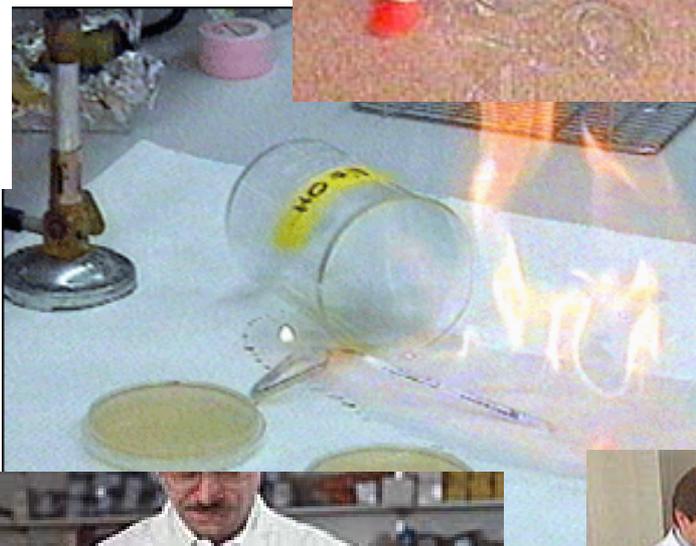
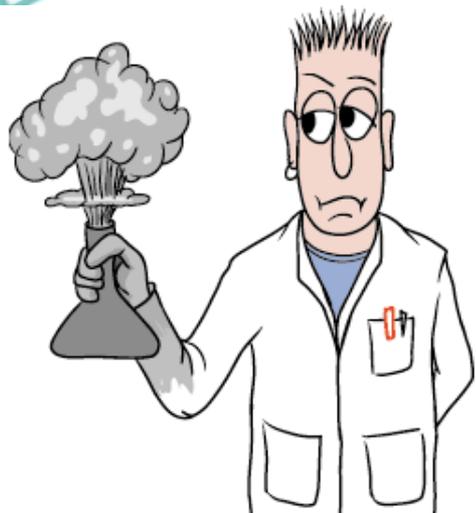


# Other Hazards in a Chemical Laboratory





# Physical Hazards

---

**Conditions, besides chemical, biological or radiological conditions or circumstances, that can cause injury, illness and death:**

**Fire / Asbestos**

**Centrifuges**

**Cryogenics**

**Ergonomic**

**Office**

**Physical stress/strain**

**Construction**

**Noise**

**Heat/cold**

**Sunlight**

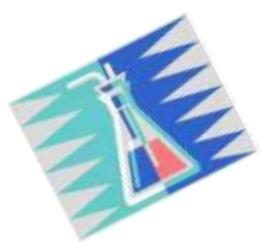
**Non-ionizing radiation**

**Mechanical**

**Electrical**

**Housekeeping**

**Spills/trips**



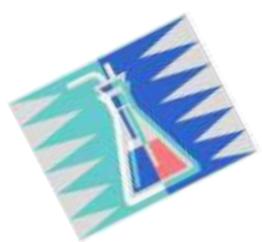
# Asbestos-Containing Materials

---

- **Gloves**
- **Lab hoods**
- **Lab benches**







# Centrifuge Equipment

- **Uses**
- **Hazards**
- **Control of hazards**
  - Only authorized users can use equipment
  - Users must be trained
  - Assign responsibility to lab tech
  - Include in periodic lab inspections





- Rotor
- Drive Shaft
- Motor
- Cabinet provides varying degrees of protection



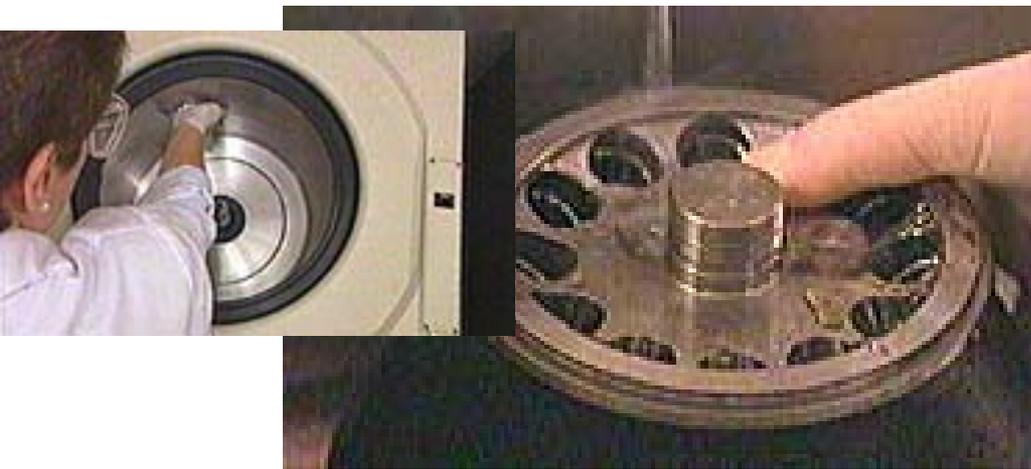
# Centrifuge Safety



Don't overload ...



Check rotor for cracks



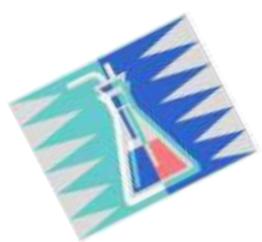
Keep rotor and centrifuge clean ...



Set it up right...



Alon	Low	5/11/03	✓	11,000	1.5h	✓
Alon	Low	5/11/03	✓	11,000	1.5h	✓
Alon	Low	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
JZ	Low	6/1/03	✓	11,000	1.5h	✓
Edina	Low	6/1/03	✓	11,000	1.5h	✓
Yao	Repair	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
Shi	Repair	6/1/03	✓	11,000	1.5h	✓
JZ	Low	6/1/03	✓	11,000	1.5h	✓
JZ	Low	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
DZ	Low	6/1/03	✓	11,000	1.5h	✓
M.W	Low	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
Yao	Repair	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
Yao	Repair	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
William	Low	6/1/03	✓	11,000	1.5h	✓
JZ	Low	6/1/03	✓	11,000	1.5h	✓

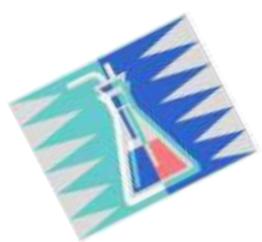


# Chemical storage: Cryogenics

---

- **Store cryogenics separately from other chemicals**
- **Store cryogenics (liquid nitrogen) & dry ice in well ventilated areas**
- **Use proper PPE (including eye protection) when handling & moving cryogenics**
- **Do not use cryogenics in closed areas**



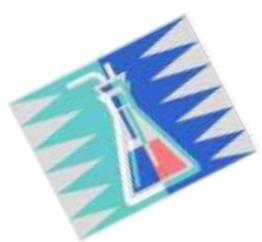


# Cryogenics

- What are they?
- Uses
- Hazards
- Control
  - training
  - inspection



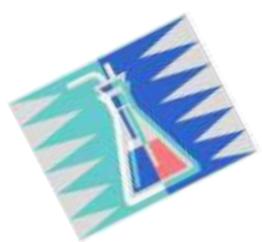




# Cyrogen Storage



**Exploding liquid nitrogen  
cylinder ruins lab.**

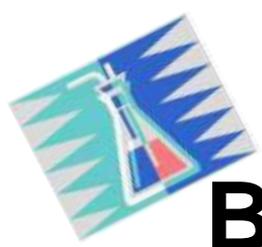


# Dry Ice

---

- **What is dry ice?**
- **Uses**
- **Hazards**
- **Control measures**





# Blocked Eyewash & Safety Shower





# Dirty Eyewash Station





# Blocked Eye Wash Station



Handwritten notes on a piece of paper, possibly a checklist or log, with a hole punch at the top. The text is illegible due to blurriness and handwriting.

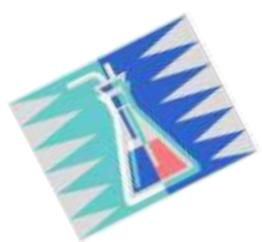


# Housekeeping









# Dangerous Housekeeping

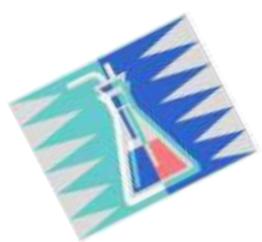


**Don't block hood  
air flow.**

---

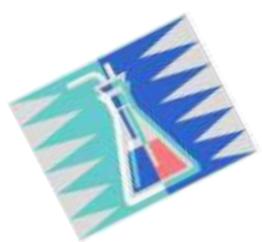
**Place large  
equipment in a  
hood on 5 cm  
blocks to allow air  
flow around and  
under equipment.**





**Safety shields  
can block  
airflow and  
reduce hood  
effectiveness.**





# Don't block hallways and exits!

---





**Access to  
emergency  
equipment is  
essential.**

**Always check  
that  
equipment is  
not blocked.**





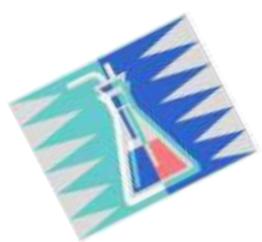
# Unsafe Transport of Gas Cylinders





# What's Wrong With This Picture?



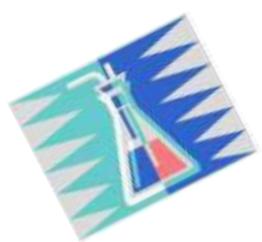


# Electrical Hazards

---

- **Can be a significant problem**
  - Frayed cords, no UL-listing, overloaded circuits
  - Static electricity
- **Hazards**
  - Fires, electrical shock, power outages
- **Control**
  - Inspect, act immediately, education

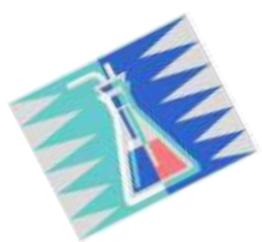




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**Check to see that all outlets are grounded and that the polarity is correct.**





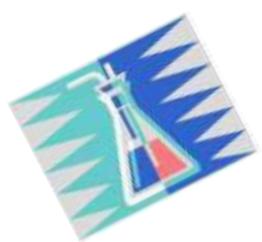
**Storage should be at least 1 m from electrical panels, mechanical rooms, air ducts, heaters, light fixtures.**

**Don't store combustibles in mechanical rooms or electrical closets.**

**In emergencies it may be necessary to access these panels quickly.**



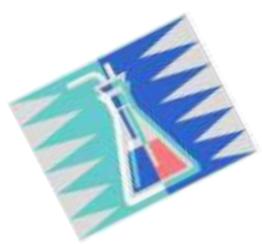




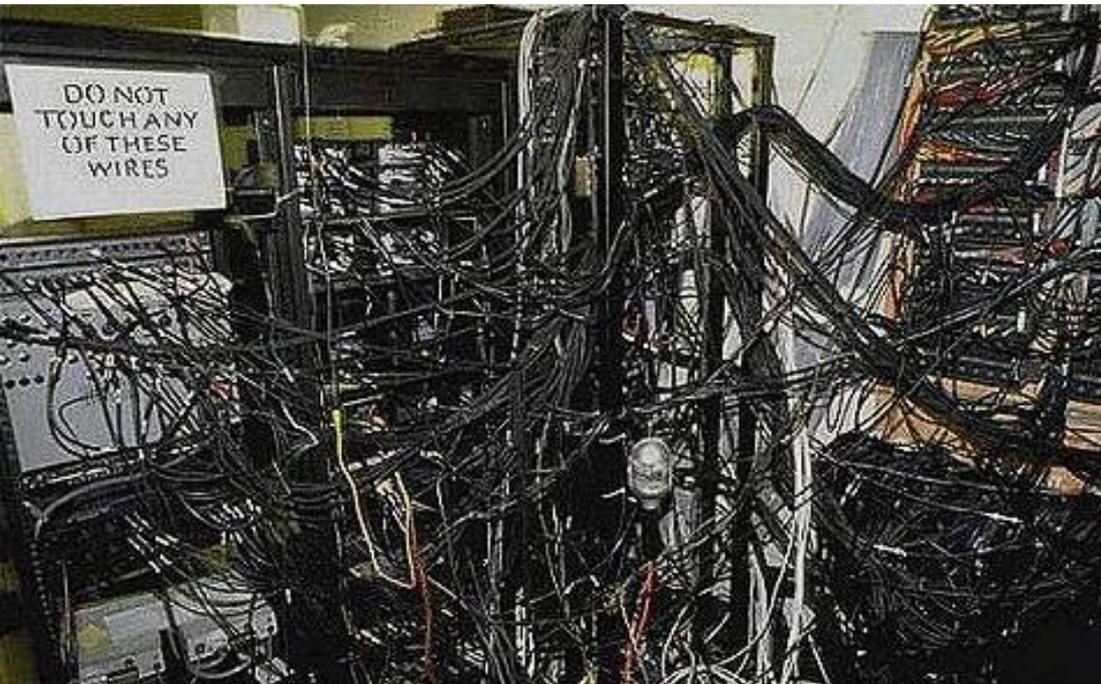
**Multi-outlet strips must be approved and not used for high-amp equipment.**

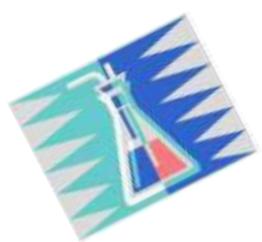
**(e.g., ovens, refrigerators)**





# Don't Do This...



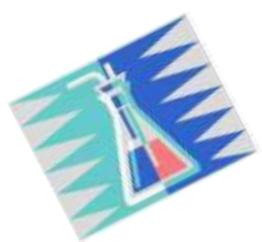


# Heating Mantles

---

- **Uses**
- **Hazards**
- **Unshielded rheostats**
- **Control measures**

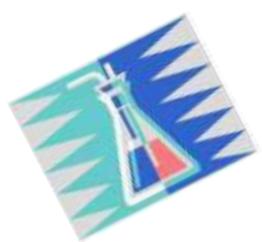




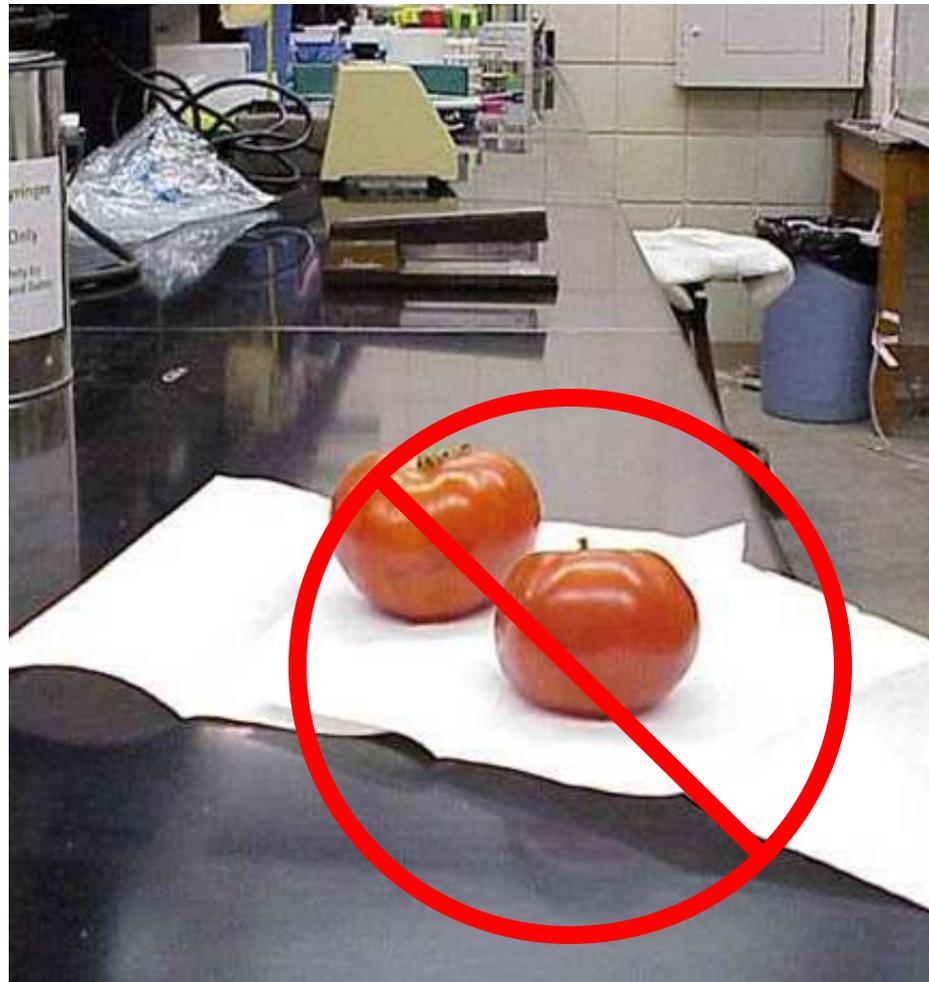
# Working Alone/Unattended Operations

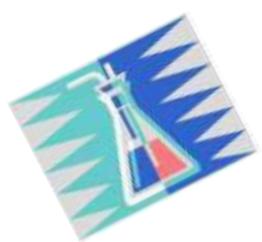
---

- **Working Alone**
  - *Avoid!*
  - **Murphy's Law will get you!**  
(Anything that can go wrong, will go wrong!)
  - Use the “Buddy System”
- **Unattended Operations/Reactions**
  - **Caution! Prime sources of fires, spills and explosions**
  - **Check periodically!**
  - **Fail-safe provisions**
  - **Leave the lights on to indicate the presence of an unattended activity**
  - *Post appropriate signs and emergency phone #'s*
  - **Notify those potentially impacted by malfunction**



**Food is never  
allowed in  
laboratories.**

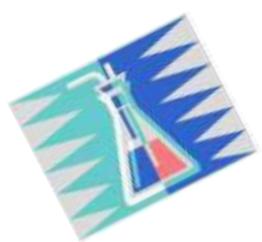




**Open-toed shoes are not allowed in laboratories.**

**Employees are not allowed to wear gloves, lab coats or other PPE outside the lab.**





# Ergonomics

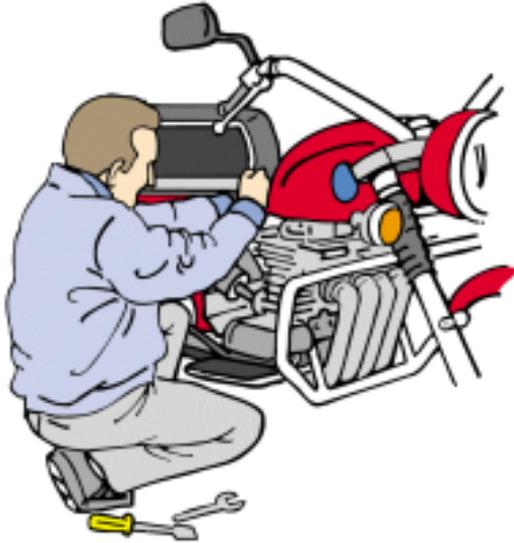
- **Types of hazards**



- **Why be concerned with Ergonomics?**



# Awkward Posture



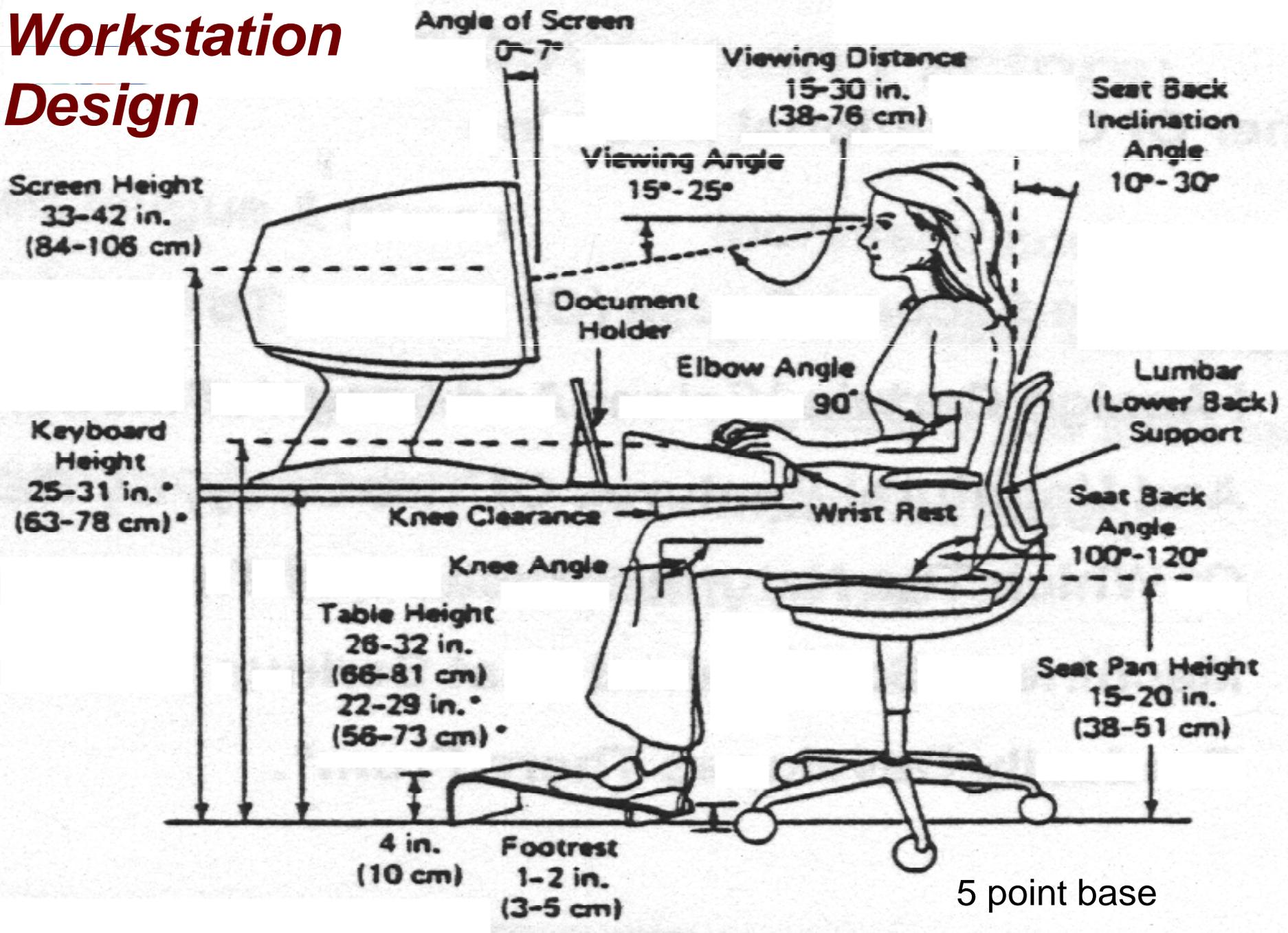
**Too low**

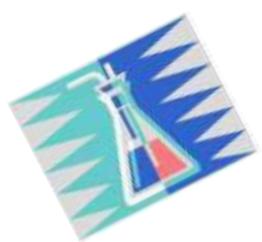
**Too far away**



**Too high**

# Workstation Design



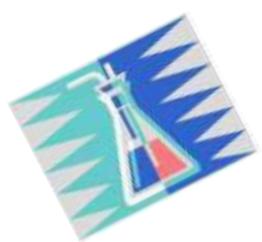


# Workstation Design Rules

---

- **Chairs: 5 cm and 110 degree rule**
  - Adequate lumbar support
- **Neutral wrist position**
- **Elbow 90 degree at “keyboard home row”**
- **Screen below eye level**
  - Copy at same height
- **Illumination: prevention of glare**
- **Breaks: rest eyes and body**



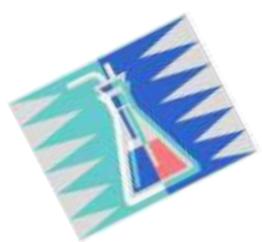


# Repetitive Motion Disorders

---

About 15 to 20% of workers in jobs requiring highly repetitive motion of shoulders, arms, wrists or hands develop repetitive motion disorders.

<u>Disorder</u>	<u>Affected Site</u>
Carpal Tunnel Syndrome	Wrist
Tendonitis	Elbow, wrist, hand
Tenosynovitis	Elbow, wrist, hand
Epicondylitis	Tennis elbow
Reynaud's phenomenon	"White finger"
Ulnar neuropathy	Fingers



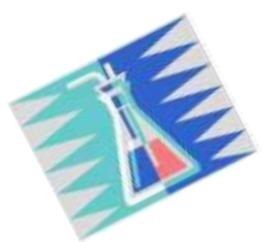
# Freezers



- Precautions
  - *No dry ice in freezers!*
  - Improper storage
- PPE

- Ultra low temperatures
  - $-20^{\circ}\text{C}$ ,  $-80^{\circ}\text{C}$
  - Upright vs. walk-in
- Emergency power
- Labels





# Glassware Handling

- **Potential Hazards**
  - Ergonomics
  - High temperature
  - Broken glassware
  - Improper use
- **Control**
  - Inspection
  - Training

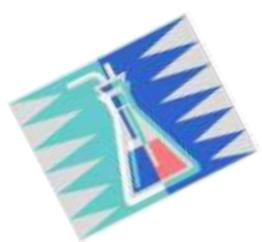


**Beware of contaminated  
Glassware, especially if broken!**



# Autoclave Explosion



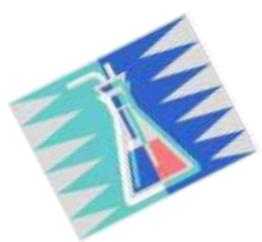


# High Pressure Reactions

- **Experiments carried out at pressures above 1 atmosphere (~1bar, 760 Torr, ~100,000 Pa).**
  - Use of supercritical fluids (CO<sub>2</sub>)
- **Hazards**
  - Explosions, equipment failure
- **Control Measures**
  - SOPs, training, engineering controls, inspection



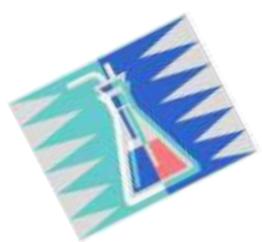




# Vacuum Work

- **Uses**
  - Aspiration
- **Hazards**
  - Injury due to glass breakage
  - Toxicity of chemical contained in vacuum
  - Fire following flask breakage
  - Contaminated pump oil
- **Control Measures**
  - SOPs, inspection, education

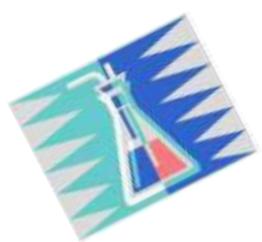




**Mechanical hazards like open drive belts with pinch points must have shields and guards.**

**Oil pumps need drip pans to contain oil.**



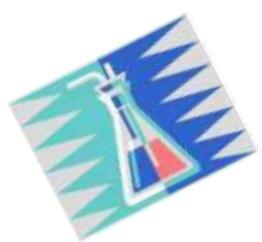


# Noise

---

- **Elevated noise levels can be a problem.**
- **Potential Hazards**
  - **Example: bone-cutting saws, mechanical water aspirators.**
- **Control Measures**
  - **Inspections, PPE, warning labels, training.**

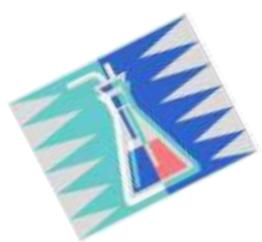




# Magnetic Fields

- Uses – NMR, MRI
- Hazards
  - Magnetic field
  - High voltage
  - Cryogenic liquids
    - e.g., nitrogen, helium
  - Other hazardous materials in lab
- Control Measures
  - Control access to area
  - Training
  - Warning signs

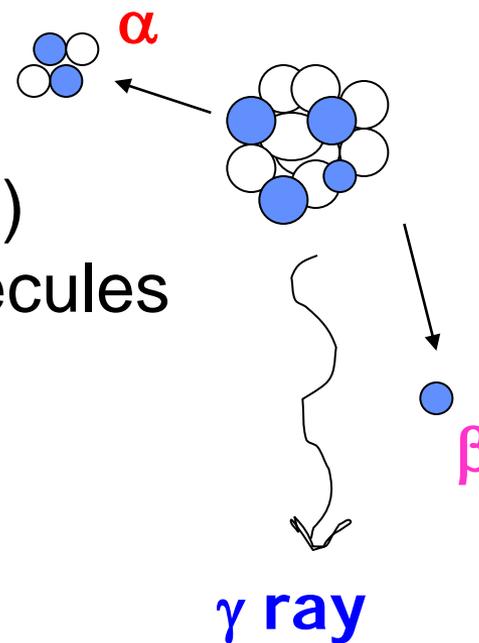




# Ionizing vs. Non-ionizing Radiation

## ❖ IONIZING RADIATION

- Particulate or electromagnetic
- Charged ( $\alpha$ ,  $\beta$ ) or uncharged ( $\gamma$ , X, n)
- Causes **ionization** of atoms or molecules



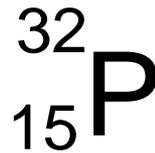
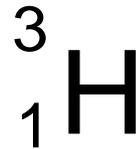
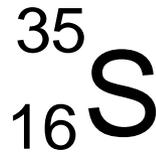
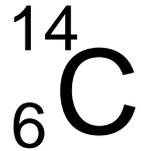
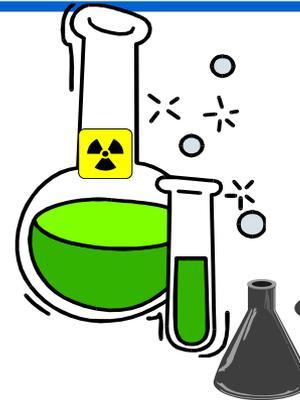
## ❖ NON-IONIZING RADIATION

- Electromagnetic (UV, IR, MW, RF)
- Can not ionize atoms or molecules



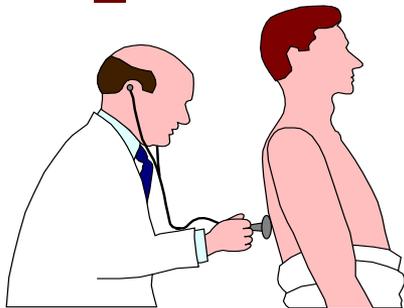
# Common Uses of Ionizing Radiation

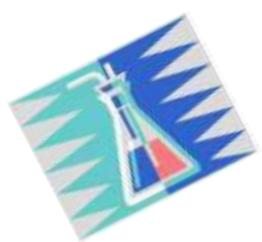
## Research & Development



## X-Rays

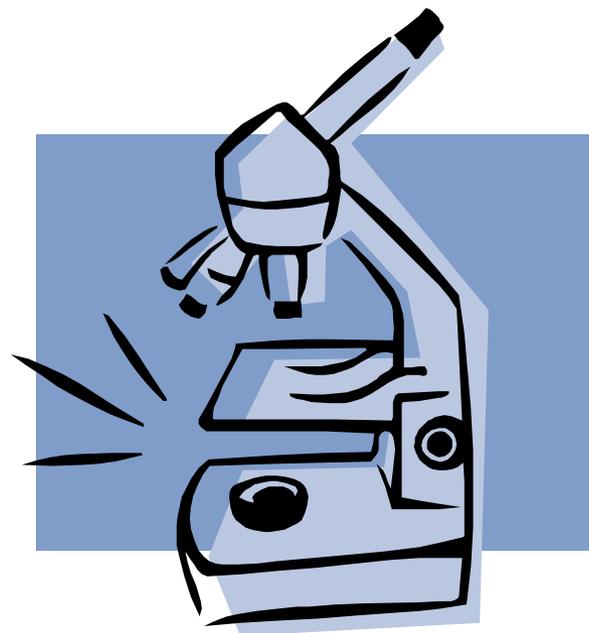
## Medical\_





# Electron Microscopes

- **Types**
  - SEM, TEM
- **Hazards**
  - X-rays
- **Control of hazard**
  - Periodic maintenance
  - Conduct radiation survey
  - Include in personnel radiation safety program





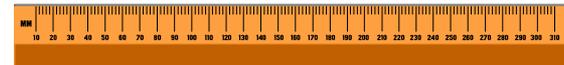
# Protect yourself by:

- **TIME** – Limit time near source

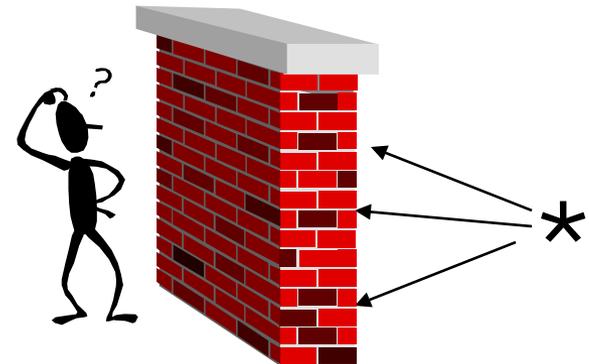


- **DISTANCE** – Stay away

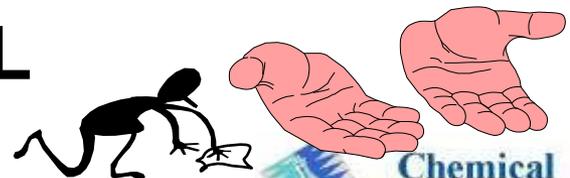
$$I_2 = I_1 \left( \frac{d_1}{d_2} \right)^2$$



