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Invent the Future

Institute for
Critical Technology and Applied Science

BIOHAZARD

Mohamed N. Seleem

Alice Evans
1881-1975

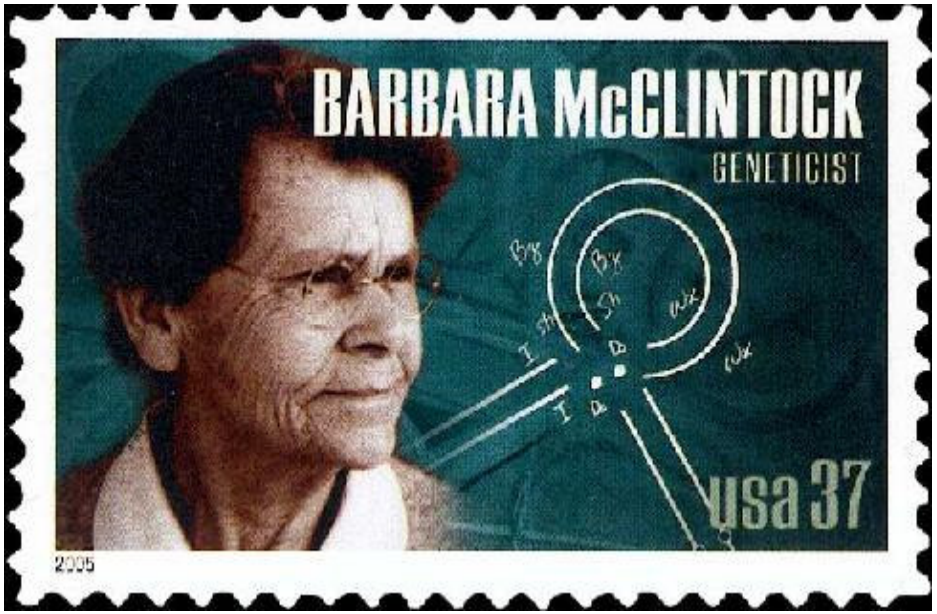
•1917 **Alice Evans**, of the Hygienic Laboratory of the U. S. Public Health Service (now the National Institute of Health) showed the close relationship between the two organisms (Bang's disease) (*M. melitensis*) and renamed the genus *Brucella* to honor Sir Bruce.

•**In 1922 Evans contracted brucellosis while doing research, and suffered from the disease for 30 years**. Evans' own chronic case of brucellosis went undetected for months. She identified it entirely by accident, while comparing her own blood against that of a sick assistant.

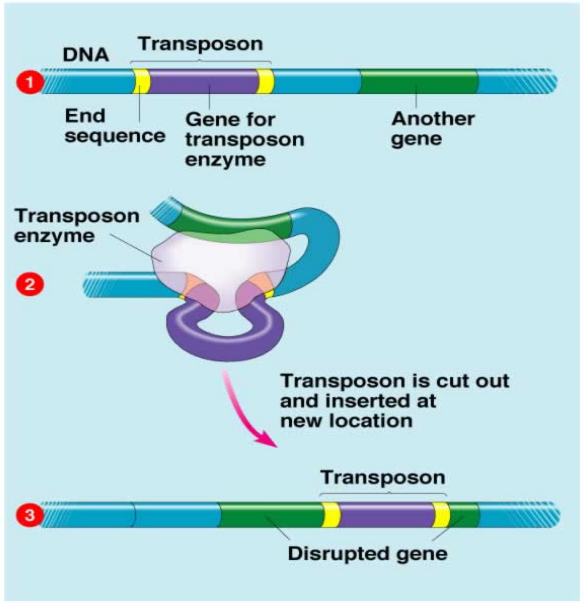
•USA was suffering from bang's disease (never thought it is zoonotic)" Dairy workers laughed at her warning that raw milk should be pasteurized to prevent people from developing disease

•Doctors eventually found brucellosis to be far more prevalent in the U.S. than they had realized. Mild forms of the disease had been misdiagnosed as influenza, while severe cases were confused with a number of diseases, including tuberculosis, typhoid fever, and malaria.

•The government enacted milk pasteurization laws.



