Cryogenic liquids (e.g. nitrogen) are liquids at extremely low temperatures (<-150°C; liquid nitrogen boils at -196°C) that are used extensively in biological research. They present both physical and toxicological hazards to the researcher if not used correctly.

What are the potential hazards?

- **Explosion due to rapid gas expansion.** Liquid nitrogen that leaks into faulty or non-cryogenic storage vials will rapidly expand 700 times its liquid volume upon warming;

- **Asphyxiation from oxygen displacement.** As noted above, rapid expansion of nitrogen (from an open dewar or spill) in a poorly or non-ventilated room (e.g. cold room) will displace oxygen quickly;

- **Severe tissue damage or death (frostbite).** There are four degrees of frostbite severity (source: Wikipedia 2013):  
  - First degree – Often called “frostnip”, it only affects the surface of the skin (frozen). Itching and pain followed by numbness and development of white, red, and yellow patches are apparent. Deep layer skin is usually not affected though long-term insensitivity to both heat and cold can sometimes happen; 
  - Second degree – If freezing persists, the skin may freeze and harden, but the deep tissues are not affected and remain soft and normal. Second degree injury usually blisters 1–2 days after becoming frozen. The blisters may become hard and blackened. Most of the injuries heal in one month, but the area may become permanently insensitive to both heat and cold. Third and Fourth degrees – If the area freezes further, deep frostbite occurs. The muscles, tendons, blood vessels, and nerves all freeze. The skin is hard, feels waxy, and use of the area is lost temporarily, and in severe cases, permanently. The deep frostbite results in areas of purplish blisters which turn black and which are generally blood-filled. Nerve damage in the area can result in a loss of feeling. If left untreated, this extreme frostbite may result in fingers and toes falling off or being amputated if the area becomes infected with gangrene.

- **Condensation of oxygen.** An open dewar of liquid nitrogen in time will condense oxygen from air. Combustible materials that are exposed to liquid oxygen will burn more rapidly and aggressively.

How do I protect myself?

- Work with liquid nitrogen in a well-ventilated area. Never store open dewars of liquid nitrogen in cold rooms or confined spaces.

- Use storage vials that are suitable for cryogenic work such as polypropylene. Glass or polystyrene may crack.

- Wear appropriate personal protective equipment. Use a face shield in combination with splash goggles or safety glasses. NOTE: Safety glasses without side shields do not give adequate protection. Always wear loose-fitting cryo gloves when handling liquid nitrogen or materials that had contact with liquid nitrogen. The gloves may be thrown off quickly if liquid should splash into them. Canvas shoes and trousers with cuffs are not recommended since skin exposure to liquid nitrogen spill would be imminent.

- **ALWAYS** employ a retrieval device or tongs to recover items submerged in liquid nitrogen. Cryo gloves do not protect against liquid nitrogen penetration; they only protect against exposure to cold surfaces. NOTE: When removing racks, boxes, or any item from liquid nitrogen, allow excess fluid to drain back into the dewar. Place frozen racks or boxes on a lab bench away from the dewar before removing associated items to prevent accidental spillage back into the dewar. Allow tubes and cryovials to acclimate before handling since they may take on liquid nitrogen (see Potential Hazards).

For additional information, review the EH&S’ Standard Operating Procedure: Cryogenic Liquids available at the EH&S web page.