UQ Chemical Safety Training Module
UQ Chemical Safety Training

Course Overview:

• This training module has been developed for workers at the University of Queensland, and forms part of the OHS training program at UQ.
• This course focuses on chemical safety and aims to provide UQ workers with an understanding of the hazards associated with working with chemicals at the University.
• It also identifies the safety controls required to be implemented during study, work or research activities at the University to manage risks associated with the use, storage, transport, handling and disposal of dangerous goods and hazardous chemicals.
Chemicals - Introduction

• Chemicals have become part of our life, sustaining many of our activities, preventing and controlling diseases, and increasing productivity.
• Chemicals, if not used properly, endanger our health and safety and poison our environment.
• We must take chemical safety SERIOUSLY and EVERYONE who uses chemicals has the responsibility for their safety.
OHS Responsibilities

Supervisors/Principal Investigators:

• provide information, training and supervision to workers and students relevant to chemical usage
• ensure workers and students under their control understand how to work with chemicals safely
• ensure chemical risk assessments have been performed and controls are in place
• ensure workers and students have access to required resources and that they are used appropriately e.g. personal protective equipment and fume cupboards
• report any OHS problems to the Workplace Health and Safety Co-ordinator immediately.
OHS Responsibilities (continued) ...

Individuals need to:

- attend required safety training and/or induction that is provided
- follow any safe working procedures which have been adopted
- perform risk assessments for chemicals prior to use
- report any OHS problems to the supervisor immediately
- use appropriate personal protective equipment and safety systems as required

Refer UQ OHS website for additional information on your OHS responsibilities,
http://www.uq.edu.au/ohs/?page=133956
Chemicals can enter the body and harm us via the following routes of exposure:

- Inhalation (breathing in)
- Absorption (through skin or eyes)
- Needle-stick (injection)
- Ingestion (eating or swallowing)
WHERE do chemicals affect?

Chemicals in the body can be described by which part of the body they affect:

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>DEFINITION</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCAL</td>
<td>adverse effects to the particular tissue</td>
<td>• phenol can severely damage the skin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ammonia can irritate the respiratory tract</td>
</tr>
<tr>
<td>SYSTEMIC</td>
<td>adverse effects on one of the 12 systems of the body</td>
<td>• lead affects the nervous system, blood, kidneys</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• organophosphate pesticides may affect the nervous system</td>
</tr>
</tbody>
</table>
WHEN do chemicals affect the body?

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>DEFINITION</th>
<th>EXAMPLE</th>
</tr>
</thead>
</table>
| ACUTE    | short lasting and develop soon after an exposure                | • irritant gases immediately irritate the eyes  
• excessive exposure to organic solvents can induce narcotic effects such as headaches  
• death from high, short term exposure to carbon monoxide |
| CHRONIC  | long lasting and sometimes permanent. Onset may be soon after exposure or delayed | • Leukaemia from benzene exposure  
• reduced fertility from lead exposure |
The importance of DOSE

• Dose takes into consideration **HOW LONG** we are exposed to a chemical and at what **CONCENTRATION**

• For example, a very high concentration of alcohol for a short time might be lethal while intermittent exposure to smaller amounts does little harm

_All substances are poisons: there is none which is not a poison. The right dose differentiates a poison and a remedy (Paracelsus: 1493-1541)_
Pregnancy and chemicals

- Transfer across the placenta of a pregnant woman to the unborn baby
- Although most people prefer to wait until the end of the first trimester before announcing their pregnancy, it is highly recommended that you consult advice from the OHS Unit and / or your supervisor to ensure the activities do not affect your unborn baby.
- Exposure to teratogens (chemicals that affect your baby in utero) in the first trimester is the most vulnerable time in the pregnancy and can lead to structural abnormalities or miscarriage.
Pregnancy and chemicals (continued) ...

- **A risk assessment** for all tasks involving reproductive hazards or teratogens must be completed and up to date.
- Safety Data Sheets will aid in the completion of risk assessments, paying attention to risk statements that may state ‘teratogenic or reproductive’ health effects are likely.
- More information can be found within the UQ “[Working Safely with Reproductive Hazards](#)” guideline.
Legislation for chemicals

When using chemicals for work or research activities, the following legislation applies:

- “Work Health and Safety Act 2011”
- “Work Health and Safety Regulation 2011”
  - Chapter 7: Hazardous Chemicals

- Codes of Practice, e.g.
  - “Preparation of Safety Data Sheets for Hazardous Chemicals”
  - “Labelling of Workplace Hazardous Chemicals”
Classification of chemicals

