Hazard Assessment in Chemical Laboratory Workshop

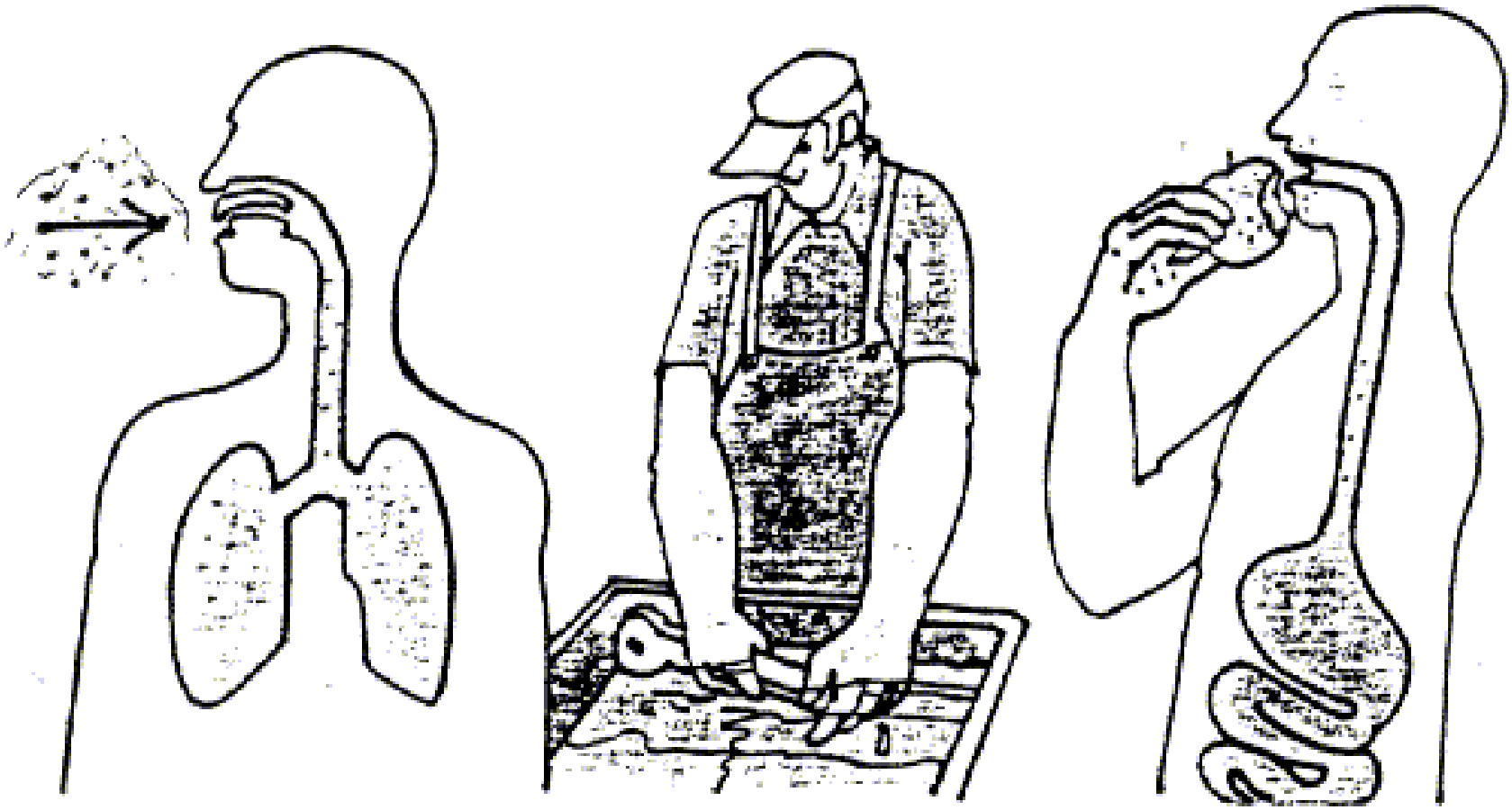
Presentation Outline:

1. Overview on chemical hazard
2. Use OF Chemical Safety Data Sheet (CSDS)
3. Job Safety Analysis (JSA)
4. Hazard Identification Risk Assessment Risk Control (HIRARC)

1.
Overview on **Chemical** hazard

Principle Modes Of Chemical Injury

1. **Chemical Burns** (strong acids, strong bases)
2. **Heat Burns** (flammable materials)
3. **Poisoning** (many chemicals are damaging or fatal if taken internally, whether by swallowing, injection, or leaching through skin)
4. **Chronic illness** (long-term exposure to even low doses of certain chemical agents can lead to chronic health conditions)



Inhalation (breathing in)
Absorption (through the skin or eyes)
Ingestion (eating, swallowing)
Transfer across the placenta of a pregnant woman to the unborn baby

Sawdust used on the spillage of nitric acid releases dangerous fumes of nitrogen oxides which are recognized from their brown to yellow colour.

