# 3.2: Hazard Concepts

## Concepts

**Globally Harmonized System**

To best classify hazards, the concept of GHS (Globally Harmonized System) has been introduced. Figure 3.2.1 demonstrates the categories of hazards:

Figure 3.2.1: The globally harmonized system (GHS) that attempts to specifically categorize the general types of threats in society. Please see emergency.cdc.gov/agent/agent...emcategory.asp for more information; commons.wikimedia.org/wiki/File:GHS_HAZCOM_Safety_Labels.jpg

Notice that each logo attempts to demonstrate pictorially the type of hazard represented by a specific chemical or material. For example, notice Figure 3.2.2 below. This particular chemical's hazard level could be listed as "gases under pressure" and "explosives". The intensity of its peculiar hazards is evaluated according to the pressure and the explosive nature of the gas.

Figure 3.2.2: A tank of propane gas commons.wikimedia.org/wiki/F...oamFatale_Pres sure_Vessel.jpg

**Exposure and Categories of Hazardous Substances**

Our overall sensitivity to hazards, again, depends on a number of factors that not only include the typical factors of levels, LDs, type of toxin, modality, etc., but also to our idiosyncratic immunity or responsiveness.

We have been accustomed to a number of wonderful creature comforts in life that have only come about because of the power, versatility, and creativity inherent in the chemical enterprise. For example, phosgene, a notorious chemical warfare agent in the Great War, is now used as a precursor for the manufacture of a number of items including polyurethane. Shown below in Figure 3.2.3 is a representation of phosgene:

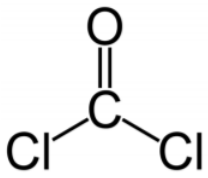


Figure 3.2.3: A chemical representation of phosgene. http://www.toxipedia.org/display/toxipedia/Phosgene

**Lab Safety**

Lab safety is an essential part of working with hazardous materials. It is important to follow good lab practice techniques and to know how to deal with situations should they occur. In the following video by Chemistry crash courses, some good lab techniques and safety guidelines are discussed. Lab Techniques and safety by crash course: https://www.youtube.com/watch?v=VRWRmIEHr3A

Reference: Green, H. Crashcourse. (2013, July 8). Lab Techniques & Safetey: Crash Course Chemistry#21. Retrieved from https://www.youtube.com/watch?v=VRWRmIEHr3A

**Lethal Dose**

*Lethal dose* (LD50) is the amount of any ingested or interfering substance that kills 50% of a test 58 sample. It is expressed in mg/kg, or milligrams of substance per kilogram of body weight. In toxicology, it is also referred to as the median lethal dose that refers specifically to a toxin, radiation, or pathogen. The lower the LD50, the more toxic is the item being measured for toxicity. It can be considered a pragmatic approach to toxicity exposure levels because in general, toxicity does NOT always scale with body mass. The choice of 50% lethality as the gold standard avoids ambiguity because it measures in the extremes and reduces the amount of testing. However, such a fact also means that LD50 is not the lethal dose for all subjects; in other words, some may be killed by much less. Measures such as “LD1” and “LD99” (dosages required to kill 1% or 99%, respectively, of the test population) are sometimes used. Shown below is a chart of sample LD50 taken from Wikipedia (en.Wikipedia.org/wiki/Median_lethal_dose) with active links to allow further investigation of the substances whose measurements are given.

| Substance | $LD_{50}$ ($LC_{50}$) | $LD_{50}$: g/kg ($LC_{50}$ g/L) standardized |
|---|---|---|
| Water | >90 g/kg | >90 |
| Pentaborane | <50 mg/kg | <0.05 |
| Cobalt(II)chloride | 80 mg/kg | 0.08 |
| Metallic Arsenic | 763 mg/kg | 0.763 |
| Cadmium oxide | 72 mg/kg | 0.072 |
| Sucrose (table sugar) | 29,700 mg/kg | 29.7 |
| Monosodium glutamate (MSG) | 16,600 mg/kg | 16.6 |
| Vitamin C (ascorbic acid) | 11,900 mg/kg | 11.9 |
| Urea | 8,471 mg/kg | 8.471 |
| Cyanuric acid | 7,700 mg/kg | 7.7 |
| Cadmium sulfide | 7,080 mg/kg | 7.08 |
| ethanol (grain alcohol) | 7,060 mg/kg | 7.06 |
| sodium isopropyl methylphosphonic acid (IMPA, metabolite of sarin) | 6,860 mg/kg | 6.86 |
| Melamine | 6,000 mg/kg | 6.00 |
| Melamine cyanurate | 4,100 mg/kg | 4.1 |

| | | |
|---|---|---|
| Venom of Brazilian Wandering Spider | 134 µg/kg | 0.000134 |
| Venom of Inland Taipan (Australian snake) | 25 µg/kg | 0.000025 |
| Ricin | 22 µg/kg<br>22-30 mg/kg | 0.000022<br>0.02 |
| 2,3,7,8- Tetrachlorodibenzodioxin (TCD-D, a dioxin) | 20 µg/kg | 0.000002 |

Sources for toxicity information:

- http://www.atsdr.cdc.gov/
- http://cfpub.epa.gov/ecotox/
- toxnet.nlm.nih.gov/

Figure 3.2.4: A Brazilian Wandering Spider commons.wikimedia.org/w/index.php?curid=332527

Notice that the venom of the Brazilian Wandering Spider is particularly potent. A ten thousandth of a g/kg or ~5mg would kill a normal sized female. Luckily the venom discharged per bite is quite small. Nevertheless, the point is that the vector (or venom) represents a toxin that is of sufficient lethality that it can cause great harm or injury to a human being.