For the purposes of Qld WHS regulations, a hazardous chemical is a:

• substance, mixture or article that satisfies the classification criteria of one or more hazard classes within the Globally Harmonised System (GHS) of Classification and Labelling of chemicals, or

• a dangerous good under the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code)

Chemicals may also be scheduled in the Qld Health (Drugs and Poisons) Regulation as controlled drugs, poisons or restricted drugs. A safety data sheet will indicate whether a chemical has a drug schedule. Further information can be found at Queensland Health.
Hazard Pictograms & Dangerous Goods Class Labels

The Globally Harmonised System (GHS) of Classification and Labelling of Chemicals is mandatory from 1 January, 2017.

There are 9 hazard pictograms in the GHS which represent the physical, health and environmental hazards.

Do I use Hazard Pictograms or DG Class Labels?
- All decanted substances should have GHS hazard pictograms on label
- All transported substances (e.g. air, road, rail) must have DG Class Labels

Users of chemicals must ensure they understand the meaning and use of the GHS Hazard Pictograms and the DG Class labels.
Comparison of hazard pictograms from the GHS & the corresponding ADG Code class labels ...

<table>
<thead>
<tr>
<th>Hazard Pictograms</th>
<th>GHS Hazard</th>
<th>Dangerous Goods class labels (pictograms)</th>
<th>Dangerous goods classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image" alt="Explosives Self-reactives Organic peroxides" /></td>
<td>Explosives Self-reactives Organic peroxides</td>
<td><img src="Image" alt="Explosive 1.4 Explosive 1.5 Explosive 1.6 Explosive" /></td>
<td>Explosive</td>
</tr>
</tbody>
</table>
| ![Flammables Self-reactives Pyrophorics Self-heating Emits flammable gas in contact with water Organic peroxides](Image) | Flammables Self-reactives Pyrophorics Self-heating Emits flammable gas in contact with water Organic peroxides | ![Flammable Liquid Flammable Solid Spontaneously Combustible Dangerous When Wet](Image) | Flammability (Liquid, Solid or Gas)  
Pyrophoric  
Emits Flammable Gas  
Organic Peroxide |
Comparison of hazard pictograms from the GHS & the corresponding ADG Code class labels (continued) ...

<table>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oxidisers</td>
<td>Oxidising Agent 5.1, Oxidising Gas 2</td>
<td>Oxidiser, Oxidising gas</td>
</tr>
<tr>
<td></td>
<td>Gases under pressure</td>
<td>Non-flammable Gas 2, Flammable Gas 2, Oxidising Gas 2, Toxic Gas 2</td>
<td>Non-toxic non-flammable gas, flammable gas, oxidising gas, toxic gas</td>
</tr>
</tbody>
</table>

...
Comparison of hazard pictograms from the GHS & the corresponding ADG Code class labels (continued) ...

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<th>Dangerous Goods class labels (pictograms)</th>
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</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Acute toxicity" /></td>
<td>Acute toxicity</td>
<td><img src="image" alt="Acute toxicity" /> <img src="image" alt="Acute Toxic gas" /></td>
<td>Acute toxicity, Acute Toxic gas</td>
</tr>
<tr>
<td><img src="image" alt="Skin irritants" /></td>
<td>Acute toxicity Skin irritants Eye irritants Skin sensitisers</td>
<td><img src="image" alt="No equivalent" /></td>
<td>No equivalent</td>
</tr>
</tbody>
</table>


Comparison of hazard pictograms from the GHS & the corresponding ADG Code class labels (continued) ...

<table>
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<tr>
<th>Hazard Pictograms</th>
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<th>Dangerous goods classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Carcinogens pictogram" /></td>
<td>Carcinogens&lt;br&gt;Respiratory sensitisers&lt;br&gt;Reproductive toxicants&lt;br&gt;Target organ toxicants&lt;br&gt;Germ cell mutagens</td>
<td>No equivalent</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Eye corrosion pictogram" /></td>
<td>Eye corrosion&lt;br&gt;Skin corrosion&lt;br&gt;Corrosive to metal</td>
<td><img src="image" alt="Corrosive pictogram" /></td>
<td>Corrosive to metals</td>
</tr>
</tbody>
</table>
Comparison of hazard pictograms from the GHS & the corresponding ADG Code class labels (continued) ...

