LPP - Syllabus Outline

- Section 1. Laboratory Safety
- Section 2. Units of Measurement
- Section 3 . Hazards in the Laboratory
- Section 4. Moles, Molarity and Solution Preparation
- Section 5. Storage & Disposal of Reagents
- Section 6. Laboratory Equipment

Books

- Lab Math: A Handbook of Measurements, Calculations, and Other Quantitative Skills for Use at the Bench - Dany Spencer
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- At the Bench: A Laboratory Navigator - Kathy Barker
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- Handbook of Laboratory Safety - A. Keith Furr
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- Chemical Safety in the Laboratory – Stephen K. Hall

Laboratory Safety

- *EU Safety and Health Authority:*

  http://osha.europa.eu/en

- ✓ *Irish Health and Safety Authority (hsa).*

  http://www.hsa.ie

- ✓ Objectives of hsa:
- ensure safe and healthy working conditions
- research in the field of occupational safety and health
- provide training programmes
- enforcement programmes

General laboratory conduct and basic precautions

1. Never run in the laboratory or along corridors.
2. Never behave in a way that could distract or startle others who are working in the lab.
3. Always exercise care when opening and closing doors on entering or leaving a room.
4. Ensure that your footwear is sensible and adequate for the laboratory. Open-toed shoes and sandals are not acceptable as they give limited protection against injury.
5. Long hair should be tied back out of harm's way. Similar attention must be paid to ties and jewelry such as pendants, necklaces and bracelets.

General laboratory conduct and Safety Precautions

1. Make sure that you know the emergency procedures and emergency exit routes applicable to all the areas of the college in which you work. Evacuation procedures are posted on the inside of the door to every laboratory.
2. Ensure that doorways and emergency exits are not obstructed stools, etc.
3. Ensure that you understand and obey all the safety signs the laboratory.
4. If you sustain an injury in the laboratory report to the demonstrator in charge of the laboratory immediately and seek first aid as required before going to the Health Centre.

General laboratory housekeeping

- The work bench should always be kept clean, and free from chemicals and apparatus which are not required.

1. Clean up as you go along, i.e. after each stage of an experiment. Ensure that the equipment that you have used during their experiment is left as required afterwards.
2. Reagent bottles should always be cleaned if the contents have been spilled down the sides.
3. All equipment not in use should be returned to its proper storage place, in a clean and working condition.
4. Laboratory reagents and chemicals should be placed on the appropriate shelves immediately after use, with their labels to the front.

General laboratory housekeeping

- All spillages on the bench or floor should be reported to the demonstrator and mopped up immediately.
  - There is a correct clean up and disposal procedures that takes into account the nature of the material spilled.
- Use laboratory equipment only for its designed purpose.
- Use the proper type of personal protective equipment (PPE)

Workplace Personal Hygiene

DON'T

1. **Eat drink, smoke, chew gum, apply makeup in a lab**
2. **Drink from any water source inside the lab**
3. **Drink from lab glassware**
4. **Sniff or taste chemicals**

Workplace Personal Hygiene

DO

1. **Always wash your hands thoroughly before leaving the laboratory**
   - **Always wash your hands before eating, drinking, smoking or applying make-up**
2. **Remove contaminated clothing immediately**
3. **Leave your lab coat behind in the lab when you are going out for a break**

- **Wear appropriate PPE AT ALL TIMES**

What is PPE?

What is PPE: Personal Protective Equipment

Equipment worn by an individual (student, technician, employee etc.) that is designed to prevent injury or illness from a specific hazard.

Notice from Handbook:

"Students must wear their own safety glasses and lab coat to every laboratory session. Students without the proper equipment will not be permitted in the laboratory. Gloves and additional safety equipment will be provided by the college where necessary"

Safety Glasses

- Safety glasses provide only the minimum protection from unexpected hazards.
- Safety glasses are not an adequate substitute for goggles or full-face visors when doing work which is known to be dangerous or the additional protection is recommended by experts.
- Safety visors afford extra protection to the eyes and face when carrying out a potentially hazardous operation such as working with alkali metals, metal hydrides, strong corrosives etc.