Barbara McClintock (1902 – 1992) Cornell University



Jumping Genes 1952

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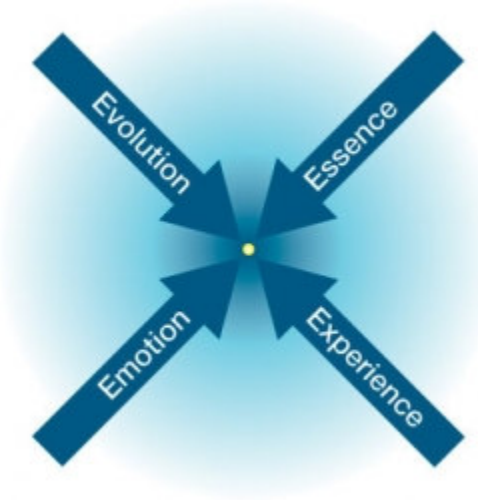
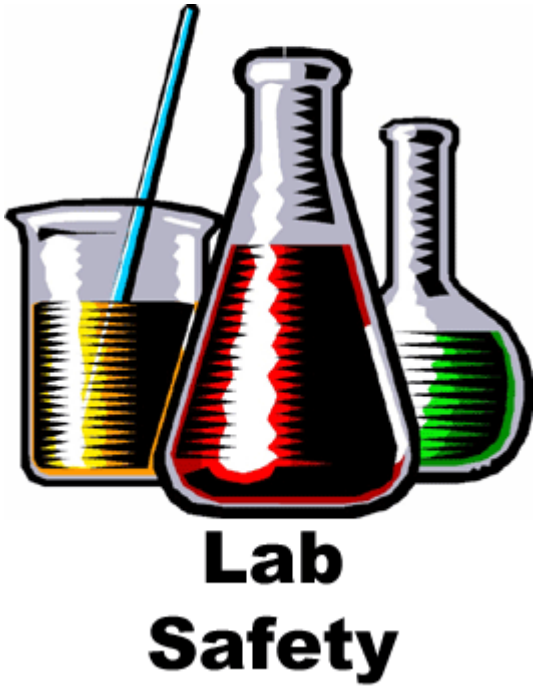


Assuming you are doing everything right

What can go wrong ?
How to handle it?

Case scenario



Needle stick

HIV, HCV & HBV
What is the risk?

	Hepatitis B (HBV)	Hepatitis C (HCV)	HIV
Estimated new cases each yr (general population)	78,000	25,000	5 million
Risk of infection after needlestick injury from infected source	6-30%	1.8%	0.3%
Treatment to prevent development of the disease	Vaccine Preventable Can be given HBIG if not previously vaccinated	NONE	Post-exposure prophylaxis reduces risk by 81%

Centrifugation

No inhalation (HBV)

Infectious agent (by inhalation)
(special centrifuge, special rotor,
special tube, special mask,
wait 30 minutes before opening

Biological Agent: Infectious dose

- The number of microorganisms required to initiate infection

  (Q fever, *Brucella*, *Francesilla*) 10 organisms by inhalation

E. coli	10^8 organisms by ingestion
Malaria	10 organisms by IV injection
Poliovirus 1	2 pfu by ingestion

Reference: Wedum, A.G., Barkley, W.E., and Hellman, A. 1972. *J Am Vet. Med Assoc.* 161:11, 1557-1567. Seleem et al., 2009.

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Vortexing

No Inhalation

Inhalation

Unknown

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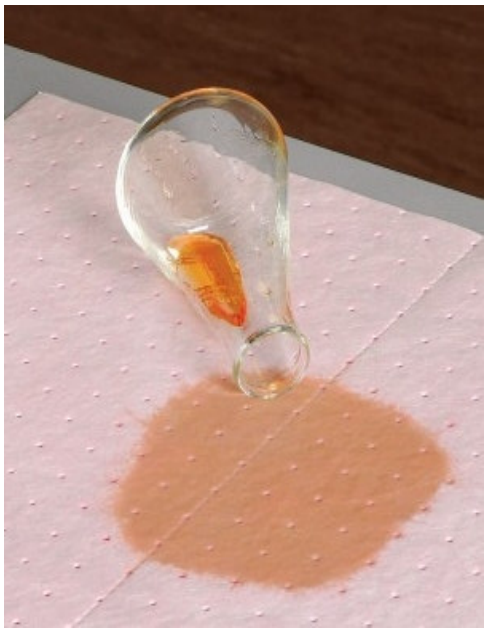
Spill

No Inhalation

Inhalation



Unknown

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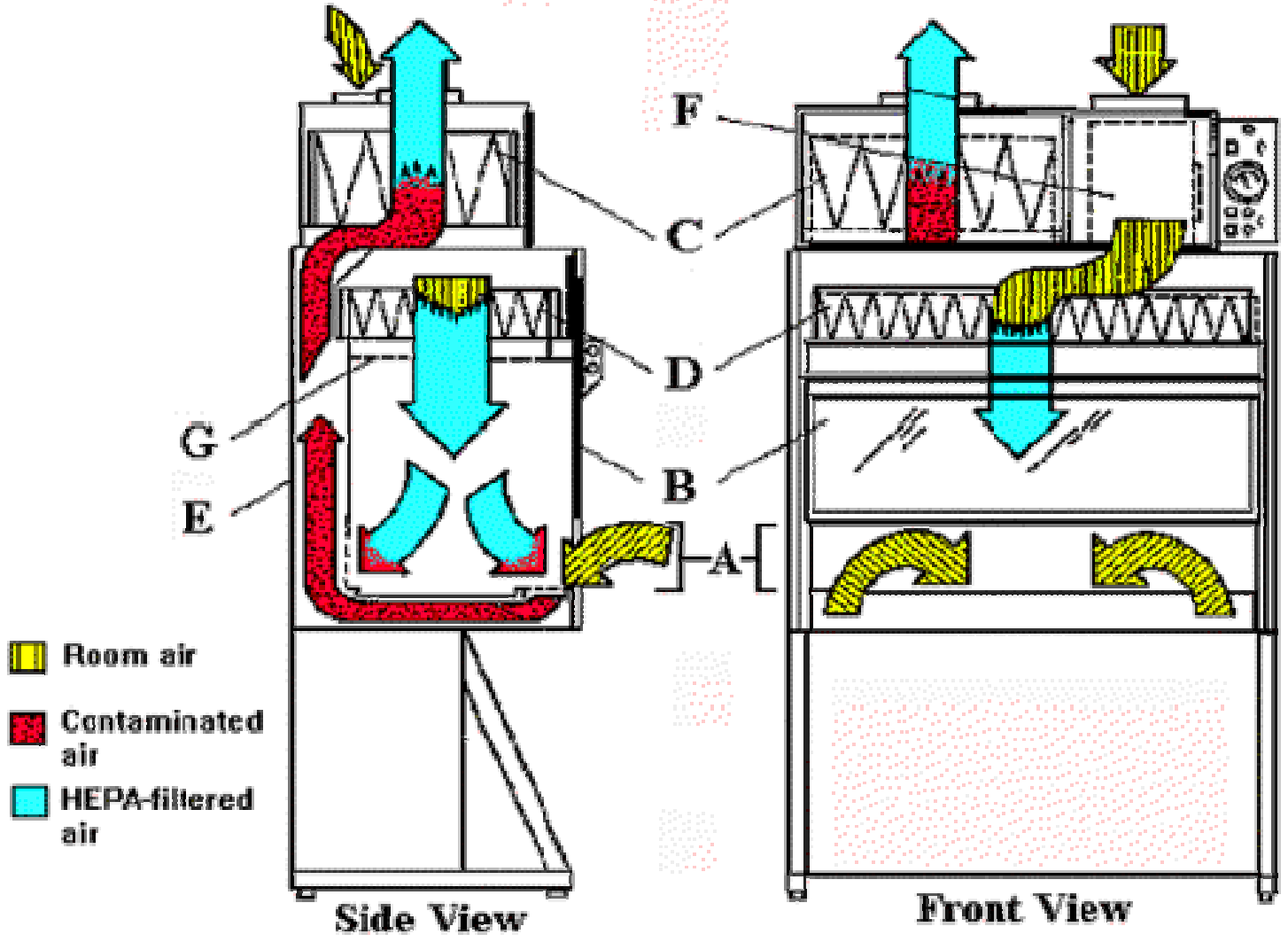
Shacking

No Inhalation

Inhalation

Unknown

Biological Safety Cabinet II type 2



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Chemical safety

Risk Factors
Read the sign

Intrinsic hazard associated with the substance

Severity of hazard

Low health hazard

Substances designated as irritant (those that affect the skin and sometimes the eyes)

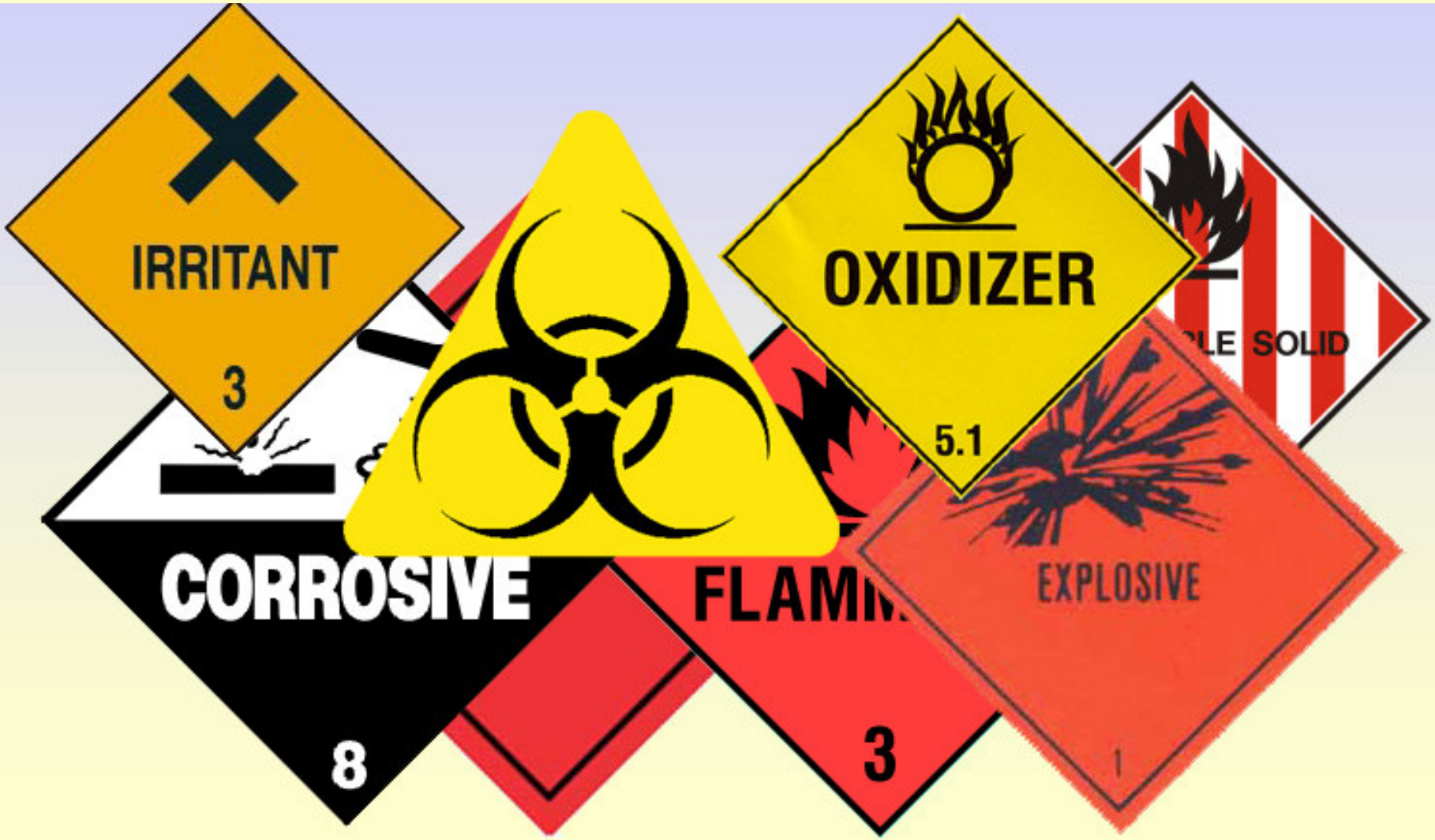
Medium health hazard

Substances designated as corrosive, irritant (particularly by the inhalation route) or harmful (particularly by the inhalation route)

High health hazard

Substances designated as toxic, very toxic, carcinogenic, mutagenic and those that may impair fertility or harm the unborn child

Chemical Categories



Physical Hazard…

Hazards due to physical characteristics of a chemical

Flammable - catches fire easily and burns rapidly.
Combustible - will burn under most conditions.
Explosive - will explode / detonate releasing hot gases.
Oxidizer - yields oxygen to enhance combustion, may cause ignition of combustibles with no external source.
Organic peroxide – bivalent – O – O – structure, tends to be reactive and unstable
Unstable – tends to decompose during normal handling and storage
Water reactive – reacts with water to release flammable gas or present a health hazard

Health Hazard…

Produces acute or chronic effects in exposed workers

Carcinogen – cause cancer or suspected cancer causer

Toxic agent – poisonous / cause acute or chronic effects

Reproductive toxin – could have harmful effect on male or female reproductive system or on developing fetus

Irritant – can cause inflammation of skin or eyes

Corrosive – cause irreversible damage to living tissue

Sensitizer – cause exposed persons to develop allergies to the substance

Target organ-specific agents – hazardous to specific organs in body (e.g., lungs, liver, blood, kidneys, nervous system)

Route of Entry…

For a chemical to have an effect on a worker, they must be exposed to it and some of it must get into their system

Inhalation / breathing – most common route, gases / vapors can pass to blood, solid particles inhaled into lungs.