<table>
<thead>
<tr>
<th>Hazard Pictograms</th>
<th>GHS Hazard</th>
<th>Dangerous Goods class labels (pictograms)</th>
<th>Dangerous goods classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aquatic toxicity. Not covered within the scope of workplace hazardous chemicals requirements</td>
<td></td>
<td>Environmental hazard</td>
</tr>
<tr>
<td>No equivalent hazard pictogram</td>
<td></td>
<td></td>
<td>Miscellaneous dangerous goods</td>
</tr>
</tbody>
</table>
Comparison of hazard pictograms from the GHS & the corresponding ADG Code class labels (continued) ...

<table>
<thead>
<tr>
<th>Hazard Pictograms</th>
<th>GHS Hazard</th>
<th>Dangerous Goods class labels (pictograms)</th>
<th>Dangerous goods classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not covered within the scope of workplace hazardous chemicals requirements</td>
<td><img src="image" alt="Infectious Substance" /></td>
<td><img src="image" alt="Infectious Substance" /></td>
<td>Infectious</td>
</tr>
<tr>
<td>Not covered within the scope of workplace hazardous chemicals requirements</td>
<td><img src="image" alt="Radioactive Substance" /></td>
<td><img src="image" alt="Radioactive Substance" /></td>
<td>Radioactive</td>
</tr>
</tbody>
</table>

Reference:
Safe Work Australia “Labelling of Workplace Hazardous Chemicals Code of Practice”
Chemical properties

Chemicals can be categorised and defined by the substances properties.

**Packaging group** – for packing purposes, some substances are assigned to one of three packaging groups based on the degree of danger they present.

<table>
<thead>
<tr>
<th>Packaging group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging Group I</td>
<td>High danger e.g. diethyl ether</td>
</tr>
<tr>
<td>Packaging Group II</td>
<td>Medium danger e.g. xylene</td>
</tr>
<tr>
<td>Packaging Group III</td>
<td>Low danger e.g. kerosene</td>
</tr>
</tbody>
</table>
Chemical properties (continued) ...

**Volvatility of liquids** – used to describe how readily a substance vaporises. For processes carried out at room temperature.

<table>
<thead>
<tr>
<th>Level of volatility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low volatility</td>
<td>those with a boiling point (BP) &gt; 150°C</td>
</tr>
<tr>
<td>Medium volatility</td>
<td>BP between 50-150°C</td>
</tr>
<tr>
<td>High volatility</td>
<td>those substances with a BP below 50°C</td>
</tr>
</tbody>
</table>
Chemical properties (continued) ...

Flash point – the lowest temperature where it will evaporate enough fluid to form a combustible concentration of gas.

- An open flame is not always necessary to ignite the gas.
- These chemicals present a notable fire risk which must be taken into account when planning work involving them.

<table>
<thead>
<tr>
<th>e.g. Chemical</th>
<th>Flash Point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>-18</td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>6</td>
</tr>
<tr>
<td>Benzene</td>
<td>11</td>
</tr>
<tr>
<td>Carbon disulfide</td>
<td>-30</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>-20</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>-45</td>
</tr>
<tr>
<td>Ethanol</td>
<td>12</td>
</tr>
<tr>
<td>Hexane</td>
<td>-23</td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
<td>-17</td>
</tr>
<tr>
<td>Vinyl acetate</td>
<td>-8</td>
</tr>
</tbody>
</table>
Chemical properties (continued) ...

**Oxidising agents** – agents that bring about an oxidation reaction.

Fire or explosion is possible when strong oxidising agents come into contact with compounds such as metals, metal hydrides or organics.

<table>
<thead>
<tr>
<th>Gases</th>
<th>Liquids</th>
<th>Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>Nitric acid</td>
<td>Nitrites</td>
</tr>
<tr>
<td>Ozone</td>
<td>Perchloric acid</td>
<td>Perchlorates</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Sulphuric acid</td>
<td>Permanganates</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Hydrogen peroxide</td>
<td>bromates</td>
</tr>
</tbody>
</table>
How do I get more information about how to use chemicals safely?

To obtain more information about the chemicals you are using, you should:

• Talk to your supervisor/lab manager
• Read the **safety data sheet, label** and/or **risk assessment** (if already available) for the chemical/s you are working with
• Attend **training** run at the university locally in your area or through the OHS Division
• Contact your local WHSC (Work Health & Safety Coordinator)
• Obtain information from the OHS Division website, [http://www.uq.edu.au/ohs/](http://www.uq.edu.au/ohs/)
Information and advice on chemical management and safety