Chemical Categories

Chemical Categories

Acids

Chemical Categories

Bases

Explosive

1. Explosive- explode under flame, more sensitive or friction to shock than dinitrobenzene
2. Involve rapid release of energy
3. Avoid store in metallic containers
4. Bund Wall
5. Filled with paraffin (solid).
6. Replace ethylene with R134a in cryogenic refrigeration system
7. Example- acetone peroxide. Ammonium nitrate, hexanitrobenzene

Chemical Categories

Flammable Chemicals

Chemical Categories

Oxidizers

Chemical Categories

Carcinogens

Toxic Materials

Description

- A toxic material is any material which is poisonous or harmful to human health.
- It can cause harm to your skin or eyes. It can get into human body and cause harm to organs, central nervous system or other parts of body.

Effect to human body

. You can inhale (breathe in) the toxic chemical.

. Toxic can absorb the chemical through your skin

. You can ingest or swallow the chemical

How can you be protected from hazardous chemicals

- **Remove the chemical from the workplace**.
- **Replace the hazardous chemical with a less harmful one**
- **Reduce the amounts of chemicals in the workplace so that even if they get into your body, the amounts are too low to cause any harm.**
- **Use safe work practices and hygiene practices.**
- **Use personal protective devices.**
- **Other Safe Practices and Emergency Provisions.**

Irritants

Definition

A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

Effect

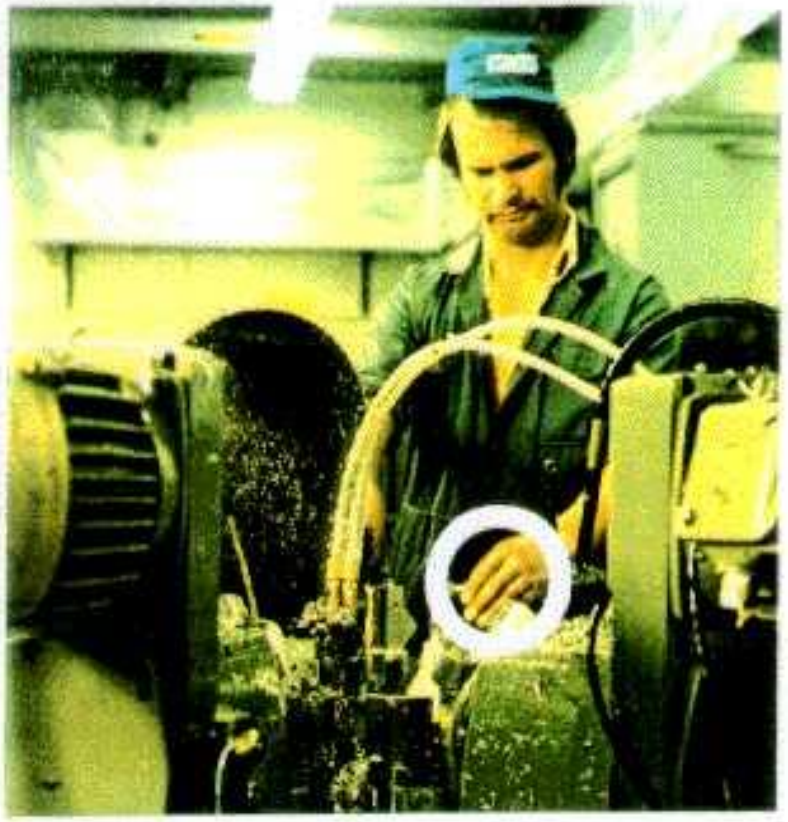
The effect of irritants is normally temporary. For example, pepper spray is a severe eye irritant, but causes no lasting effects.

Chronic irritation can be a symptom of a variety of other underlying disease conditions or allergies.

How can you be protected from hazardous chemicals

- Wear personal protective equipment.
- First aid treatment for skin irritation is to flush the affected area with water.