Eye protection

Safety Glasses

- ✓ For light-to-moderate work

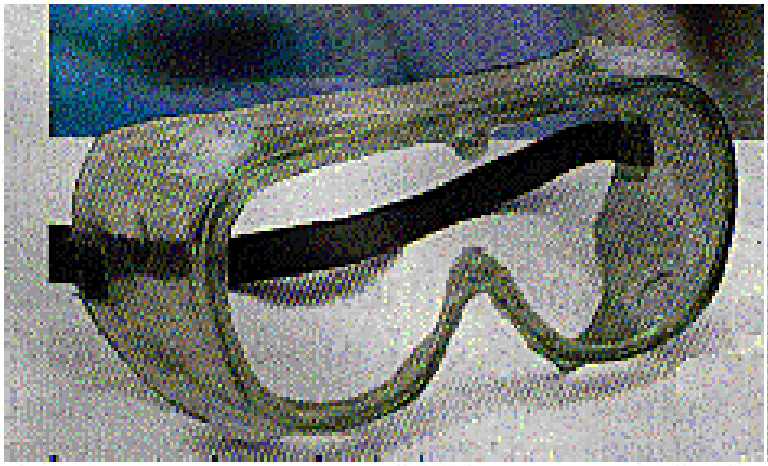
Goggles

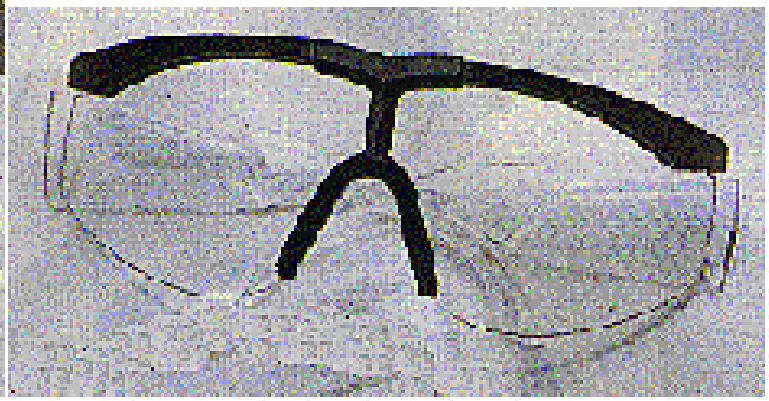
- For work with significant risk of splash of chemicals or projectiles

Face Shield

- For work with significant risk of explosion
- ***Wearing of contact lenses in the lab in not advised***

SAFETY APPAREL, cont'd.





Laboratory Safety goggles come in a variety of styles. Those appropriate to the chemistry laboratory should have side shields for splash resistance. Both of the styles pictured here carry the ANSI Z87.1 rating for impact resistance and splash protection.

Eye protection

This Pipefitter Escaped Serious Facial Injury By Wearing His Personal Protective Equipment

northwood
pulp and timber limited

SAFETY APPAREL

- Wear eye protection whenever manipulating chemicals; safety goggles are a minimum requirement, but full face shields are warranted when pouring concentrated acids and bases.

- Wear a lab apron or coat to protect exposed body parts and clothing.

- Wear gloves whenever there is potential for contact with corrosive or toxic material.

- Full-mask respirators (including self-contained breathing apparatus) are for emergency use by trained personnel only. By law, such respirators must be fitted to the trained individual. But, cartridge masks can be useful for prolonged exposure to organics and corrosives.

- Never wear perforated shoes, sandals or cloth sneakers when working with corrosives.