Contact your Workplace Health and Safety Coordinator or the UQ OHS Division

Email: ohs@uq.edu.au  
Phone: 336-52365  
Location: Building 69 Level 6, Room 603  
           St Lucia Campus
Hazardous chemicals requirements
When using hazardous chemicals at UQ, you must:
• obtain a manufacturer’s Material Safety Data Sheet for the chemicals being used and stored
• ensure the container is labelled
• conduct risk assessments for its use and storage
• conduct air monitoring and/or health surveillance, if necessary or required
• maintain a manifest of hazardous chemicals
• provide induction and training to all users
• dispose of chemical waste in accordance with the University EMS Guideline “Waste Management Program”
• ensure emergency procedures are in place for using these chemicals i.e. emergency response and spill management.
Material Safety Data Sheets (MSDS)

A Material Safety Data Sheet (MSDS) is a chemical information sheet provided by the manufacturer or supplier of chemicals

- It describes the identity, properties, uses, precautions for use and safe handling procedures of a hazardous chemical
- A Material Safety Data Sheet must be readily available at each location where the chemical is used.
- Access to Material Safety Data Sheets (as well as labels) at UQ is via Chemwatch,
Labels

All chemical packages, containers, tanks or bulk stores must be clearly labelled with the following information:

- The **product identifier**
- Proper **shipping name** and **UN number** (if chemical is dangerous goods)
- The **contact details of manufacturer** or importer
- Identity and proportion of each **ingredient**
- Any **hazard pictogram** (see examples on next slide) or a **dangerous goods class label** (for transport)
- Any **hazard statement**, **signal word** and **precautionary statement**
- Any information about the **hazards**, **first aid** and **emergency procedures**
- Expiry date
Decanted substances - Label

When a substance is decanted from the original container and not used immediately (or given to someone else), the decanted container must have a label which states:

- the **product identifier** (name)
- hazard **pictogram** or **hazard statement**

If you print your labels from Chemwatch, you can be assured that you are meeting the current legislative requirements,

Decanted substances

GOOD labelling

POOR labelling
Labels for time sensitive chemicals

*Time sensitive chemicals* are those chemicals that, when stored for prolonged periods or under poor storage conditions, can develop hazards that were not present in the original formulation e.g. picric acid, chloroform, isopropyl ether

- **peroxide-forming chemicals** must be labelled with:
  - Date received/opened and date to be disposed
General principles for storage

• Packages must be inspected regularly to ensure their integrity and seal. Leaking or damaged packages must be removed to a safe area for repacking or disposal.

• Incompatible chemicals must be kept from one another

• All containers must be labelled to clearly identify the contents of the package.

• Hazard zoning assessments may be required for new laboratories or may already be in place, in accordance with the provisions of AS 60079 (Explosive Atmospheres)
General principles for storage (continued) ...

• Ensure that chemical stores are well ventilated to prevent odours and flammable/toxic vapours being present

• The quantities of hazardous chemicals must be kept to a minimum

• Regularly review the chemicals held in storage and correctly dispose of those no longer required following the UQ chemical waste disposal procedures,

• Sunlight can affect some plastic containers or the chemical contents. Containers or chemicals that can be affected must not be stored in areas where they can be exposed to direct sunlight
General principles for storage (continued) ...

- Substances which are unstable at ambient temperature must be kept in a controlled temperature environment. Reliable alternative safety measures must be provided for situations when utilities, such as power, fail e.g. -80 freezers.
- Use containers supplied by the manufacturer and store them upright. Liquid hypochlorite decomposes to oxygen and salt. Must have gas vent cap.
- Substances that can present additional hazards on heating must be clearly identified.
- Pre-planned procedures must be established to deal with clean up and safe disposal of spillages.
Examples of POOR chemical storage
Examples of GOOD chemical storage
Open bench storage

- **AS2243.10 – Safety in Laboratories: Storage of Chemicals**, specifies the maximum quantities of chemicals that are permitted to be stored in a laboratory, other than in a chemical storage cabinet (i.e. open bench storage).
- These limits should be followed as closely as possible, and quantities in excess of these levels should be stored in a dedicated storage cabinet.