Your hands?
which may c

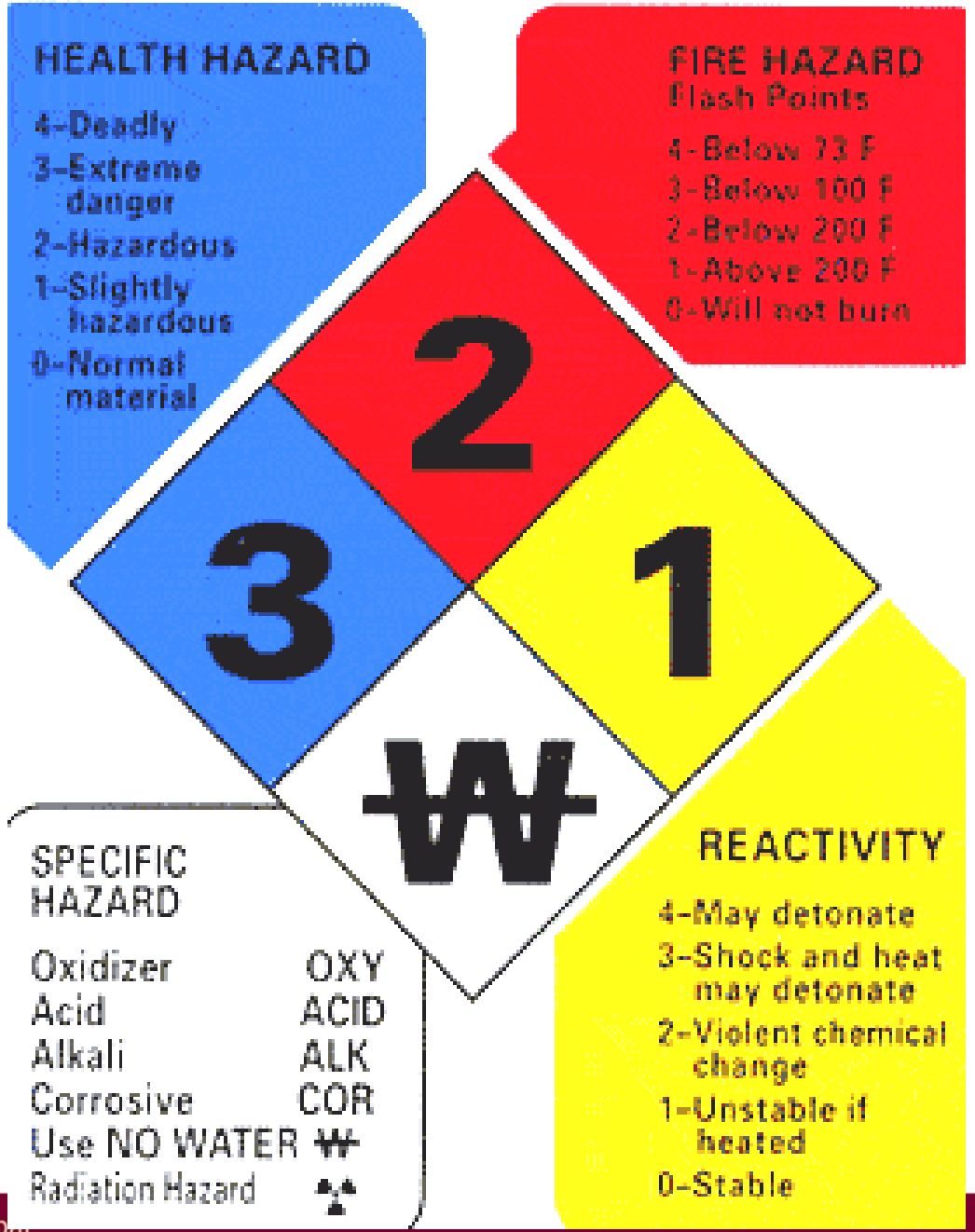


Cutting oils preserve and lubricate the metals which are under work but not hands. Also mists contain components hazardous to health.

Radioactive Hazard

- Radioisotopes are used in many laboratories and on all campuses of the University
- Caretaking staff are trained to recognize the radiation warning sign.
- Caretaking staff are trained not to touch or remove any materials, including waste, labelled with the radiation warning sign.
- Any spill discovered in any laboratory should be reported to the supervisor immediately.
- Equipment or materials in work areas in which radioactive materials are used must be decontaminated prior to maintenance, transfer or disposal being conducted.

