Environmental Health and Safety Offices
Miami University, Oxford, OH

Fundamentals of Laboratory Safety

Jeffrey A. Johnson, Environmental Health and Safety Offices
David L. Tierney, Department of Chemistry and Biochemistry

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Report Unsafe Practices and Conditions

Immediately notify your Supervisor, Faculty Advisor and/or Laboratory Manager of any situation you perceive to be unsafe

Do not continue work if you suspect a safety problem

When In Doubt . . . ASK!!!

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Why Laboratory Safety Training?

Your personal safety and the safety of those around you

We will review:

- Regulatory background
- Good housekeeping and work practices
- Types of hazards
- Engineering controls
- Personal protective equipment
- Emergency procedures and response

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Chemical Hygiene Plan

http://www.units.muohio.edu/ehso/Occup_IH.html

OSHA Lab Standard: 29 CFR 1910.1450

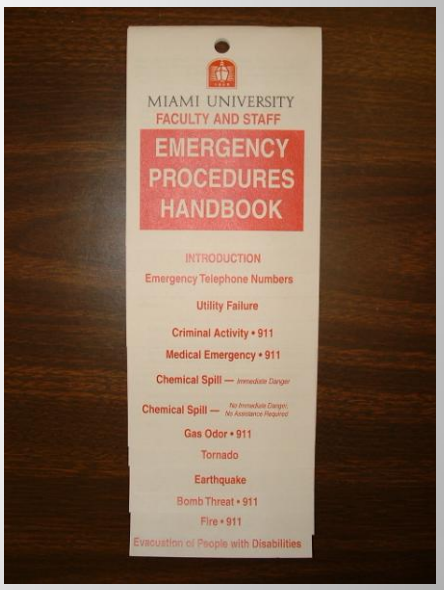
"Occupational exposure
to hazardous chemicals in laboratories"

"Prudent Practices in the Laboratory"

Emergency Procedures

Handbook posted in every laboratory

- Emergency telephone numbers
- Medical emergency
- Chemical spills
- Gas odors
- Fire



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Know Your Surroundings

- Exits
- Eyewashes and safety showers
- Fire extinguishers
- First aid kits
- Phones

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General Housekeeping

- Keep work areas and floors uncluttered
- Store equipment *and* chemicals properly
- Keep wastes segregated and labeled
- Clean up spills immediately

Hazards Present in Laboratories

- Physical
- Biological
- Chemical

Electrical Hazards

BE AWARE OF:

- Frayed or damaged cords
- Equipment that “tingles”
- Overloaded circuits
- Daisy-chaining of cords
- Wet locations

Not all outlets are

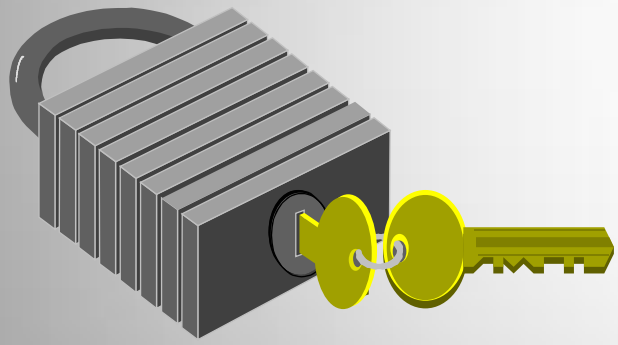
Ground Fault Circuit Interrupt (GFCI)

