**Potential Health Hazards of Laboratory Chemicals**

* **Irritants** - cause inflammation (redness and swelling) of the skin or mucous membranes following immediate, prolonged, or repeated direct contact. Effects can be severe, but are generally reversible.
* **Corrosives** – generally cause visible damage (severe irritant) to skin, eyes, or the mucous membranes of the respiratory or gastrointestinal tract on contact. Can result in severe burns or blistering of the skin or impaired vision or blindness.
* **Asphyxiants** – take oxygen away from the body, a tissue or a cell, causing injury or death due to suffocation.
  + Simple (physical) asphyxiants - gases (CO, CO2, He, N and Ar) that displace oxygen.
  + Chemical asphyxiants – chemicals that reduce the body’s ability to absorb, transport, or utilize inhaled oxygen. CO decreases blood’s ability to carry oxygen to cells, while hydrogen sulphide and hydrogen cyanide interfere with the cell’s ability to use oxygen.
* **Primary Anaesthetics** – depresses central nervous system activity e.g. diethyl ether, hexane, etc. Signs and symptoms include headache, nausea, dizziness, and mental confusion, lack of muscle coordination, unconsciousness, and death.
* **Systemic Poisons** – chemicals that cause damage to targeted organs or tissues of the body including the lungs, liver, kidneys, and the nervous system.
* **Carcinogens** - cause cancer or increase the risk for development of cancer.
* **Reproductive Toxins** – mutagens (interfere with replication of genetic material, causing mutations in exposed cells) and teratogens (interfere with normal embryonic development and can lead to miscarriage or congenital defects).
* **Sensitizers** - cause an allergic reaction in normal tissue after repeated exposure to the chemical.
  + Skin – severe reaction can include redness, itching, swelling or hives.
  + Respiratory – severe asthmatic response, including coughing, wheezing, shortness of breath, chest pain, difficulty breathing and potentially, death.

**Factors to Consider When Assessing the Toxic Potential of laboratory Chemicals**

1. **Route of exposure** – main routes of exposure through which chemicals can come into contact with or enter the body. Some important considerations:
2. Chemicals are absorbed most rapidly by inhalation, resulting in higher potential doses and a greater likelihood of injury
3. Chemicals are absorbed more slowly through the skin and thus, for a similar exposure (quantity and time), less chemical tends to enter the body than for respiratory or gastrointestinal exposures
4. Ingestion exposures are more likely to cause harm than dermal exposures, but are less likely, overall, because skin is more exposed to chemicals
   1. **Inhalation -** chemicals that become airborne can be inhaled, including:
      1. Gases and vapors (the gaseous form of substances normally liquid or solid at room temperature) can reach the alveoli of the lung and readily enter the body. There is a high risk of acute toxicity because they can enter the blood directly.
      2. Aerosols are solid or liquid particles dispersed in a gaseous medium. Particle size determines the depth to which aerosols are deposited in the respiratory system; the smaller the particle size, the deeper into the lungs they can be deposited. Aerosols include dusts, fumes, smoke, fogs or mists and smog.
   2. **Skin Contact** – chemicals can cause direct effects at the point of contact or can be absorbed through the skin and cause systemic effects. More than 150 chemicals can be absorbed through the skin. Bruises, cuts and abrasions allow a chemical to be absorbed more readily
   3. **Ingestion** – this is the least common route of exposure, wherein the primary mechanisms are eating with contaminated hands or consuming contaminated food or drink.
   4. **Eye Contact** – typically through airborne dusts, mists, fumes, gases, or vapors or through splashing of liquids.
   5. **Injection** - by way of needles or broken glass that deposit chemicals through punctures in the skin.
5. **Length of Exposure (Duration/Frequency/Timing)**
   1. **Acute exposure** (short term exposure) – Usually a single exposure or repeated exposures over a short period of time (minutes, hours or days). Effect usually has a rapid onset and may include irritation, corrosion, central nervous system depression, or asphyxiation. Health effects are generally reversible.
   2. **Chronic exposure** (long-term exposure) – Continuous exposure or repeated exposures occurring over an extended period of time (months or years). Symptoms either take a long time to manifest themselves, or they manifest themselves rapidly and are long lasting. Health effects are often long lasting or permanent/irreversible (e.g. nerve damage, tumors, etc.).
      1. Chronic exposure is of greater concern when the chemical is able to accumulate in the body. The cumulative toxic effect, whether it is the same chemical or chemicals with similar target organs, is dependent on solubility (especially lipid solubility), metabolism and excretion.
6. **Local vs Systemic effect** - highly reactive chemicals are more likely to have local effects, whereas those that are less reactive are more likely to be absorbed and accumulate in target organs causing systemic health effects. Some chemicals have both local and systemic effects.
7. **Interactive effects with other chemicals** – toxic potential of a chemical can be influenced by the presence, or previous exposure (accumulation), of other chemicals depending on the interaction of the chemicals with respect to health effects.
   1. **Independent effect** – chemicals have toxicities independent of each other.
   2. **Additive effect** - the total effect is the sum of the two independent effects.
   3. **Synergistic effect** - the effect of two chemicals is greater than the expected additive effect.
   4. **Potentiating effect** (a form of synergistic effect)- one of the compounds is not toxic in itself but enhances the effect of another compound.
   5. **Antagonistic effect** - one compound opposes the effect of another
8. **Individual susceptibilities** – factors associated with individuals that modulate their response to a particular chemical. The toxic potential of a given chemical for an individual is influenced by:
   1. Genetics – most particularly related to the complement of enzymes available for an individual to metabolize or detoxify absorbed chemicals.
   2. Gender
   3. Age - in general, infants (undeveloped systems) and old people (poor immune system) are more sensitive to toxic chemicals
   4. Pregnancy
   5. Health condition
   6. Previous exposures - allergies or sensitivities
9. **Physical/chemical properties of a chemical**
   1. Phase:
      1. Solids:
         * Generally little risk, but can get adverse effects through contact (irritant or corrosive).
         * Smaller particles can become airborne (dusts) and can persist in the respiratory tract
         * May be solubilized by moisture on the skin or in the digestive tract leading to absorption
      2. Liquids:
         * Fluidity gives mobility and problems with containment
         * More readily converted to vapors or aerosols and present a greater risk for inhalation
         * Have the potential to dissolve other chemicals and enhance toxic effects.
      3. Gases:
         * Can have physical (asphyxiant) and chemical adverse effects.
   2. Solubility - influences reactivity, route of entry, metabolism, excretion and accumulation.
   3. Purity - impurities can have toxic effects alone or through interaction with the chemical.
   4. Boiling or vaporization point – influences volatility and flammability