Protective clothing

Laboratory Coats:

- Laboratory coats are for the protection of your person and clothing from contamination by chemicals.
- They should be worn all the time in the laboratory;
- They should be properly fastened all the way up;
- They should be white and clean so that contamination can be seen easily;
- They should be regularly laundered and kept in good repair;

Protective clothing

Laboratory Gloves:

- There are various types of protective gloves available to protect against all the hazards you are likely to encounter:

  Disposable plastic gloves are better for some purposes: they can be discarded immediately after use and thus reduce the risk of contamination.

  Plastics used in gloves: Latex and Nitrile

  (powdered and unpowdered)

  (some people have allergic reaction to one type or other)

  Plastic gloves give good protection against powdered reagents but solvents can permeate through.

- ✓ For strong solvents rubber (neoprene) gloves are required; these can be washed and re-used

Guidelines for use of laboratory gloves:

- Wear protective gloves to handle corrosive or hazardous chemicals.
- Be familiar with the type best suited to you and to the particular job.
- Take care not to contaminate common equipment, bottles, switches and controls which are likely to be handled by other unprotected persons. (Slip contaminated gloves off the hand to handle cupboard doors, water taps and so on)

- Wash and clean gloves frequently during a hazardous job.
- Regard gloves as a personal item, not to be passed round the laboratory for others to use (to avoid contamination).
- Gloves which have become contaminated should be destroyed and replaced.

Laboratory Design and Signs/Notices

- All laboratories are designed with two exit doorways. Never block the second exit with anything. Also never block the door in the open position.

- Fire exit and escape routes
- Evacuation Procedure
- Telephone No. List on Wall
  - emergency services
  - police
  - fire department
  - nearest hospital
  - lab. supervisor

Signs in the Laboratory

Colour	Meaning	Example
BLUE	Mandatory And information	
YELLOW/ AMBER	Warning Possible danger	

Signs in the Laboratory

Colour	Meaning	Example
GREEN	Safe procedure and First Aid	
RED	Stop, Prohibition Fire fighting equipment	

Signs in the Laboratory

Electrical Hazard

Fire Extinguisher

No Open Flames

Signs in Laboratory or as labels on Containers

Harmful

Very Toxic

Signs in Laboratory or as labels on Containers

Corrosive material

Flammable Material

Oxidising

Difference between Flammable and Combustible

Both terms mean that the material can burn.

- **Flammable liquids** can easily be ignited at normal working temperatures.
- A **combustible liquid** does not catch fire as easily as a flammable liquid.
  - The temperature has to be higher than normal working temperature (above 100 ° F or 37.8 °C).
- A combustible gas is a gas containing oxygen.

New System - GHS

GHS: Globally Harmonised System

A UN (United Nations) agreement to make labelling common across the industrialised world.

The EU are now requiring that all countries in the EU make certain changes in labelling that will bring the EU more into line with USA.

The most notable change is the change in the symbols:

- - instead of black symbols on orange/yellow rectangles, there are now black symbols on a white background with red-rimmed red rhombuses.

The Complete set of New Symbols

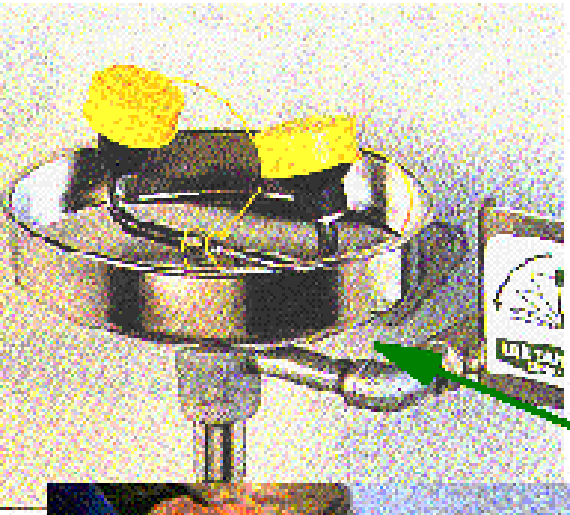
GHS01 Exploding bombs 	GHS02 Flame 	GHS03 Flame over circle 
GHS04 Gas cylinder 	GHS05 Corrosion 	GHS06 Skull and crossbones 
GHS07 Exclamation mark 	GHS08 Health hazard 	GHS09 Environment 

The St Andrew's cross is gone.