standard

GFCI

Lock-Out Tag-Out

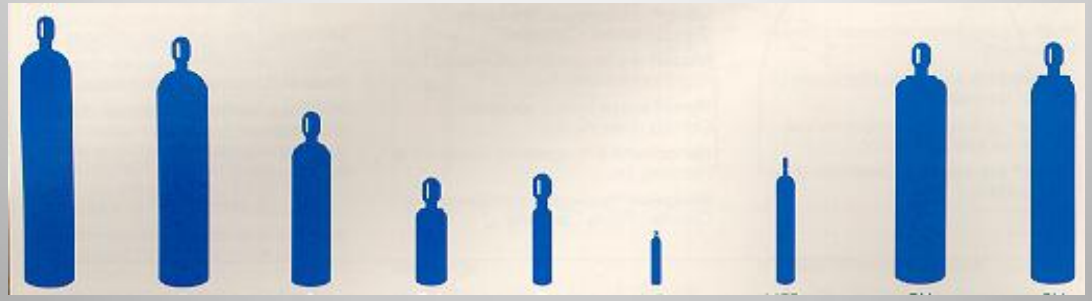
Identify all Sources of Energy



- Electrical
- Hydraulic
- Pneumatic
- Mechanical

Compressed Gas Cylinders

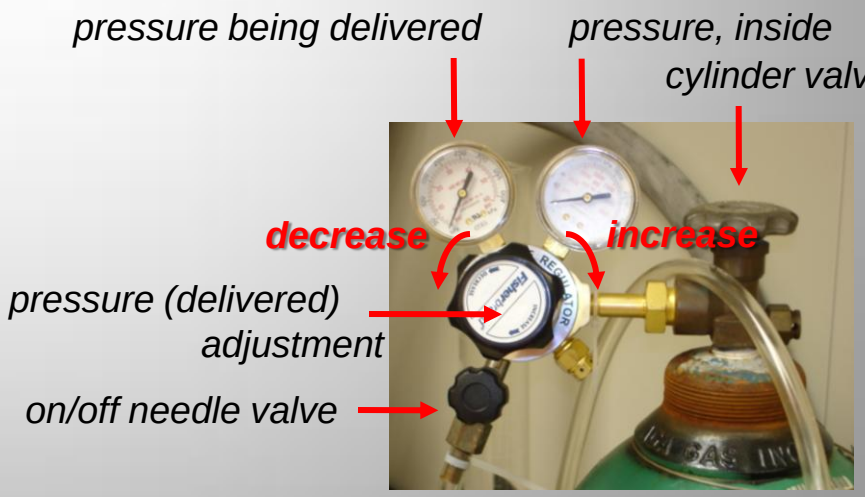
- HIGH PRESSURE (1800-2400 psi)
- Only transport upright, on a cart,
  with valve cap in place
- Empty cylinders are heavy
  (up to 141 lbs.)



Compressed Gas Cylinders

- Be familiar with
  the nature of the gas
- All cylinders, *empty or full*,
  must be properly secured

- Use the correct regulator;
  make *NO* adaptations



Cryogens

• *Solid carbon dioxide (dry ice)*	*- 78˚*	*C*	*(195 K)*
• Liquid argon	- 186˚	C	*(87 K)*
• *Liquid nitrogen*	*- 196˚*	*C*	*(77 K)*
• Liquid oxygen	- 219˚	C	*(54 K)*
• *Liquid helium*	*- 269˚*	*C*	*(4 K)*

Hazards

- Frost bite
- Asphyxiation

- Fire and Explosion
- Embrittlement

Glassware

BE AWARE OF:

- Cracks
- Chips
- Sharp edges

- Disposal

only in approved container!

Radioactive Materials

Use of radioactive materials requires additional training

This is covered in the *EH&S Radiation Safety Course*

Radiation Safety Office 529-2812

http://www.units.muohio.edu/ehso/RadiationSafety.html

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Sharps

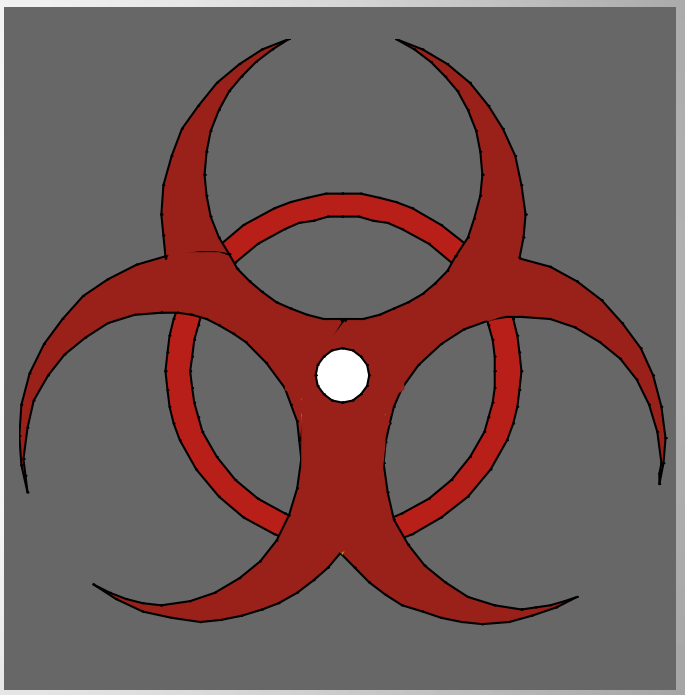
- Needles and razor blades
- Do not
  - remove needles from syringes
  - recap syringes
- Dispose only in a red sharps container