Additional information

### Open bench storage – limits (AS2243.10)

<table>
<thead>
<tr>
<th>DG Class</th>
<th>Class of Dangerous Goods</th>
<th>Maximum per 50m$^2$ (kg or L)</th>
<th>Maximum pack size (kg or L)</th>
<th>Alternative storage options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 3</td>
<td></td>
<td>10</td>
<td>5</td>
<td>AS 1940 or AS3833</td>
</tr>
<tr>
<td>Combustible liquids</td>
<td></td>
<td>50</td>
<td>20</td>
<td>AS 1940 or AS3833</td>
</tr>
<tr>
<td>Classes 4.1, 4.2, 4.3, 5.1 or 5.2</td>
<td></td>
<td>20 but &lt;10 of any one class</td>
<td>10</td>
<td>AS2714 or AS3833</td>
</tr>
<tr>
<td>Class 6.1</td>
<td>PGI – 10 Other - 50</td>
<td>PGI – 10 Other - 20</td>
<td></td>
<td>AS 4452 or AS3833</td>
</tr>
<tr>
<td>Class 8</td>
<td>20 – liquids 100 - solids</td>
<td>20</td>
<td></td>
<td>AS 3780 or AS3833</td>
</tr>
<tr>
<td>Class 9 and aerosols</td>
<td></td>
<td>50 – liquids 100 - solids</td>
<td>5 – liquids 20 – solids</td>
<td>AS 4681 or AS3833</td>
</tr>
<tr>
<td>Maximum aggregate quantity</td>
<td></td>
<td>200</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
Flammable liquids storage at UQ

• Within a **radius of 10m**, measured from any Class 3 flammable liquid cabinet, the combined storage capacity for all DG cabinets in that radius **shall not exceed 250L or 250kg**.

• When storing flammable substances, the **contents of the cabinet shall not exceed 100L**.

• If a 250L cabinet is used, it must be **de-rated**. This involves removing some of the shelving and placing a sticker over the manufacturer’s capacity rating, so that it is clear that 100L is the maximum cabinet capacity

• All new installations of flammable solvent cabinets should be mechanically vented if possible
Chemical storage in cabinets

- **DO NOT** store chemicals in the bund of storage cabinets
- The capacity of any chemical storage cabinet used in a laboratory to store chemicals of classes 4.1, 4.2, 4.3, 5.1 or 5.2 shall not exceed 50L
- Cabinets shall not be located:
  - One above the other
  - Where they can jeopardize emergency escape (minimum 3m)
  - Under stairs or in corridors
- The spill catchment/bund of cabinets must not be used to store chemicals
- Where possible, store chemicals on spill trays within cupboards or cabinets
Chemical storage in fridges

- Chemicals must be stored in a safe manner to avoid fridge corrosion and damage i.e. use trays under liquid chemicals.
- Fridges used to store flammable liquids (Class 3) MUST be university approved spark-free fridges. There have been several major incidents following explosions inside unsuitable fridges.
- All laboratory fridges must be labelled with one of the following:
  - Approved spark free fridges: CLASS 3 FLAMMABLE LIQUIDS.
  - All other fridges: NO FLAMMABLE LIQUIDS IN THIS FRIDGE.
- **Modifying domestic fridges is NOT permitted at UQ**
Chemical storage in fridges

GOOD Storage

POOR Storage
Separation of Incompatible Chemicals in the Lab - a Practical Guide

• Segregation Charts list chemical classes that must be separated from each other by distance and structure. These are for large scale facilities, or apply to transport by road and rail.

• In research and teaching labs it is not necessary to segregate because of the small quantities stored, or practical because of space limitations.

• For solid chemicals in 500g plastic bottles, if the containers are in good condition then that is adequate separation. Liquids are more problematic, especially acids that may be incompatible even in the same DG class. In such cases storage within trays of the principal storage area will be adequate to provide protection against leakage and mixing of incompatible chemicals.

• Seek advice from an Occupational Hygiene Advisor for larger scale chemical storage if you have incompatibility concerns
Carcinogens

• If you are working with carcinogens, you must follow the UQ Carcinogens Safety Policy and Guideline. https://ppl.app.uq.edu.au/content/2.70.10-carcinogens-safety

• Carcinogen clearance is a requirement of research grant application for the ARC and the NHMRC granting bodies if research falls within IARC category 1, category 2A and category 2B carcinogens.

• Refer to the following link for detailed information on classifications,
  - http://monographs.iarc.fr/ENG/Classification/
Obtaining chemicals

Before chemicals are ordered, the following questions should be considered:

- What is the least hazardous chemical available that can be used?
- What is the minimum quantity needed to complete the experiment or job?
- Is the chemical already available? Check your chemical inventory.
- How should the chemical be stored?
- Where will the chemical be stored?
- Is the work area equipped to handle a spill?
- Are personnel trained on how to safely handle the chemical?
- How will waste be disposed of?
**Purchasing chemicals**

- All hazardous chemicals must be purchased via the [UQeMarket website](http://www.uq.edu.au/ohs/wps/portal/ohs/Purchasing)
- University credit cards must **not** be used to purchase chemicals

- University Purchasing Policy 9.40.01,
  - [http://ppl.app.uq.edu.au/content/9.40.01-purchasing](http://ppl.app.uq.edu.au/content/9.40.01-purchasing)

- Contact for additional information,
  - [uqemarket@uq.edu.au](mailto:uqemarket@uq.edu.au)
Chemical Waste

• Chemical waste will either be sewerable (go down the sink), or require collection.

