

3.1: Introduction to Hazards of Chemistry

Hazards Introduction

What we as a population must realize is that no substance in and of itself is a poison or a remedy. It is the dosage that defines the activity of the substance. For example, let's look at the concept of "hormesis" as a precursor to the concept of poison/remedy by dosage.

We all have heard at one time or another the phrase, "What doesn't kill you makes you stronger". This phrase contains truth and contains at its essence the theory of hormesis: when organisms are exposed to low levels of stressors or toxins, they become more resistant to larger levels of stressors or toxins. This theory has been met with skepticism. Recently, however, biologists have put together a molecular explanation of its function and it has finally been accepted as a fundamental principle of biomedicine.

For example, exposing mice to low levels of gamma ray radiation before irradiating them with high levels actually decreases their likelihood of cancer. Similarly, when dioxin is given to rats we find the same situation. However, the biochemical mechanisms are not well understood. It is believed that a low dose of a toxin can trigger repair mechanisms that are efficient enough to not only neutralize the toxin, but repair other defects not caused by the toxin.

Thus, hormesis is nature's way of dealing with harmful agents; in fact, antibodies are a natural consequence of hormesis. However, the toxins/poisons that were once absolute, are NO LONGER. For example, thalidomide was found to be a very dangerous chemical for embryo development, but has recently found great promise in a number of ailments according to the Mayo Clinic including HIV, skin lesions, and multiple myeloma (please see: <http://www.mayoclinic.org/diseasesco...e/art-20046534>). Such a fact is outstanding considering the horrific aftermath (a few photographs shown below(Figure 3.1.1) of its use in the middle part of last century:



Figure 3.1.1: A child disfigured because of thalidomide <https://www.flickr.com/photos/22719239@N04/2241322031>



Figure 3.1.2: A few adults with disfigurements directly caused by thalidomide intake by the natural mother
<https://www.flickr.com/photos/bowbrick/3525018934>

In fact, the list of former “pure” toxins is extremely interesting: snake venom, bacteria (botulin), fungi (penicillin), leeches (Hirudin), maggots (gangrene), etc. The toxic aspect notwithstanding, we all live in the wake of a world and society that is rife with potential hazards.

Types of hazards

A hazard is “threat” to life, health, property, or environment. These can come in many forms, but they are classified according to their modalities or nature of operation. The modalities of hazards are the following:

- Dormant: Has the potential, but nothing currently can be affected. This modality is typified by the “volcano” scenario – a volcano that is no longer showing any signs of activity or imminent threat but is lying “dormant”. There is no immediate and pressing issue based on human perception.
- Armed: Has the potential, and something can be affected. This modality is given by a person holding a gun in the midst of a war or other aggressive situation. The gun has the potential to affect life, limb, or other vital function, but it is not yet doing so, although the intention is there
- Active: Currently on-going event (something is being affected). Finally, this is the modality that is actually affecting life, limb, or some other vital function. A volcano that is spewing, a gun that is being fired, a fire that is consuming a building, radiation that is leaking, etc. These are the situations that are causing harm.

Within these modalities of hazards, hazards can be further refined as to their types. The following types of hazards classify the threats to life:

- Physical: Condition or situations that cause the body physical harm, e.g., a bullet that is entering into a human being.
- Chemical: Substances that cause harm or damage to the body, property or the environment, e.g., liquid oxygen converting to gaseous oxygen within a closed container (bomb).
- Biological: Biological agents that cause harm to the body, e.g., anthrax bacteria.
- Psychological: Stress affecting the mental state, e.g., the knowledge that the trajectory of a five-mile wide asteroid coincides with earth.
- Radiation: Electromagnetic radiation that harms or damages biological organisms.

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