- If a needle has come in contact with a potentially infectious agent, it should be treated as *infectious waste*

Biological Agents

Infectious Agents

Any type of microorganism, helminth, or virus that causes, or significantly contributes to, increased morbidity or mortality in human beings



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Biological Agents

Biological Safety Levels (BSL)

BSL-1 Well characterized agents not known to cause disease in healthy adult humans

non pathogenic viruses and bacteria

BSL-2 Agents with moderate potential hazard that cause only mild disease to humans, or are difficult to contract in a lab

mumps, measles, salmonella, Lyme disease

BSL-3 Agents that may cause serious or potentially lethal disease in humans; vaccines or other treatments exist

West Nile virus, mycobacterium tuberculosis

BSL-4 Dangerous or exotic agents which cause severe to fatal disease in humans; no vaccines or other treatments exist

Ebola, Smallpox and Marburg viruses

Biological Agents

Work Requiring Approval of the
Institutional Biosafety Committee (IBC)

http://www.units.muohio.edu/compliance/biosafety/index.htm

- Work involving select agents or toxins
- Work involving recombinant DNA
- Work requiring facilities above BSL-2

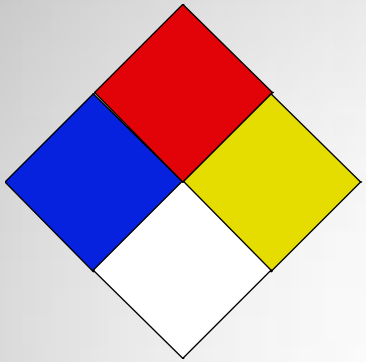
Animal Involvement

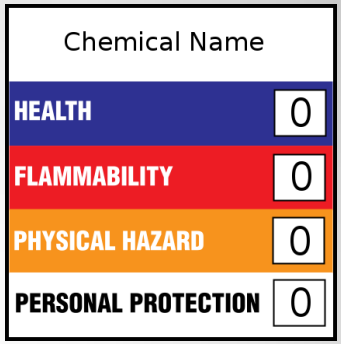
Use of Animals Requires Approval from the

Institutional Animal Care and Use Committee (IACUC)

http://www.units.muohio.edu/compliance/iacuc/index.htm

Chemical Hazard Categories





NFPA Fire Diamond

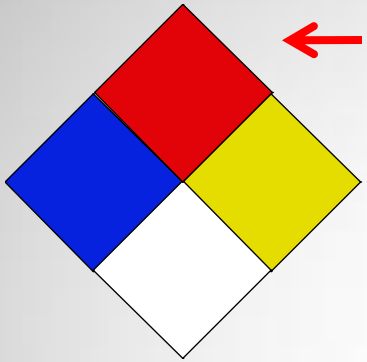
Red	*Flammability*
Blue	*Health*
Yellow	*Instability/Reactivity*
White	*Special Hazards*

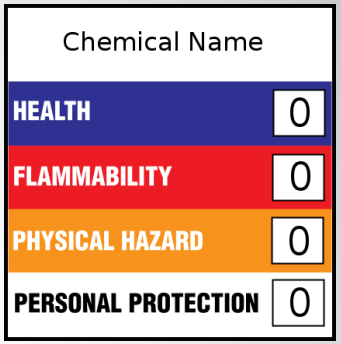
HMIS label

Red	*Flammability*
Blue	*Health*
Orange	*Physical Hazard*
White	*Personal Protection*