Safety Equipment

- Fire extinguisher
- First Aid Box
- Eye wash bottle
- Shower

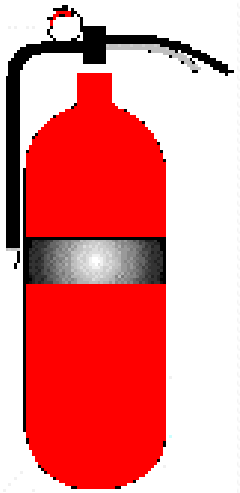
PERSONAL SAFETY STATIONS



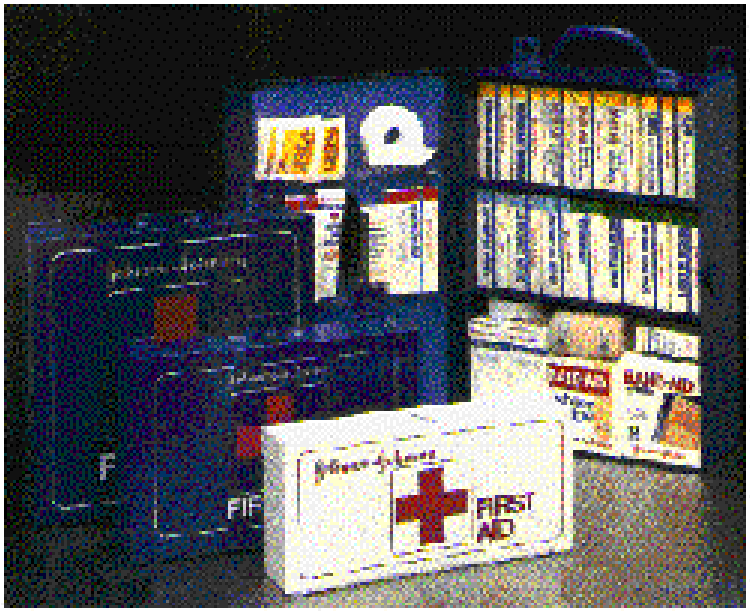
Learn the location of safety devices both in the stockroom and laboratories

When treating chemical splashes to the eyes, flush the eyes in with an eyewash fountain or eyewash bottle for a full 15 minutes.

Fire extinguisher (The dry chemical type is most appropriate for the general chemical environment. See that it is checked yearly and make it a point to learn how to use it).