• Any chemicals discharged to sewer must meet the relevant trade waste sewer acceptance criteria. General requirements:
  – Waste must be miscible (soluble) with water
  – Waste **must not** be TOXIC (DG 6) or hazardous to aquatic, marine and terrestrial life and environments (refer to SDS)
  – Waste **must not** be FLAMMABLE (DG3) at the point of being sewered (refer to SDS)
  – Waste solutions must be within a pH range of 6 to 10

• For further information refer to [UQ Chemical Waste Operating Procedure](http://www.uq.edu.au/ohs/).
Collection of chemical waste

- The University offers free chemical waste disposal for the majority of staff and researchers when certain procedures are followed.
- White, 5 litre capacity or other appropriate ‘dangerous goods grade’ labelled containers, will be provided on request from the University Chemical Store,
  - [http://www.science.uq.edu.au/facilities/content/uq-science-store](http://www.science.uq.edu.au/facilities/content/uq-science-store)
- **Do not mix** chemical waste from different processes even if they are of similar properties. The waste disposal contractor will assess which wastes may be combined and will perform this task.
Gas Cylinders

- All Gas cylinders must be restrained with a suitable chain.
- When moving gas cylinders, always use a trolley that has been made for cylinders.
- Never move a gas cylinder with the regulator attached.
- Always use a regulator that is suitable for the gas being used.
- Close the valves of any cylinders that are not in use.
- If you are working with compressed gases, you should complete the on-line training module for gas safety.
Gas cylinder storage

GOOD Storage

POOR Storage
Register of chemicals

• The regulations require the University to keep an inventory of all chemicals.

• The benefits are:
  – It enables generation of emergency services manifest (for dangerous goods)
  – Stock control (rationalise supply, minimise costs)
  – Alerts staff and students to chemicals present in their workplace
Risk assessment of chemicals

• All chemicals must be assessed for the health and safety risks associated with their use, handling, storage and disposal

• A process should not commence without this risk assessment being completed and approved by your supervisor

• Risk Assessments at UQ are completed online via: UQSafe – Risk database
Chemical Emergencies

In the case of an emergency (e.g. major chemical spill, fire, explosion, gas release) call:

**On Campus ... UQ Security ... Phone: 336-53333**
(or equivalent local Security)

**Triple Zero (000)**
for Australian Emergency Services
(fire, police, ambulance)

UQ Security is available on the major UQ Campuses:

- 24 hours a day
- 7 days a week
- 365 days a year
Safety and Emergency Procedures

- Know the location of and how to use the cut-off switches and valves for the water, gas, and electricity
- Know the location of and how to use all safety and emergency equipment (i.e., safety shower, eyewash, first-aid kit, fire blanket, fire extinguishers)
- Be prepared by having correct spill kits in appropriate locations, and have trained staff prepared to respond to an emergency situation
- Keep a list of emergency phone numbers near the phone
- Should your risk assessment identify a need for a specific response e.g. working with mercury, cyanide, hydrogen fluoride or phenol, appropriate antidotes and clean-up equipment must be available and up to date.
Chemical first aid

If your skin or eyes have come into contact with hazardous material, they must be thoroughly washed for a minimum of 20 minutes.

- When using emergency showers and eye-washes you must consider the following:
  - flush the area with large amounts of fresh clean water for 20 minutes
  - take off contaminated clothing
  - DO NOT use soap or detergent unless stated on the SDS
  - obtain further medical treatment for all eye splashes
  - obtain further medical treatment for skin splashes if:
    - irritation persists
    - damage is apparent
    - the safety data sheet tells you to
Controlling chemical hazards

When controlling chemical hazards, the hierarchy of control should be followed:

- **Elimination** of the chemical/process
- **Substitution** of chemical or process e.g. asbestos with glass wool, benzene with xylene, using pellets instead of powder, changing from a dry process to wet, dipping instead of spraying
- **Engineering (ventilation)** e.g. fumehoods, canopy hoods, filtration systems
- **Engineering (isolation)** e.g. a glove box for handling toxics, remote controls, performing certain work after hours
- **Administrative** e.g. modifying work schedules, air monitoring, training, work methods, signage, health surveillance
- **Personal Protective Equipment** e.g. gloves, respirators, goggles, lab coats, enclosed footwear
Personal protective equipment - EYES