Many chemicals present multiple hazards

Flammability

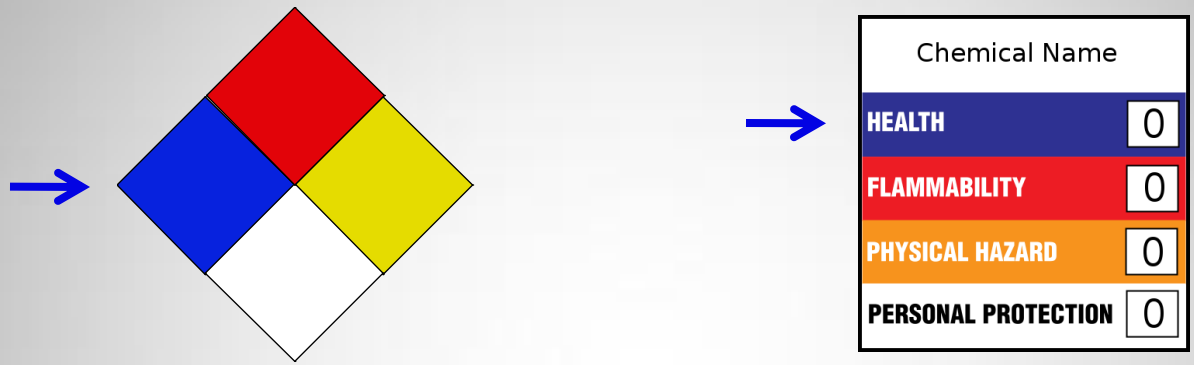




How readily will a solid, liquid, vapor, or gas ignite and burn?

Common Solvents			
Acetone	3	Toluene	3
Methanol	3	Ethanol	3
Ether	4	Xylene	3

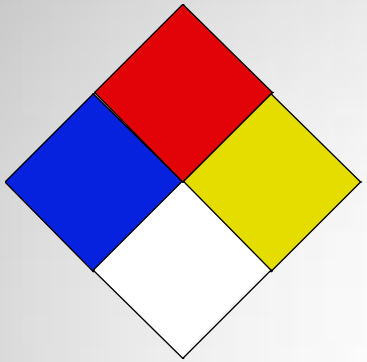
Health



What is the toxicity of the substance?

Poisons			
Chlorine	3	Hydrofluoric acid	4
Hydrogen cyanide	4	Hydrogen sulfide	4
Sulfuric acid	3	Phenol	3

Instability/Reactivity



Relative measurement of the material's stability

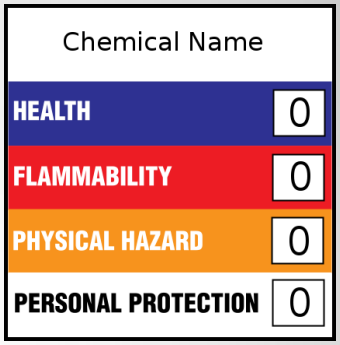
Reactives

picric acid (shock-sensitive)

sodium and potassium (air/water reactive)

nitro and diazo compounds (chemical instability)

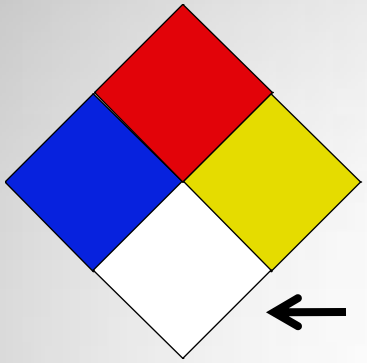
Physical Hazard

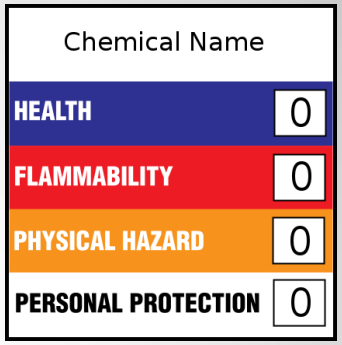


OSHA-defined Hazard Categories

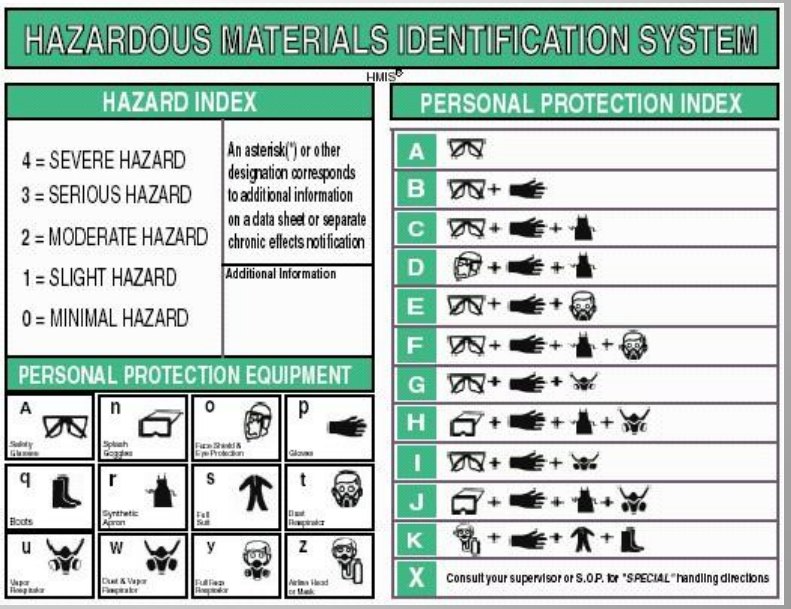
Water reactives
Organic peroxides
Explosives
Compressed gases
Pyrophoric materials
Oxidizers
Unstable reactives

Special Hazards Personal Protection





OX	oxidizer
ACID	acid
ALK	alkali
COR	corrosive
~~W~~	use NO WATER



Limiting Personal Exposure

Ensure Your Safety By Building Good Work Habits

In the laboratory, there should be no:

- *Eating*
- *Drinking*
- *Smoking*
- *Applying cosmetics*
- *Headphones*

No mouth pipetting!

Avoid working alone in the lab

Never work alone

if hazardous chemicals/equipment are involved

Limiting Personal Exposure

Know the hazards of the materials you will be using, before you use them

- Get hazard information from your PI or research advisor
- Consult the Material Safety Data Sheet (MSDS)

www.units.muohio.edu/ehso/

- Consult the scientific literature, or other resources

Transport and Storage

Handle Containers with Care

- Use a bucket to carry acids or bases
- Use a cart to transport two or more

Store Containers According to their Hazards

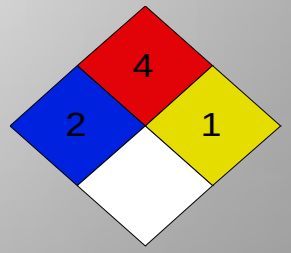
Flammable Liquids

Reactives

Acids/Bases

Oxidizers

Date Peroxide Forming Chemicals



Ethyl Ether

Storage

Never Store

Flammable liquids (*e.g.,* acetone, ethanol, benzene, xylene)

With

Oxidizers such as peroxides and inorganic acids (*e.g.*, nitric, sulfuric, hydrochloric, hydrofluoric, phosphoric, and perchloric acids)

Note: Glacial acetic acid is a flammable liquid

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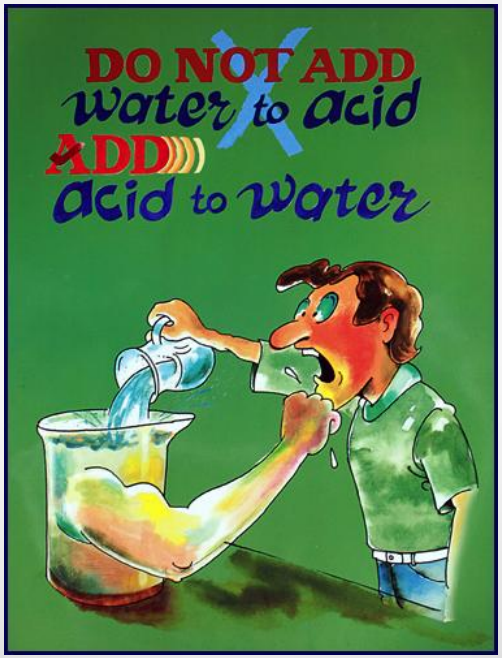
Acid Use

Never Add Water to an Acid



Always Add Acid to Water

Engineering Controls

Chemical fume hoods

Biological safety cabinets

- Class I
- Class II – Types A1, A2, B1, B2
- Class III

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Chemical Fume Hoods

Proper use of the Laboratory Fume Hood

- Keep sash closed
  when not performing work
- Work with the sash as low as possible
- Always work at least 4 inches
  from front of hood
- Electrical cords should run
  under base of sash rest
- *Not a storage cabinet*

Biological Safety Cabinets

Class II, type A1

Class II, type A2

Class II, type B1

HEPA – High Efficiency Particulate Air filter

A Clean Bench – *not to be confused*

Operates like a fume hood in reverse,
It blows filtered air into the room
For sample protection,
not for personal protection!

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Personal Protective Equipment

(PPE)

Proper Attire in the Laboratory

Long pants or skirts are recommended

Lab coats are also recommended

Closed-toe shoes are mandatory when working with chemicals or equipment

Eye Protection

Goggles are required when:

- using reactive reagents
- there is a risk of splash or aspiration

Safety glasses are sufficient when there is no risk of a splash

Chloroacetic acid splash

Exploding glassware

Ohio Law, Section 3313.643 of the Ohio Revised Code requires eye protection in all laboratories and anywhere chemicals are stored and/or handled

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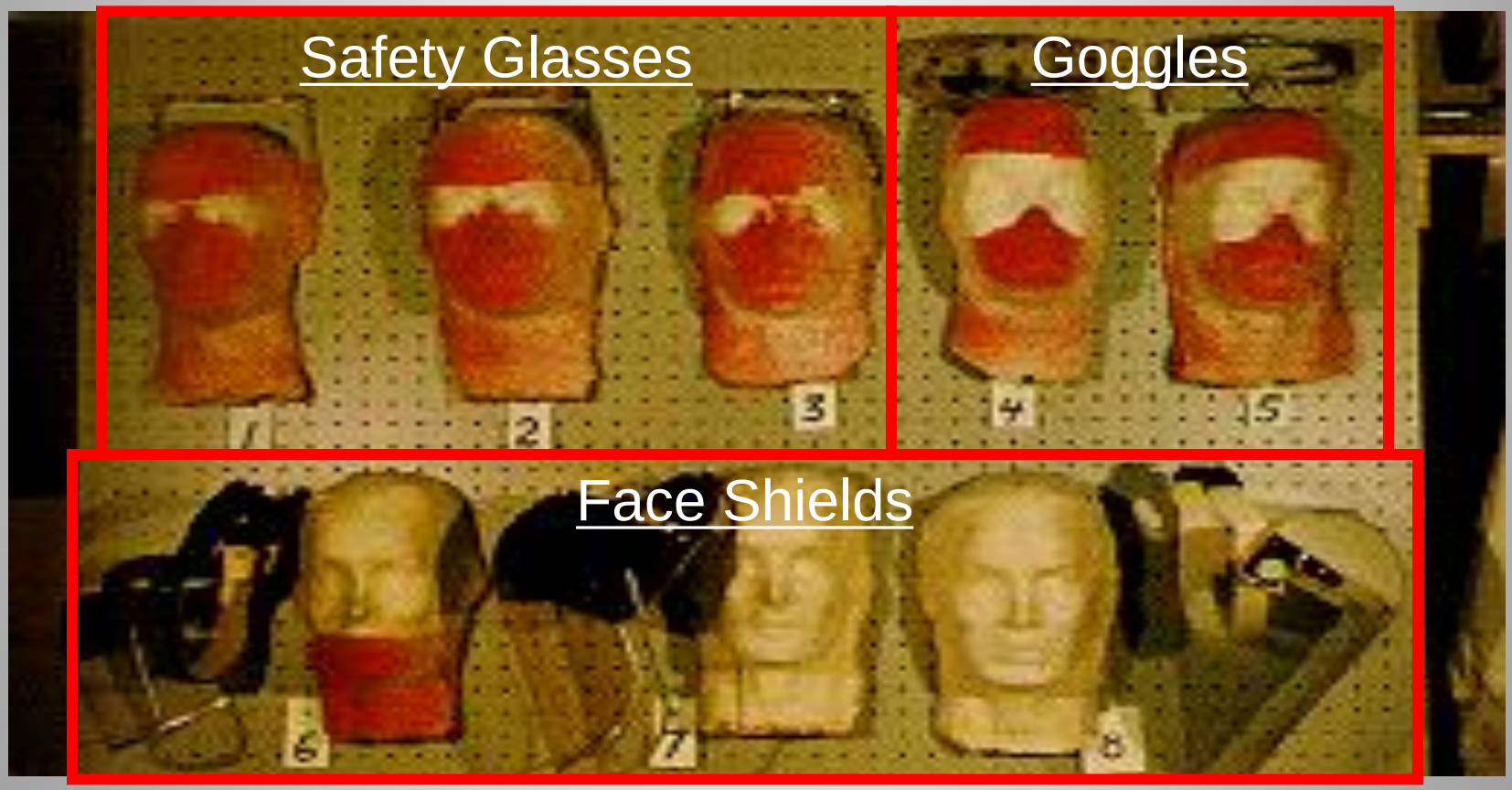
Levels of Eye Protection



Hand Protection

ethyl aziridinyl formate

aqueous bromine

All Gloves Are Not Created Equal

Selection Guide for Chemical Resistant Gloves

Glove Material	Chemical Resistant To:	Not Recommended For:
Nitrile rubber	solvents, oils, alcohols, some acids and caustics	ketones, oxidizing acids and nitrogen-containing organics
Natural (latex) rubber	alcohols, acids, caustics and ketones	aromatics and halogenated solvents
Neoprene	organic acids, caustics, peroxides, alcohols, phenols and petroleum-based solvents	aromatics and halogenated solvents
Viton	alcohols, halogenated and aromatic solvents	
Butyl rubber	organics, ketones, esters	aliphatic and aromatic hydrocarbons, halogenated hydrocarbons and gasoline
Polyvinylchloride (PVC)	alcohols, acids, caustics	aromatics and halogenated solvents
Polyvinyl alcohol (PVA)	most solvents, *including aromatics and halogenated solvents*	aqueous solutions, alcohols, inorganic acids and caustics

Industrial Hygiene Reference & Study Guide, First Edition
http://www2.umdnj.edu/eohssweb/aiha/technical/ppe.htm#Gloves/Chemical

Personal Hygiene

Wash your hands after handling chemicals *even if you were wearing gloves*

Always remove your gloves and discard them before you leave the laboratory *for any reason!*

Each pair of gloves costs just a few pennies
In trying to save that few pennies,
by not taking them off before you…
take something to another lab
take a sample to the NMR
go to the bathroom
Every doorknob you touch,
every keyboard you type on…
Exposes multiple people to the same chemicals
that you are trying to protect yourself from
by wearing gloves!
Be courteous…
Remove your gloves and discard them
BEFORE YOU STEP INTO THE HALLWAY

Waste Disposal

Chemical waste must be

- Segregated and stored properly
- Labeled properly
- Sealable containers

that are compatible with the material

When the containers are full…

http://www.units.muohio.edu/ehso/ChemHazWaste.html

The EHSO chemical, infectious & hazardous waste program

waste pick-up request

chemical waste guide

online training – chemical waste management

All wastes are managed through EHSO

Biological wastes, especially those generated by working with infectious materials, require special handling

Emergency Response

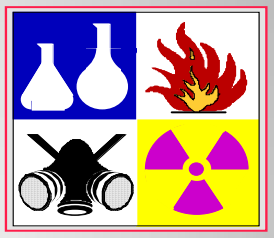
Chemical spills

Small (< 1 gal.)

use good judgement

Large amount, or hazardous material

contact EHSO



In Case of Fire

Extinguish small fires

only if you are trained

to use one of these →

Leave by the nearest exit and

pull the alarm on the way out

Emergency Response

Chemical Exposure

Skin

Cleanse thoroughly with water for 15 minutes. Speed is important, do not wait.

Eyes

Hold eyelids open and wash eyes with gentle stream of water for 15 minutes.

Emergency Response

Cuts and Abrasions

If minor, apply good judgement and treat as needed

If serious, call 911 – again, time is critical

If you choose to assist, in either case,
USE UNIVERSAL PRECAUTIONS

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Report Unsafe Practices and Conditions

Immediately notify your Supervisor, Faculty Advisor and/or Laboratory Manager of any situation you perceive to be unsafe

Do not continue work if you suspect a safety problem

When In Doubt . . . ASK!!!