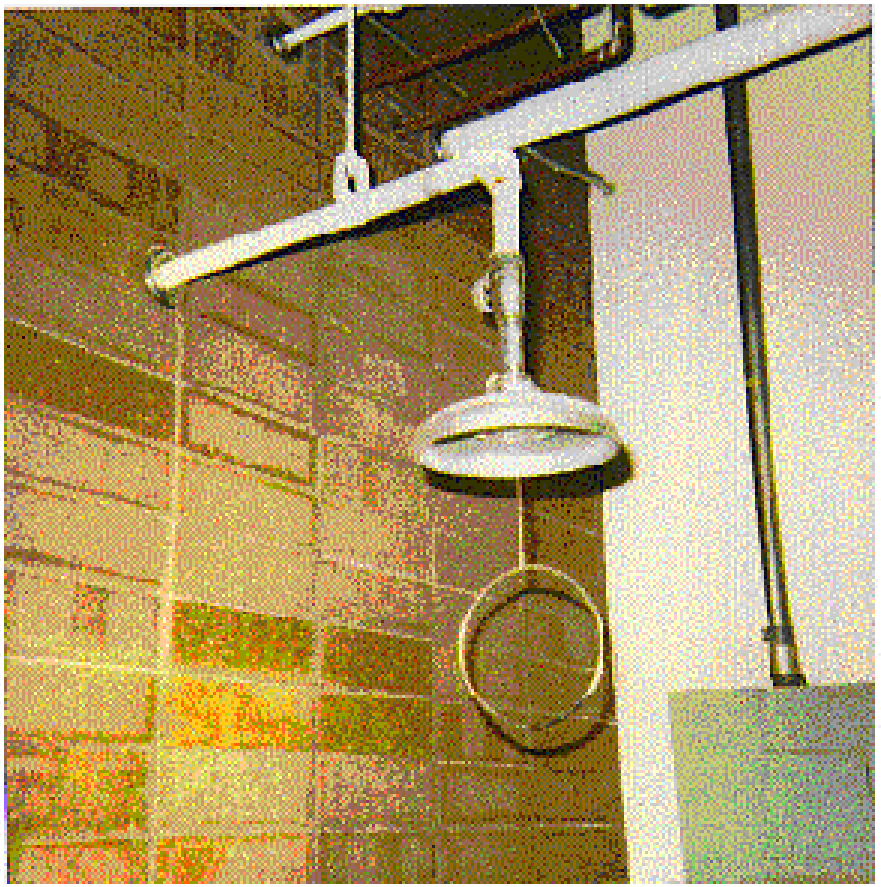


PERSONAL SAFETY STATIONS, cont'd.



First-aid kit (be sure to examine the kit regularly for commonly used items like band-aids).

The chemistry Central Stockroom carries the most common replacement items for such kits.



Use the safety shower when burned or exposed to a hazardous chemical splash. Remove contaminated clothing and flush for 15 minutes). Inspect showers quarterly for proper operation (this includes a flush-out).

Before Leaving the Laboratory

Turn off:

Gas

Water

Electrical Apparatus

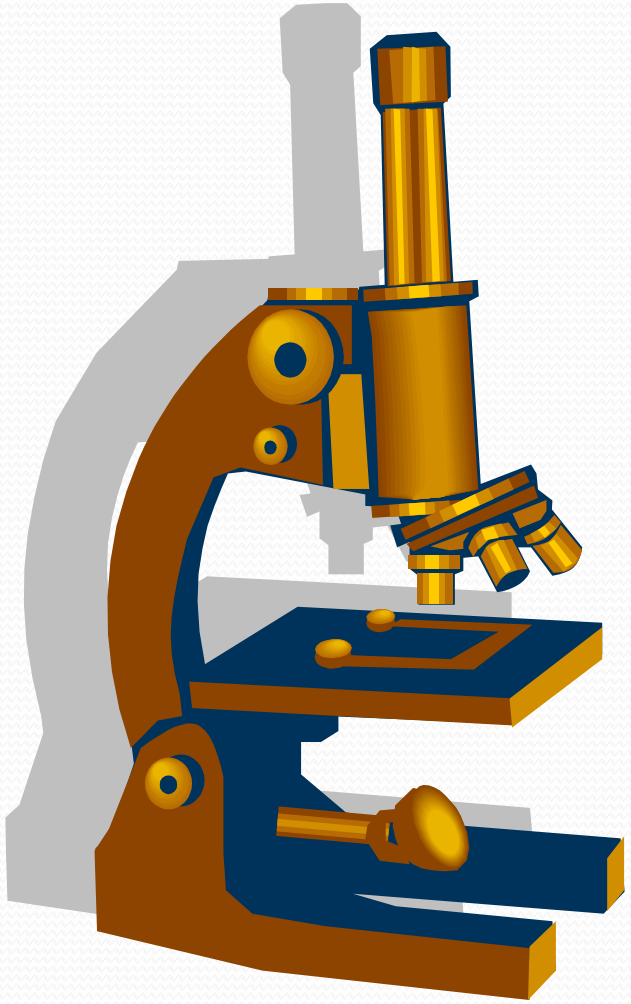
Heating apparatus

Before Leaving the Lab:

Return equipment, apparatus, to correct place

Lock/out and tag/out defective equipment

Decontaminate work surfaces and equipment



Before Leaving the Lab:

Identify and package waste, and dispose properly. Treat contents of unlabelled containers as hazardous wastes. Dispose accordingly.