- Always protect your eyes – Safety glasses with side shields, splash goggles and full face shield offer varying degrees of protection against chemicals
- Safety glasses may be adequate where the potential splash is minimal e.g. opening eppendorf tubes, or where the chemicals in use are of low toxicity
- Safety goggles should be worn when you are dealing with a chemical that is highly caustic or in larger volumes. For example, goggles should be worn when working with glassware under reduced or elevated pressure and when glass apparatus is used in combustion or other high temperature operations
- Faceshields should be worn when you are working with large volumes or working with chemicals that are very corrosive or toxic e.g. liquid nitrogen, hydrofluoric acid
**Personal Protective Equipment - SKIN**

- Wearing gloves is a simple and effective way to protect yourself against chemicals but YOU must choose the correct glove.
- No glove material is impermeable to all chemicals
- Change gloves regularly and whenever they are contaminated
- Chemical glove compatibility indexes are available to assist with your choice of gloves, e.g. [http://www.ansellasiapacific.com/chemical-glove-guide](http://www.ansellasiapacific.com/chemical-glove-guide)
- Lab coats provide protection for your clothing and skin against minor chemical splashes and are required in most UQ laboratories
- Where there is a high risk of splash or skin contamination disposable coveralls may be needed
Respirators - LUNGS

- Respirators may also be necessary for some jobs where the contaminant cannot be eliminated, substituted, controlled by ventilation or by other means.
- Like gloves, the selection of a respirator is specific to the chemical and not one respirator suits every purpose.
- Respirators need to be fitted to the wearer to ensure correct sizing and contact seal is maintained.
- For situations where a respirator is required, contact the Occupational Health and Safety Division for further information.
Exposure limits

• Exposure limits are intended to protect workers from excessive exposure to hazardous substances

• Generally defined in three different ways
  – Ceiling Limit (C): the concentration that must not be exceeded at any part of the workday
  – Short Term Exposure Limit (STEL): the maximum concentration to which workers may be exposed for a short period of time (15 minutes)
  – Time Weighted Average (TWA): the average concentration to which workers may be exposed for a normal, 8-hour workday

• The Safety Data Sheet will indicate if and what the exposure limit for the substance is.
Evaluating Toxicity Data

- Most estimates of human toxicity are based on animal studies, which may or may not relate to human toxicity. In most animal studies, the effect measured is usually death. This measure of toxicity is often expressed as an LD50 – the dose required to kill 50% of the test population. The LD50 is usually measured in milligrams of the material per kilogram of body weight of the test animal. The concentration in air that kills half of the population is the LC50.

- To estimate a lethal dose for a human based on animal tests, the LD50 must be multiplied by the weight of an average person. Using this method, it is evident that just a few drops of a highly toxic substance, such as dioxin, may be lethal, while much larger quantities of a slightly toxic substance, such as acetone, would be necessary for the same effect.

- The Safety Data sheet often refers to the LD50 or LC50
Air monitoring

- Air monitoring may be required as part of the risk assessment (where it is necessary to obtain a quantitative estimate of exposure), or to determine the effectiveness of engineering controls
- The results of air monitoring are then compared to the relevant workplace exposure standards
- Air monitoring can be performed by an OHS Division Occupational Hygiene Advisor
  - Rob Alcock. Email: r.alcock@uq.edu.au
Health surveillance

Health surveillance is required to be performed if workers are at risk of *significant* exposure to any hazardous chemical. The following substances require health surveillance under QLD WHS legislation:

- MOCA, Acrylonitrile, Asbestos, Benzene, Cadmium, Creosote, Crystalline Silica, Inorganic Arsenic, Inorganic Chromium, Inorganic Mercury, Isocyanates, Organophosphate Pesticides, Lead, Polycyclic Aromatic Hydrocarbons (PAH), Pentachlorophenol (PCP), Vinyl Chloride, Thallium
- Restricted and Prohibited Carcinogens

Contact the Occupational Health Nurse Adviser for more information
  - Fiona Coulthard. Email: f.couthard@uq.edu.au
Chemicals of high risk

At the university, several groups work with a range of chemicals that are considered more dangerous than usual and require additional safety controls to be implemented. IE do not work in isolation or after hours.

These are covered in the final slides:

– Cryogenics
– Highly reactive chemicals
– Toxic chemicals
– Corrosive chemicals
– Unstable chemicals
– Oxidising chemicals

Cryogenics

Liquid nitrogen, liquid argon, liquid helium and liquid carbon dioxide are commonly used at the University

• The hazards associated with cryogenic fluids include:
  – Asphyxiation due to the displacement of oxygen in the air we breathe
  – Combustion and explosion hazards
  – Cold burns and frost bite

• Controls which should be in place include:
  – Appropriate ventilation
  – Suitable footwear, full face shield, cryogenic gloves
  – Low oxygen alarms
  – Appropriate storage and decanting areas
  – Training of all persons using cryogenic liquids

• Further information is contained in the UQ Guideline,
  – “Working Safely with Liquid Nitrogen and Dry Ice”

Do you need to complete the Cryogen Safety online training module?
Highly reactive chemicals

• There are a range of highly reactive chemicals which people work with at UQ, e.g.
  – Sodium amide reacts violently with water forming ammonia and sodium hydroxide and becomes unstable in air
  – Bromine and chlorine can form explosive mixtures with hydrogen and volatile hydrocarbons. Fluorine is also highly reactive with a range of substances
  – Sodium and potassium react explosively with water and are readily oxidised in air (should be stored under paraffin oil)
  – Powdered metals e.g. magnesium, aluminium, zinc and iron are easily ignited and will burn vigorously
  – Trimethylaluminium is spontaneously flammable
  – Butyl lithium and other organolithium compounds are extremely reactive (a student was fatally injured using t-butyl lithium at UCLA in 2010)
  – Metal phosphides in air liberate very toxic phosphine gas
  – When mixed with combustible materials, chlorates and nitrates can form friction-sensitive explosive mixtures e.g. potassium chlorate mixed with sulfur

• The appropriate storage and handling of these chemicals must be planned for prior to commencing work and included in your risk assessment
Toxic chemicals

• Toxic chemicals if not used in a controlled manner can lead to short and long term health effects.
  – Examples of these include:
    • aniline, benzene, bromine, carbon monoxide, carbon disulfide, chlorinated hydrocarbons, nickel carbonyl, chromium compounds, cyanides, ethidium bromide, formaldehyde, hydrofluoric (HF) acid, lead salts, mercury, nitrobenzene, phenol, pyridine, sulfur dioxide, thallium

• Suitable first aid measures should also be in place for these chemicals, for example:
  • glycerol should be used to treat phenol burns
  • calcium gluconate should be used to treat HF burns
  • dicobalt edetate should be used to treat cyanide poisoning (note: this antidote is administered by a paramedic not by first aider)
Corrosive chemicals

- Strong acids and bases can lead to corrosive effects not only to the skin and eyes but to the respiratory tract through inhalation and gastrointestinal tract through ingestion. Many of these substances generate heat, produce toxic gases or react violently in contact with liquids or water. Risk assessments should identify this.

- Examples of strong acids:
  - Hydrochloric acid, nitric acid, sulfuric acid, oleum, chromic acid, perchloric acid

- Examples of strong bases:
  - sodium hydroxide, pottasium hydroxide, calcium oxide, ammonia

- Examples of halides:
  - boron trichloride, boron tribromide, silicon tetrachloride, aluminium chloride
Unstable substances

Unstable substances have been known to form explosive peroxides or mixtures.

- Examples include:
  - acetylene reacts with salts of silver and copper to form acetylides (touch sensitive detonators)
  - the use of sodium azide in any chemical procedures may lead to an explosive azide
  - azo and diazo compounds, chlorates and perchlorates are dangerously unstable
  - some ethers, dioxane and tetrahydrofuran are prone to aerial oxidation producing peroxides and are likely to explode (partially filled bottle of ether should not be kept for long periods)
  - highly nitrated organic compounds (nitro-compound, picric acid, trinitrobenzene) are potentially explosive but are safe if kept damp and stored in a dry, cool place
  - concentrated hydrogen peroxide should be handled with care. If contaminated with organic or particulate matter it may decompose uncontrollably resulting in intense heat, fire or explosion.
Assessment

• You have now completed the University of Queensland Chemical Safety Training module.
• If you would like to revise any of the topics covered before you begin the assessment, please use the quick find index to navigate to a particular topic.
• You will be asked a set of randomly selected questions.
• The pass mark is 80%.
• You may repeat the test as many times as you require. Each time you attempt the assessment, you will be presented with a different set of questions.
Assessment Location

You can return to eLearning@UQ (Blackboard) at any time to complete the assessment.

OR

You can complete the assessment now by selecting this link:

[ Start Assessment ]