- **SHIELDING** – Absorb energy

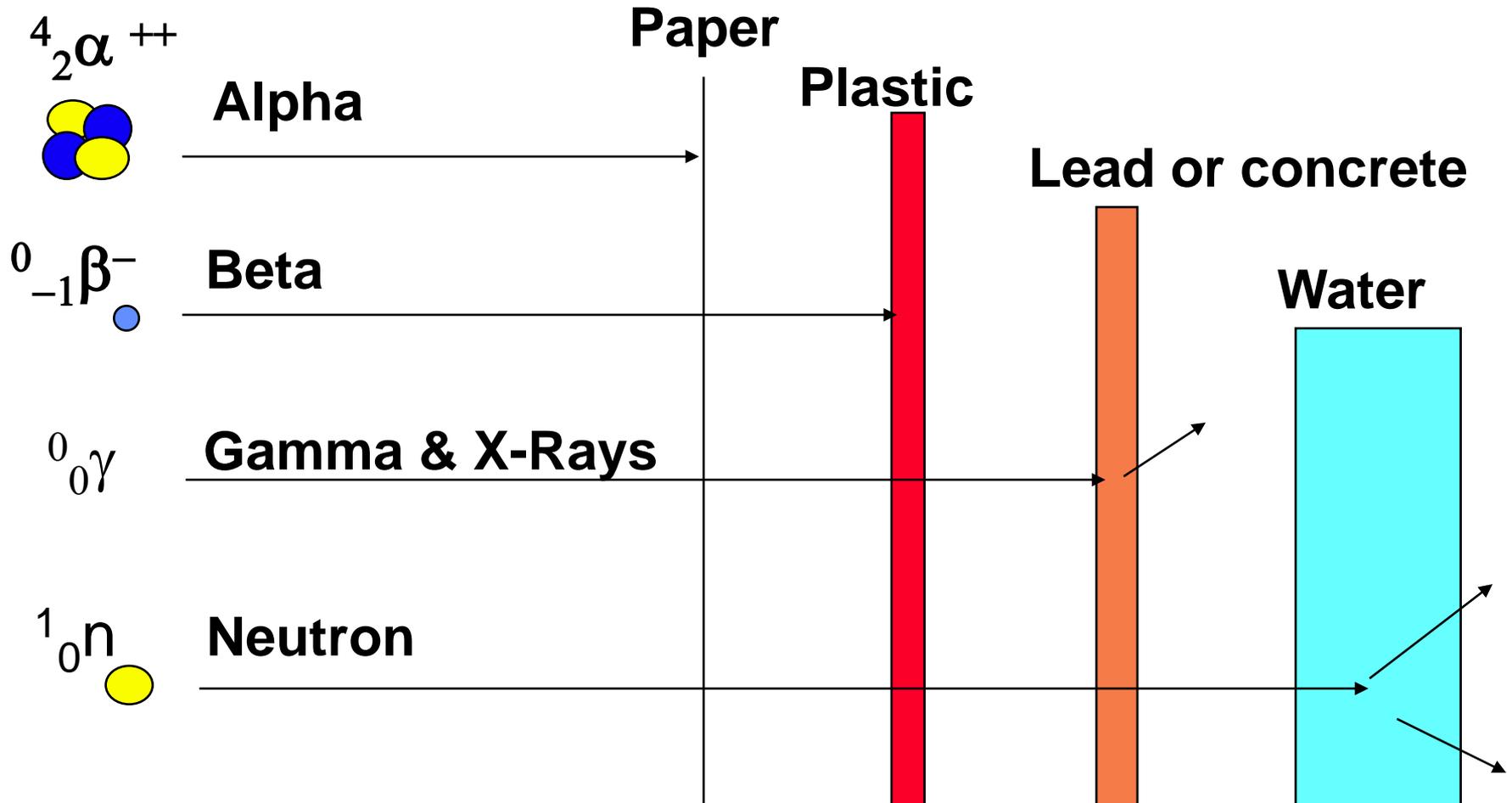


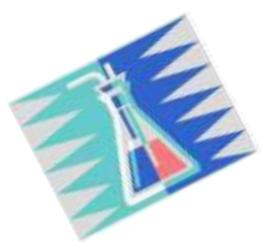
- **CONTAMINATION CONTROL**





# Shielding Materials





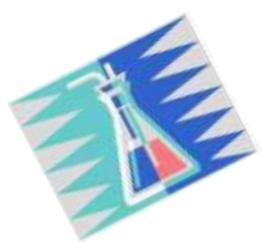
# Non-Ionizing Radiation

---

- **UV, Visible, IR, Lasers**
- **Hazards**
  - Skin erythema
  - Eye injuries
- **Control Measures**
  - Training, PPE, warning signs and labels, interlocks





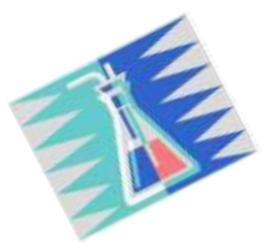


# Sharps, Needles, Blades

## Hazards

- Needlesticks
- Cuts
- Contamination

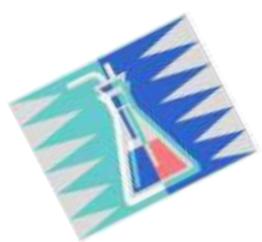




# Sharps, Needles, Blades

- **Control Measures**
  - SOPs
  - Training
  - Modify work practices
  - Engineering Controls

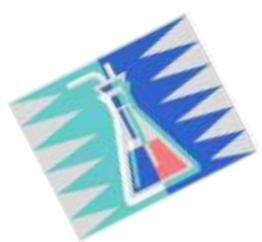




# Slips, Trips, Falls

- **Most common injuries**
- **Causes**
  - **Chemical spills and leaks**
  - **Improper work practices**
- **Control Measures**
  - **SOPs, proper equipment, effective communication, engineering controls**





# Control of Hazards

---

- **Think!**
- **Develop SOPs, safety manual, policies**
  - reviewed and approved by management
- **Research protocol review**
- **Install engineering controls**
- **Provide PPE**
- **Provide training**
- **Conduct inspections, routine & unannounced with lab supervisor**
- **Document and *follow-up***
- **Take action**



**Any Questions?**