Remove lab coat immediately on exiting

Wash hands

Emergencies

- fires
- chemical spills
- release of radioactive materials
- release of compressed toxic and corrosive gases
- release of pathogens (biological materials)
- power failure
- explosions
- physical injuries to individuals
- consequences of natural disasters

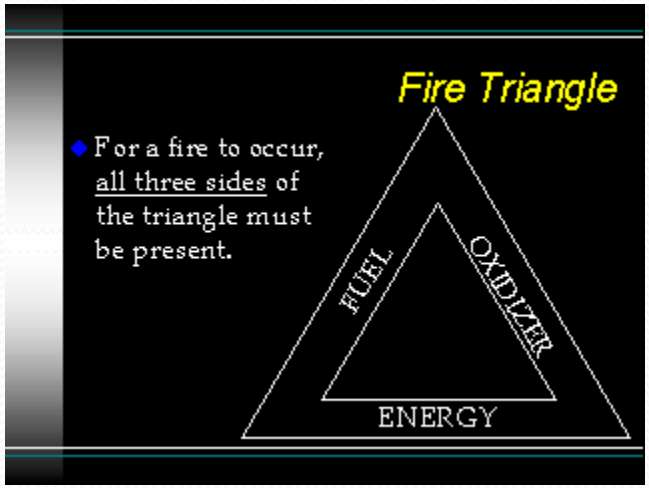
Fire Safety

- In order to understand how fire extinguishers work, one first needs to know a bit about fire.

- Essentially, fire extinguishers put out fire by taking away one or more elements of the fire triangle.

- Only minor fires can be safely put out with portable extinguishers

Fire Triangle



Fire Triangle

- The "Fire Triangle" identifies the three components of any fire:
  - **Fuel** paper, wood, flammable gas, energized electrical equipment, etc...
  - **Energy** (heat), sufficient to support combustion. Often referred to as the ignition source.
  - **Oxidizer** (air)

IF ANY ONE OF THESE IS MISSING, A FIRE CANNOT CONTINUE.

Fire Prevention

- Prevention is based on eliminating or minimizing one of the components of the "Fire Triangle".
- Fire prevention methods include:
  - Heat and/or smoke detectors.
  - Automatic fire sprinkler systems.
  - Kitchen hood systems.
  - Building codes and materials.
  - Flame retardant furnishings and materials

Types of Fires

Fires

- Class A: paper, wood fires
- Class B: flammable solvents, petrol
- Class C: electrical fires
- Class D: reactive metal fires e.g. Mg, K

Fire Extinguishers

Class	Used for	Colour	Contains
A	paper, wood	Red	Water
B	flammable solvents	Black	CO_2
C	electrical fires or gases	Blue	dry powder
D	reactive metal	Yellow	Met-L-X (powdered graphite)

Fire Extinguishers

- Remember this easy acronym when using an extinguisher - **P.A.S.S.**

- **P**ull the pin.
- **A**im the nozzle.
- **S**queeze the handle.
- **S**weep side to side at the base of the fire.
- extinquishers last less than 1 min.

Remember to RACE during a fire

- *R* escue – rescue clients in immediate danger.
- *A* lert – yell out "Fire", push fire alarm, dial emergency phone number.
- *C* ontain – Close all doors and windows.
- *E* xtinguish/Evacuate – Extinguish small fires, evacuate clients, if appropriate.

