Six Classes: Chemical Classes of Concern:

6. Metals

What Are They and How Are They Used?
Metals are elements found naturally on earth that are characterized by a shared series of properties including electrical conduction and malleability. They are typically found as ores, which are metals combined with oxygen, sulfur and other elements. These ores are mined and then processed in a furnace to extract just the metals of interest. They are then used to make thousands of useful products in society. Often, metals are the primary material of a consumer product (such as steel products), but sometimes they are also used in consumer products as minor components such as pigments, or to enhance performance of a product (such as to add anti-microbial action to treated lumber or mascara).

Which Metals Are Of Concern?
Metals are often released into the environment by mining and processing, and can be much more reactive when transformed to other chemical forms (called ions) or when bound to carbon (such as in methyl mercury). Because they are elements and do not break down, in certain forms they bind tightly to organic molecules and end up in the food chain where they can bioaccumulate in mammals[i]. When metals are used in consumer products, they can make their way into the food chain and then to humans and animals. Many metals are essential constituents of a human diet and are known as nutrients[ii]. However, metals that interact with human biochemistry in some forms are of most concern. Examples include mercury, lead, arsenic, cadmium and chromium. These metals are widely used in consumer products, yet are toxic to humans.

Why Are They A Concern?
Metals interact with human biochemistry in a myriad of ways, and as a result can cause a variety of disorders in humans. A partial list of some metals of concern and their harmful properties is below.

- **Mercury** can be inhaled as vapor and ingested from foods and can readily cross the blood-brain barrier[iii]. It can bioaccumulate and chronic exposure can cause nervous system disorders such as memory loss, tremors and numbness[iv].
- **Lead** has targets the brain, the nervous system and the peripheral sensory system[v]. Lead poisoning in children is known to cause blindness, hearing loss and decreased cognitive functions[vi]. Epidemiological studies have shown a direct correlation between children's lead levels in blood and decreased neurological function and attention deficit[vii].
- **Arsenic** is known to accumulate in red blood cells, as well as adhering to proteins in the skin and hair[viii]. Arsenic is strongly correlated with certain types of skin and lung cancers, but can also cause anemia and vascular disease[ix].
- **Chromium** can cause kidney damage and lung cancer[x].
- **Cadmium** can affect the lungs and cause emphysema, act as a calcium substitute, and cause kidney failure[xi].

When consumer products containing certain metals get into the human food chain, very low levels of these metals can begin to affect human health. For some of these metals, human health harm has been measured in response to metal concentrations in the part-per-billion level[xii].

Do We Need Them?

Metals are essential in some applications and very convenient in many more. For this reason they are widely used and recycled. However, because of the sensitivity of human health to very low levels of certain metals there are many examples where their use has caused inadvertent toxicity[xiii]. In many cases, there are safer alternatives that could be used to replace the toxic metals in consumer products (such as re-engineering the car engine to reduce engine knock instead of using leaded fuel additives and replacing arsenic in treated playground wood with copper). While we are unlikely to reduce our societal use of metals, the unintentional dispersal in the environment and the use of harmful metals in consumer products can be reduced by identifying them and finding safer alternatives

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[xiii] See for example: Martin, D. M., DeRouen, T. A., and B. G. Leroux. Is Mercury Amalgam Safe for Dental Fillings? Washington Public Health 1997 15, 30-32; Mercury poisoning associated with beauty cream – Arizona, California, New Mexico and Texas, 1996. MMWR 1996 45(29), 633-635. [accessed November 25, 2013]; Brief Report: Lead Poisoning from Ingestion of a Toy Necklace --- Oregon, 2003. MMWR 2004 53(23), 509-511[accessed November 25, 2013]; Death of a Child After Ingestion of a Metallic Charm --- Minnesota, 2006. MMWR 2006 55(12), 340-341. [accessed November 25, 2013]; Jacobs, David E, Clickner, Robert P, Zhou, Joey Y, Viet, Susan M, Marker, David A, Rogers, John W, Zeldin, Darryl C, Broene, Pamela, Friedman, Warren. The Prevalence of Lead-Based Paint Hazards in US Housing. Environmental Health Perspectives 2002 110, 10; Smith, A. H., Lingas, E. O., and M. Rahman. Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. Bulletin World Health Organization 2000 78(9), 1093-1103; Guney, Mert, and Gerald J. Zagury. Contamination by ten harmful elements in toys and children's jewelry bought on the North American market. Environmental science & technology 2013 47(11), 5921–5930.