HAZARDOUS MATERIALS CLASSIFICATION



1 EXPLOSIVES

2.1 FLAMMABLE GASES

2.2 NON-FLAMMABLE NON-TOXIC GASES

2.2 OXIDIZING GAS
SUB RISK
5.1 (NITROUS OXIDE & OXYGEN ONLY)

2.3 TOXIC GASES

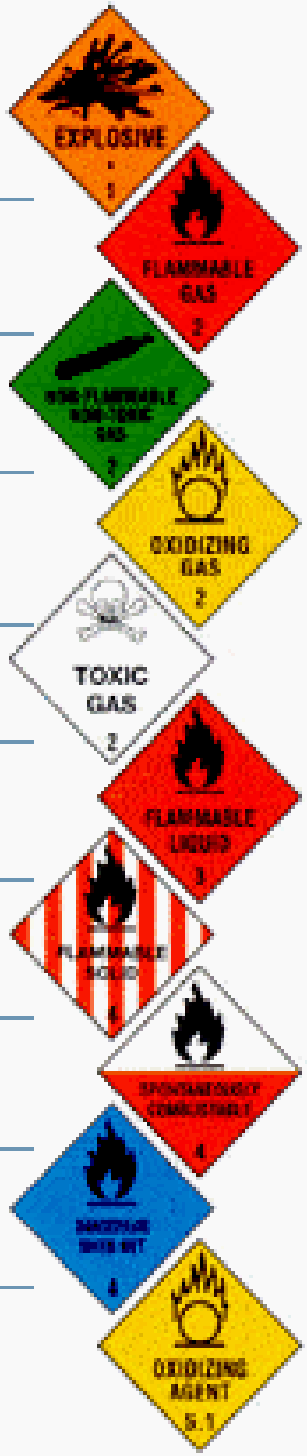
3 FLAMMABLE LIQUIDS

4.1 FLAMMABLE SOLIDS
(and other reactive substances)

4.2 SUBSTANCES LIABLE TO SPONTANEOUS COMBUSTION

4.3 SUBSTANCES THAT IN CONTACT WITH WATER EMIT FLAMMABLE GASES

5.1 OXIDIZING SUBSTANCES



5.2 ORGANIC PEROXIDES

6.1 TOXIC SUBSTANCES

6.2 INFECTIOUS SUBSTANCES

7 RADIOACTIVE MATERIAL
(CATEGORY I)

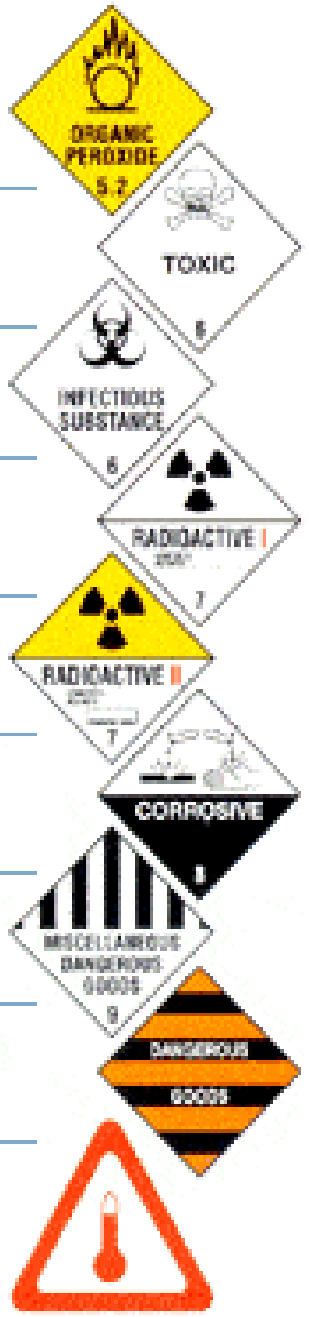
7 RADIOACTIVE MATERIAL
(CATEGORY II or III)

8 CORROSIVE SUBSTANCES

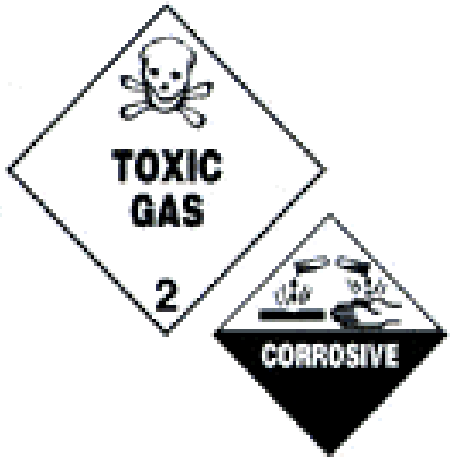
9 MISCELLANEOUS DANGEROUS GOODS AND ARTICLES

MIXED CLASS LABEL FOR ROAD AND RAIL TRANSPORT

SUBSIDIARY RISK LABEL TO BE USED WITH ELEVATED TEMPERATURE SUBSTANCES



ANHYDROUS AMMONIA



UN No. **1005**

HAZCHEM **2RE**

IN EMERGENCY DIAL
000 POLICE or FIRE BRIGADE

SPECIALIST ADVICE
ORGANISATION
NAME AND PHONE NUMBER

1	WATER JETS
2	WATER FOG
3	FOAM
4	DRY AGENT

In the absence of fog, a fine spray may be used.

Water must not be allowed to come in contact with the material.