Explosions

Caused by:

- ignition of confined gases/fumes
- runaway chemical reaction

Explosions can lead to:

- Release of toxic fumes
- Fires

Fire procedure

- In the case of a minor fire in the laboratory which can be contained, the fire extinguishers should be used (by authorized staff only) to put out the fire

- If there is a major fire in the building an emergency fire alarm will sound and students should follow the Emergency Evacuation Procedure outlined next

Emergency Evacuation Procedure

1. Turn off electricity, water, gas etc.
2. Leave the area without delay
3. Obey the instructions of the staff and proceed quietly and without panic to the nearest exit
4. Do not use lifts
5. Assemble in an orderly fashion at the designated assembly points
6. Do not re-enter building until told to do so

Chemical Spills - What to do

- Report all spills to the person in charge of lab
- Direct any victim of chemical exposure to NEAREST eyewash and safety shower
- Evacuate the exposure area
- Contain the spillage
  - paper towels for minor spills; dispose of as hazardous waste
- rinse area with copious amounts of water
- mercury spill kits, e.g. for thermometer breakages
- Give as much detail as possible about the nature of the chemical spill when requested.

SPILLS AND LEAKS, cont'd.

Commercial spill control powders; organic absorbent, acid & base neutralizers.

Citric acid - for neutralizing base spills; Sodium bicarbonate - for neutralizing acid spills.

Commercial adsorbent pillows for caustic acids and bases and organic, flammable liquids.

Treat the spent adsorbent pillow as a hazardous waste and dispose of properly.

Functions of Safety Department

1) Training
   - fire, first aid, chemical safety

2) Waste disposal
   - all wastes

3) Building safety
   - inspections, fire drills

Functions of Safety Department

4) Environmental protection and Industrial Hygiene
   - air quality, hoods testing, reviewing lab practicals, projects, research

5) Medical program
   - analysing accidents, preparation of reports

6) Radiation safety
   - testing and reviewing

Personal Injury

Medical emergency in the teaching labs:

Minor incident (minor cuts, burns, etc.)

- Wash thoroughly with lots of water. Administer all appropriate first aid using nearest first-aid kit. Assess injury with lab supervisor.

Major incident (cuts requiring stitches, 2nd degree burns, inhalation etc)

- Alert lab supervisor, who will summon emergency medical help.

Personal Injury –Acids & Bases, Gas

- If skin is exposed to moderate concentrations of acid or base or other hazardous chemicals, wash thoroughly with running water.
- Remove any contaminated clothing at once.
- If eyes are infected, flush thoroughly with water for 15 minutes.

- If noxious gas is inhaled, get to fresh air a.s.a.p. and contact authorities immediately.

First Aid

Severe Bleed

- Arterial bleed can be more frightening but artery wall stems flow by contraction
- Venous bleed is slower but flows steadily

1. Apply pressure directly to wound
2. Apply sterile dressing/other cloth
3. Do not remove dressing - add another one
4. Elevate wound higher than heart (decreases blood pressure to wound)
5. If bleeding persists, put pressure on arteries supplying area

First Aid

- ***Shock***
- Can accompany any type of severe injury, skin may be cold, clammy, pale, weakness, weak pulse
- Victim should be lying down and given 1/2 glass liquid every 15 min. Legs raised 10 – 12 inches.
- ***Poisoning (by inhalation)***
- Evacuate to a safe place
- Check for breath odours
- Loosen tight clothing
- Maintain open airway
- If not breathing perform A.R. (manual method)

First Aid

- ***Burns (first degree)***
  - painful and red area, no blisters
  - apply cold water
- ***Burns (second degree)***
  - severe and painful, blisters and swelling
  - immerse in cold water
  - apply cold, clean cloths to area
  - do not break blisters
- ***Burns (third degree)***
  - deep, severe burns, tissue damage
  - do not remove burnt clothing, hospitalisation required

Accident Report Form

- Name:
- Date:
- Dept.:
- Description of Event:
- Action Taken:
- Signature of Person Involved:
- Signature of Manager: