University's video recorded experiment, where an ultraviolet light and fluorescent background were used to examine vapors being released from spilled mercury. Those vapors, when breathed, get transported through our lungs and directly into the blood stream. Such an unnecessary hazard in the laboratories is unacceptable. The goal of Environmental Health and Safety is to protect the safety of workers, the environment, students, staff, and faculty. It is our responsibility as well as the responsibility of the University of California public education system to remove this easy target from our campus.

After testing the P-trap from one of our science labs at UCSC, we observed that not everyone in the lab is trained on the specifics of mercury contamination; often times mercury contaminated materials will get rinsed in the sink or bits will get dumped down the drain. Water waste on campus from showers, sinks, and toilets are all transported to the City of Santa Cruz waste treatment facility. At the waste treatment facility, toxins, solid waste, and metals are

filtered, but not completely. The 2011 levels of mercury are provided by City of Santa Cruz waste treatment facility (appendix A) and as a University of California, UCSC has an obligation to not contribute ANY mercury to the levels shown. The UC Sustainability Plan, Land Habitat and Watershed, section 2, states: "Support public safety and protect sensitive species…" We have a responsibility as a University to not only contain mercury contamination, but to use non-mercury products in the future. As stated in the UC Sustainability Plan, Procurement: 1) Increase the number of Environmentally Preferred Products campus purchases. 2) Educate the campus community through effective outreach and collaboration to institutionalize sustainable procurement practices." All UC's should be aiming to be entirely Mercury Free, as modeled by UC Irvine already. The mercury thermometer exchange will decrease environmental degradation in our oceans, soils, and our food chain.

Project Description

By the end of the 2013-2014 school-year, the Environmental Health and Safety Department of UCSC will have successfully outreached to the laboratories on campus to remind them of the dangers of mercury, and will have replaced as many mercury thermometers as possible with non-mercury devices.

Objectives

1. **Create 5 forms of outreach for Mercury Thermometer Exchange Program for Fall & Winter quarters**.

   I successfully planned and created the Mercury Thermometer Exchange page on the Environmental Health and Safety page, attended and presented at the Fall 2013 Lab Representative Safety meeting, tabled and advocated the project at the Personal

Protective Equipment fitting event, did flyering, and also created a site for the project on the Project Clearinghouse website.

2. **Educate myself on previous programs & mercury during Fall quarter.**

   I read through provided literature on U.C. Berkley and Irvine's Mercury Thermometer Exchange programs to get tips and ideas and also did personal research online on mercury pollution, environmental impacts and impacts on humans. I also read through compiled emails about various EH&S staff's opinions and concerns around the subject of mercury thermometers.

3. **Purchase 50 spirit filled thermometers by the end of Winter Quarter.**

   To begin the purchasing process, I read through literature provided to determine what brands Berkley and Irvine purchased from. From there I got a general idea of what prices would be like. The purchasing was solely based on participant need, so emailing was crucial to determine exactly what types of thermometers I would need to purchase and how many. During the course of the project we received an offer from Sigma Aldrich scientific products to purchase through them at a discount with free thermometer disposal through the company. This was an exciting offer; however, due to our low amount participation vs. what was expected, the deal would have been incredibly cost-deficient. Instead we opted for a cost-efficient method; buying Fisher thermometers when the ranges were available, and the slightly more pricey Sigma Aldrich thermometers for other ranges. Before orders were made, a quick conformation email was sent out to participants with the thermometers we were prepared to purchase from them. After conformation from participants, the orders were made through Cruzbuy and inventory was taken when the thermometers

arrived—this was an important step; one of our thermometers was incorrectly sent and the matter was resolved.

4. **Create process of exchange to be used for Spring Quarter.**

   My mentor and I met with Lisa Wiesser (Laboratory Safety Program Manager) and Terra Haddad (Chemical Hygiene Officer) to determine best way to physically exchange the thermometers. We determined it would be best to go lab to lab and drop off/pick up thermometers directly so as to make the process as easy and safe as possible for participants. I next created an SOP (Standard Operating Procedure) with my mentor for the physical exchange of thermometers, and completed both the Intro to Lab Safety and Hazardous Waste online trainings so as to be certified to enter the labs and handle hazardous chemicals through EH&S.

5. **Exchange 50 thermometers during Spring Quarter.**

   So far, we have only purchased 34 thermometers and exchanged 30 of them. This is due to overflow on bulk purchasing (the thermometers we cheaper if we bought them in groups of 5 or 25). Since more thermometers were not requested, it would be prudent to wait for specific range requests before purchasing more to exchange in the future. To get the physical exchanges started, I informed participants that their orders had arrived and gave them a window of times and days to schedule ten minute meetings with me. Approximately ten minutes before each meeting I printed out a sheet of the mercury thermometers we were expecting to receive from them as well as the spirit-filled thermometers we would be bringing. I donned my PPE (Personal Protective Equipment) consisting of gloves, lab coat, glasses, close-toed shoes, and full length pants. I brought with me the SOP, thermometer list, and a bucket filled

with vermiculite, a small foam like substance to keep the mercury thermometers in place while transporting them. Once at the laboratory (on time), I checked off mercury thermometers received and wrote down extras. I also checked off spirit-filled thermometers as we gave them to the lab representative and entered this data into the computer upon arrival to EH&S.

6. **Round out program by May 30th for smooth exchanges in the future.**
   This included final excel spreadsheets of all of the data collected from the program, a program accomplishments poster, a final write up paper for EH&S, sustainability newsletter submission, as well as addition of resources, data, pictures, and results for the Mercury Thermometer Exchange website—also included on the webpage is a quick survey for those who would like to participate in the exchange in the future, this will be on ongoing program.

This method of mercury elimination has been successfully modeled at UCLA, UC Irvine, UCSF, and UC Berkley. Student and staff will see beneficial impacts every time a thermometer is dropped and does not have to involve an expensive and time consuming mercury spill kit. As well as removing any further mercury contamination from our campus or the environment, this program is great for the campus's image and will have clearly defined measures of success to be shown.

Project Timeline

During the Fall Quarter my big push was the Lab Safety Representative meeting on November 19th. To prepare for the meeting I spent a lot of time researching other campuses

Mercury Thermometer Exchange Programs and compiling potential purchasing lists of thermometers from this information. The presentation was a big success—we got a lot of positive feedback and gained the participation of five laboratories on campus. The rest of Fall Quarter I spent my time determining exactly what thermometers each laboratory would need and what company we would purchase from (Fisher Scientific with lower prices or Sigma Aldrich with an offer to dispose of thermometers for us). In the end, we opted to purchase mostly from Fisher Scientific and dispose of the mercury thermometers on our own.

Winter Quarter the purchases were made, and a system for exchange had been decided on. I advocated for the exchange at the Personal Protective Equipment fitting event during January, and did flyering in all of the science buildings at UCSC.

Spring Quarter was devoted to the physical exchanges and wrapping up the Mercury Thermometer Exchange program. I will also be finalizing reports and data and making the information public for the use of other campuses and helping with further projects such as Ethidium Bromide destaining bags.

Project Stakeholders, Student and Mentor Roles.

The most important stakeholder in the Mercury Thermometer Exchange is the laboratory representatives (faculty). My mentors explained to me that lab representatives often feel badgered by Environmental Health and Safety, and a new face with none of those connotations was ideally beneficial for advocating the program. It was also important to understand the education level of who I corresponded with—these are lab representatives who know what mercury is and what it does, that is not something I needed to explain. However they

may have had/ still have some false ideas about non-mercury thermometers and that's where I felt I was able to give information. It was important not to sound patronizing and to be respectful.

EH&S hazardous waste (staff), including April Anesty and Justin Demarkus were the staff behind this project—they had all of the background knowledge and contacts needed to support me, as well as relationships with lab representatives and others who helped to push our project.

My role as an intern (student) was to plan and facilitate this entire project from start to finish. With the help of my mentor, Shauna, David, and my PSI peers this process has been manageable. I was responsible for finding time in between my three other classes, my job, and my recreational activities to go forward with this project. I was responsible for preparing media and presentations, collecting and keeping our data, corresponding with participants, talking with other universities and our purchasing company to determine pricings, and coordinating with other programs to push a mercury free campus.

Measurable Results

This project has achieved a higher level of safety in labs, as well as lower levels of potential pollution caused from our campus. We have collected 159 mercury thermometers and counting—that's 159 less eventual calls to EH&S to deal with a mercury spill: an average mercury clean up kit ranges from $30-$200 depending on the severity, making mercury the one of the most expensive clean ups found commonly on campus. Many of these thermometers were sitting in drawers unused, but the fact remains that they were still a hazard and are much better

off in the hands of EH&S. These 159 mercury thermometers collected translate to about 477 grams of mercury removed from UCSC campus, as well as 477 grams of elemental mercury form the mercury cycle. Another measure of success is the number of spirit thermometers given out: 31 spirit thermometers. It is not particularly strange that we saw such huge differences in numbers exchanged vs. numbers collected; this was seen in UC Santa Barbara's results as well as UC Irvine's. Aside from monetary costs, the environmental and health savings of this project are priceless. Mercury poisoning causes birth defects, deformations, and is a large concern in today's oceans. This project will help thwart the buildup of mercury in our ecosystem.

Evaluation

By the end of this project I came to the realization that there are just not many mercury thermometers on campus—many of the labs we approached informed us that they had already eradicated mercury thermometers from their labs or simply do not use thermometers. This is great news—I would take a good guess that the 159 mercury thermometers we removed were 50% of the mercury thermometers on campus. This was indeed an important project for UCSC, but I feel the project's strongest purpose is being an example to other campuses. My project was based off of the extremely successful projects of UC Irvine and UC Berkley, and it is my goal to include enough information and pointers for UC Santa Cruz's program to be a base for other campuses. Mercury thermometers should not be used in labs anymore—we are all too aware of the consequence of mercury bioaccumulation to accept the presence of the element in our classrooms and potentially our surrounding ecosystems. Environmental Health and Safety is always excepting all mercury thermometers and devices, there is no limit to how many a lab can

bring in. With costs at roughly $150 for purchasing non-mercury thermometers, disposal costs of the mercury thermometer and purchasing of an incentive raffle item, this project really didn't spend anything near what we had available to us. However, if the thermometers aren't present then maybe the real mission for this entire project should had been to ban mercury thermometers outright. I wish I had come to this conclusion sooner, but hopefully this is push that EH&S can make with the help of Greenlabs in the near future.