1 WATER JETS 2 FOG 3 FOAM 4 DRY AGENT

P	V	FULL	DILUTE
R			
S	V	BA	
S		BA for FIRE only	
T		BA	
T		BA for FIRE only	
W	V	FULL	
X			
Y	V	BA	CONTAIN
Y		BA for FIRE only	
Z		BA	
Z		BA for FIRE only	

E	CONSIDER EVACUATION

2.
Chemical Hazard Identification

- Group Activity

- Based on your CSDS, identify the chemical hazard, health effect and its hazard rating according to CHRA Procedure

- Points to look: LD50, LC50, R-phase and/or clinical effect

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Table 1: Hazard Rating

HR	HEALTH EFFECTS	HAZARD CATEGORY
5	Local: Injury to the skin, eyes, or mucous membranes of sufficient severity to threaten life by single exposure Systemic: Severe irreversible effects (e.g. central nervous system effects, kidney necrosis, liver lesions, anemia or paralysis) after a single exposure	*Very Toxic chemicals:- -LD50<25 mg/kg (oral) -LD50<50 mg/kg (skin) -LC50<0.5 mg/litre
	Known human carcinogens, mutagens or teratogens	*Category 1 carcinogen, mutagen and teratogen
4	Local: Injury to the skin, eyes, or mucous membranes of sufficient severity to cause permanent impairment, disfigurement or irreversible change from single or repeated exposure Systemic: Very serious physical or health impairment by repeated or prolonged exposure	*Very Corrosive (R35: Causes severe burn) *Toxic chemicals:- -LD50: 25-200mg/kg(oral) -LD50: 50-400mg/kg(skin) -LC50: 0.5-2 mg/litre
	Probable human carcinogens, mutagens or teratogens based on animal studies	*Category 2 carcinogen, mutagen and teratogen
3	Local: Serious damage to skin, eyes or mucous membranes from single or repeated exposure Systemic: Severe effects after repeated or prolonged exposure	*Corrosive(R34:Cause burn) *Respiratory sensitisers *Irritant-serious eye damage *Harmful chemicals:- -LD50:200-500mg/kg(oral) -LD50:400-2000mg/kg(sk) -LC50: 2-20 mg/litre
	Possible human or animal carcinogens or mutagens, but for which data is inadequate	*Category 3 carcinogen and mutagen
2	Local: Reversible effects to the skin, eyes or mucous membranes not severe enough to cause serious health impairment Systemic: Changes readily reversible once exposure ceases	*Skin sensitisers *Skin irritants
1	No known adverse health effects	Not classified as hazardous

Table 2: Hazard Rating Based on Risk Phrases

EFFECT	ACUTE/ CHRONIC	ROUTES OF EXPOSURE					HAZARD RATING (HR)
		INH.	DERMAL		ING.	NOT SPECIFIED	
			SKIN	EYE			
Very Toxic	Acute	R26	R27		R28	R39	5
	Chronic	-	-		-	-	
Toxic	Acute	R23	R24		R25	R39	4
	Chronic	-	-		-	R48, R39	
Harmful	Acute	R20	R21		R22	R40	3
	Chronic	-	-		-	R48, R40	
Corrosive	Acute		R35				4
			R34				3
Irritant	Acute	R37	-	R41			3
		-	R38	R36			2
Sensitising	Acute	R42	-				3
		-	R43				2
Carcinogenic	Chronic	R49(1)				R45(1)	5
		R49(2)				R45(2)	4
		-				R40(3)	3
Mutagenic						R46(1)	5
						R46(2)	4
						R40(M2)	3
Teratogenic						R47(1)	5
						R47(2)	4

3.
Job Safety Analysis (JSA)

- Main STEP

Select the job to be analyzed
Prepare the JSA form
Break the job task into steps
Identify the hazards
Identify the controls

Example of JSA form :

Job Safety Analysis Worksheet

Company name:		Date:		JSA No.	
Site name:		Permit to work requirement:	Yes ☐	No ☐	
Contractor:		Approved by:			
Activity:					

Activity List the tasks required to perform the activity in the sequence they are carried out.	**Hazards** Against each task list the hazards that could cause injury when the task is performed.	**Risk control measures** List the control measures required to eliminate or minimise the risk of injury arising from the identified hazard.	**Who is responsible?** Write the name of the person responsible (supervisor or above) to implement the control measure identified.

4th case

Direct Compression Process

Flow chart	Machine, operation time
Sieving	Machine: Free weight granulator
Blending	Machine: Double cone blender for 120 min Capacity: 400 kg, Source: U.S.A Source: Germany
Slugging	Citt roller compactor / Operation time: 4 hrs **or** Hutt compactor / Operation time:18 hrs
Granulation	Machine Zinnerman Sieve Size: 32
Sieving add lubricant	Machine: Free weight granulator Source: Germany
Blending	Machine: Double cone blender for 120 min Capacity: 400 kg, Source: U.S.A
Compression	See list machine used Machine: Sejong Source: Korea Capacity: 120 kg R.P.M. 8
Coating	No. of guns: 2

EXAMPLE:

JOBS STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES
1. Reach into box to the right of the machine, grasp casting and carry to wheel.	Strike hand on edge of metal box or casting; cut hand on burr. Drop casting on toes.	Provide gloves and safety shoes.
2. Push casting against wheel to grind off burr.	Strike hand against wheel, sparks in eyes. Wheel breakage, dust, sleeves get caught.	Provide larger guard over wheel. Install exhaust system. Provide safety goggles. Instruct employee to wear short sleeved shirts.
3. Place finished casting in box to the left of the machine.	Strike hand against metal box or casting.	Provide tool for removal of completed stock.

C. Worked example Job Hazard Analysis

Cleaning Inside Surface of Chemical Tank - Top Manhole Entry

STEP	HAZARD	REQUIREMENTS
1. Determine what is in the tank, what process is going on in the tank, and what hazards this can pose.	Improper oxygen level Chemical exposure - Gas, dust, vapor - irritant, toxic Liquid - irritant, toxic, corrosive, heated Solid - irritant, corrosive Moving blades/ equipment	Establish confined space entry procedures (Code of Practice for confine space). • Obtain work permit signed by safety, maintenance, and supervisors. • Test air by qualified person. • Ventilate to 19.5% -23.5% oxygen and less than 10% LEL of any flammable gas. Steaming inside of tank, flushing and draining, then ventilating, as previously described, may be required. • Provide appropriate respiratory equipment - SCBA or air line respirator. • Provide protective clothing for head, eyes, body, and feet. • Provide harness and lifeline. (Reference: .....). • Tanks should be cleaned from outside, if possible.
2. Select and train operators.	Operator with respiratory or heart problem; other physical limitation. Untrained operator - failure to perform task	• Examination by industrial physician for suitability to work. • Train operators. • Dry run. (Reference: .....).
3. Set up equipment	Hoses, cord, equipment - tripping hazards. Electrical - voltage too high, exposed conductors. Motors not locked out and tagged.	• Arrange hoses, cords, lines, and equipment in orderly fashion, with room to manoeuvre safely. • Use ground-fault circuit interrupter. • Lockout and tag mixing motor, if present.
4. Install ladder in tank.	Ladder slipping.	• Secure to manhole top or rigid structure.
5. Prepare to enter tank.	Gas or liquid in tank.	Empty tank through existing piping. • Review emergency procedures. • Open tank. • Check of jobsite by industrial hygienist or safety professional. • Install blanks in flanges in piping to tank (isolate tank). • Test atmosphere in tank by qualified person (long probe).

STEP	HAZARD	REQUIREMENTS
6. Place equipment at tank-entry position.	Trip or fall.	Use mechanical-handling equipment. • Provide guardrails around work positions at tank top. • Provide personal protective equipment for conditions found. (Reference:.....).
7. Enter tank.		• Provide outside helper to watch, instruct, and guide operator entering tank, with capability to lift operator from tank in emergency.
8. Cleaning tank.	Reaction to chemicals, causing mist or expulsion of air contaminant.	Provide protective clothing and equipment for all operators and helpers. • Provide lighting for tank (Class I, Div. 1). • Provide exhaust ventilation. • Provide air supply to interior of tank. • Frequent monitoring of air in tank. • Replace operator or provide rest periods. • Provide means of communication to get help, if needed. • Provide tow-man standby for any emergency.
9. Cleaning up.	Handling of equipment, causing injury.	Dry run. • Use material-handling equipment.

4.
Hazard Identification Risk Assessment Risk Control (HIRARC)

HIRARC form :

CENTRE OF HYDROGEN ENERGY (CHE)

FORM A: HAZARD ASSESSMENT AND CONTROL FORM FOR LABORATORY

Prepared by: CHE Safety Manager (Dr Umi Aisah Asli), Update on 15/2/2017

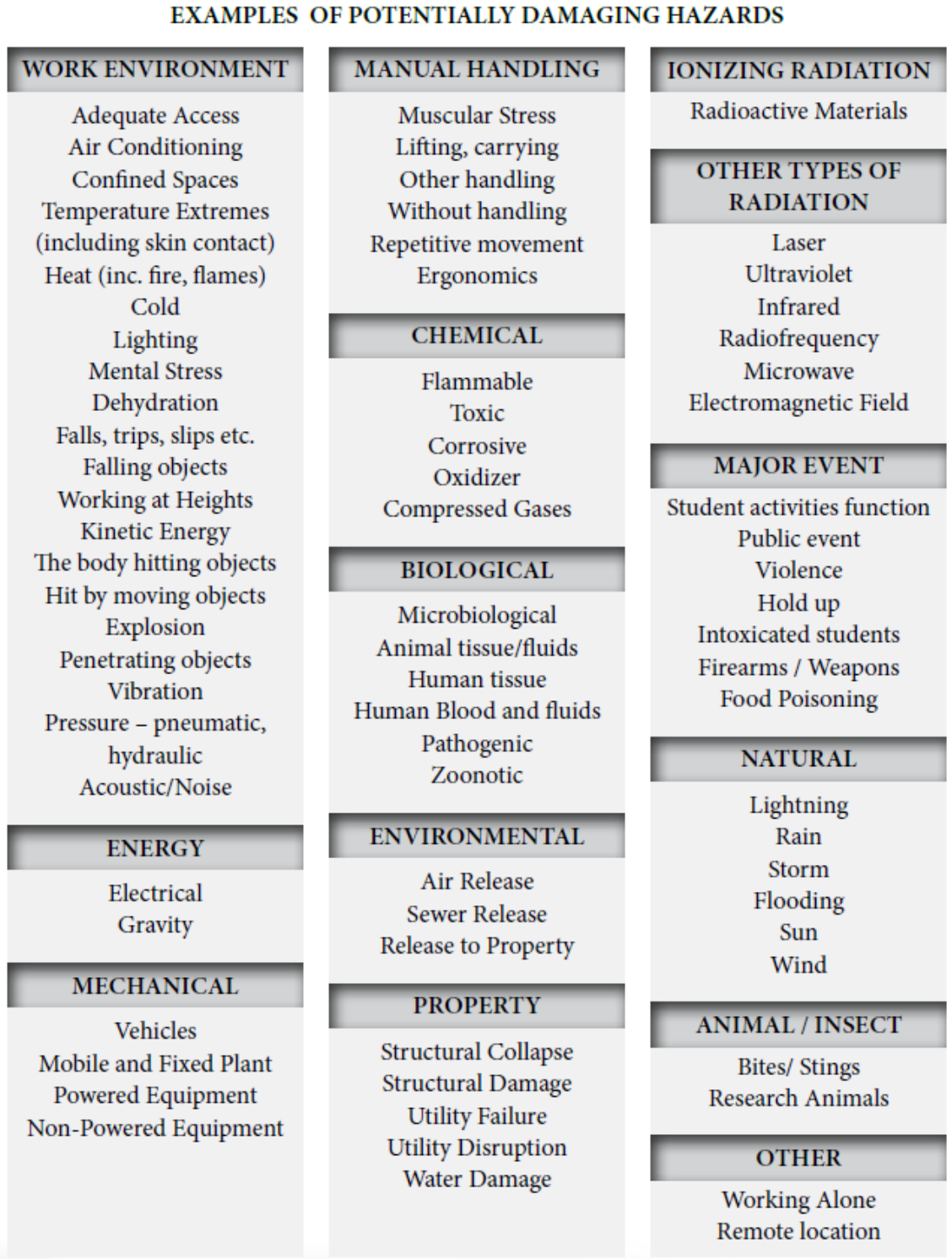
Location: Building _____ Room _____	Date of assessment:
Project/experiment tittle:	
Assessment performed by:	Reviewed/revised by (Head of Laboratory):

Hazard Identification

Tasks (List all tasks/activities of the job/position)	Hazards (List all existing and potential health and safety hazards)	Severity	Likelihood	Risk (S x L = R)	Controls (List the controls for each hazard: Elimination, Engineering, Administrative, Personal Protective Equipment)	Date implemented:

Severity:	Likelihood:	Risk:
How serious could the consequences be? 3 – It could kill you or cause a permanent disability, today or over time. 2 – It could send you to the hospital. 1 – It could make you uncomfortable	How likely is it going to happen? 3 – It is highly likely. 2 – It might happen. 1 – It is unlikely.	Calculate the risk of hazards to prioritize preventive actions. Severity x Likelihood = Risk

- Appendix A & B



EXAMPLES OF POTENTIALLY DAMAGING HAZARDS

WORK ENVIRONMENT
Adequate Access
Air Conditioning
Confined Spaces
Temperature Extremes (including skin contact)
Heat (inc. fire, flames)
Cold
Lighting
Mental Stress
Dehydration
Falls, trips, slips etc.
Falling objects
Working at Heights
Kinetic Energy
The body hitting objects
Hit by moving objects
Explosion
Penetrating objects
Vibration
Pressure – pneumatic, hydraulic
Acoustic/Noise

ENERGY
Electrical
Gravity

MECHANICAL
Vehicles
Mobile and Fixed Plant
Powered Equipment
Non-Powered Equipment

MANUAL HANDLING
Muscular Stress
Lifting, carrying
Other handling
Without handling
Repetitive movement
Ergonomics

CHEMICAL
Flammable
Toxic
Corrosive
Oxidizer
Compressed Gases

BIOLOGICAL
Microbiological
Animal tissue/fluids
Human tissue
Human Blood and fluids
Pathogenic
Zoonotic

ENVIRONMENTAL
Air Release
Sewer Release
Release to Property

PROPERTY
Structural Collapse
Structural Damage
Utility Failure
Utility Disruption
Water Damage

IONIZING RADIATION
Radioactive Materials

OTHER TYPES OF RADIATION
Laser
Ultraviolet
Infrared
Radiofrequency
Microwave
Electromagnetic Field

MAJOR EVENT
Student activities function
Public event
Violence
Hold up
Intoxicated students
Firearms / Weapons
Food Poisoning

NATURAL
Lightning
Rain
Storm
Flooding
Sun
Wind

ANIMAL / INSECT
Bites/ Stings
Research Animals

OTHER
Working Alone
Remote location

Likelihood

LIKELIHOOD	EXAMPLE	RATING
Most likely	The most likely result of the hazard / event being realised	5
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at sometime in future	3
Remote	Has not been occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

Severity

SEVERITY	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality, major property damage if hazard is realised	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasion, bruises, cuts, first aid type injury	1

Risk Matrix Table

	Severity (S)				
Likelihood (L)	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

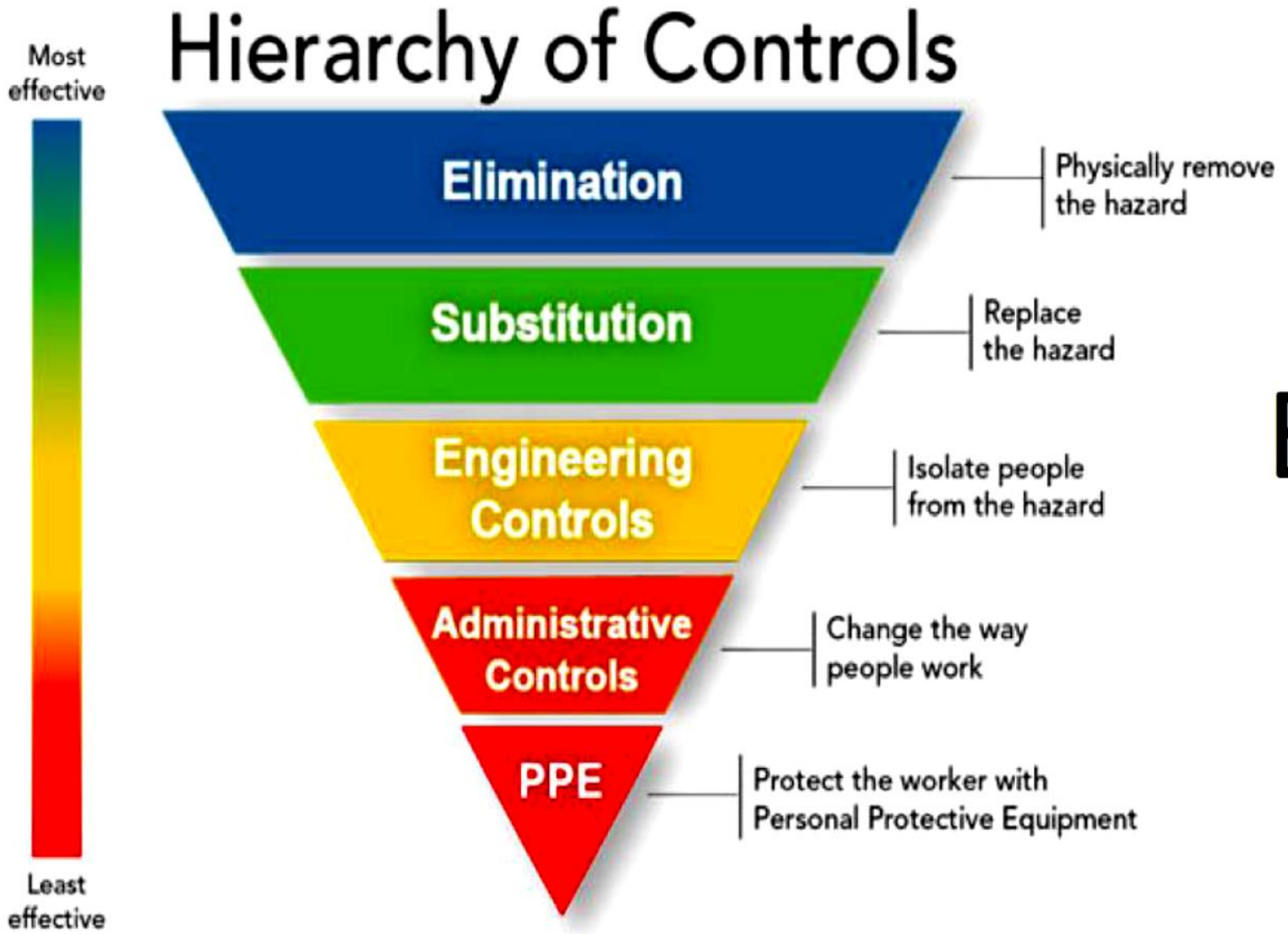
Table C

High

Medium

Low

Hierarchy of control



ESEAP

Elimination

Substitution

Engineering

Administrative

Personal Protective Equipment (PPE)

HIRARC

Group Activity

Q&A Session

Thank You