Absorption through the skin – many solids, liquids, vapors and gases can be absorbed through the skin

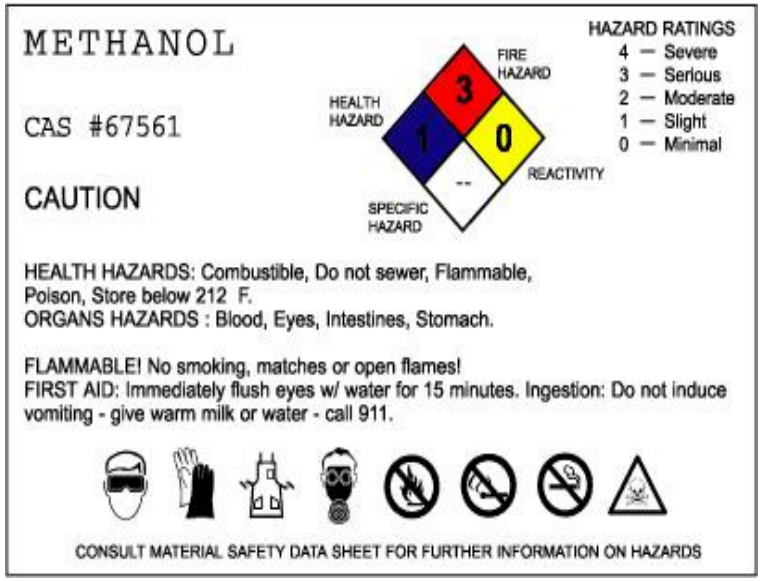
Ingestion / swallowing – while not intentional, failure to wash hands, eating in contaminated lab, etc.

Injection – accidents handling glass, sharps, etc.

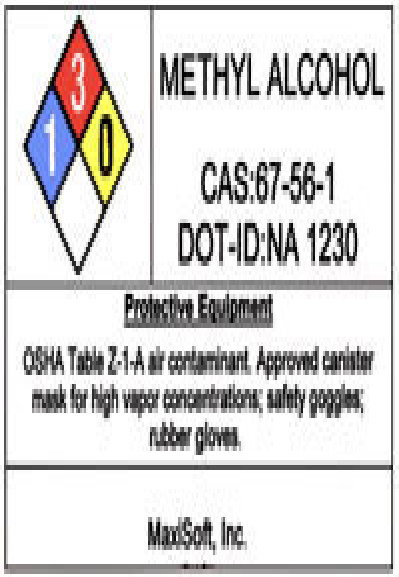
Eye contact – either physical damage or absorption

The route of entry dictates protective equipment


HEALTH HAZARD
4 - DEADLY
3 - EXTREME DANGER
2 - DANGEROUS
1 - SLIGHT HAZARD
0 - NO HAZARD
FIRE HAZARD
(FLASH POINTS)
4 - BELOW 73 °F
3 - BELOW 100 °F
2 - BELOW 200 °F
1 - ABOVE 200 °F
0 - WILL NOT BURN
FIRE
HEALTH
REACTIVITY
SPECIAL HAZARD
REACTIVITY
4 - MAY DETONATE
3 - EXPLOSIVE
2 - UNSTABLE
1 - NORMALLY STABLE
0 - STABLE
SPECIAL HAZARD
W - WATER REACTIVE
OX - OXIDIZER
- RADIOACTIVE


METHANOL
CAS #67561
CAUTION
HAZARD RATINGS
4 — Severe
3 — Serious
2 — Moderate
1 — Slight
0 — Minimal
FIRE HAZARD
HEALTH HAZARD
REACTIVITY
SPECIFIC HAZARD
3
1
0
--
HEALTH HAZARDS: Combustible, Do not sewer, Flammable, Poison, Store below 212 F.
ORGANS HAZARDS : Blood, Eyes, Intestines, Stomach.
FLAMMABLE! No smoking, matches or open flames!
FIRST AID: Immediately flush eyes w/ water for 15 minutes. Ingestion: Do not induce vomiting - give warm milk or water - call 911.
CONSULT MATERIAL SAFETY DATA SHEET FOR FURTHER INFORMATION ON HAZARDS


ACETONE
1 Health
3 Flammability
0 Reactivity
C Protective Equipment
HAZARD RATING
4 EXTREME
3 SERIOUS
2 MODERATE
1 SLIGHT
0 MINIMAL


3
1
0
METHYL ALCOHOL
CAS:67-56-1
DOT-ID:NA 1230
Protective Equipment
OSHA Table Z-1-A air contaminant. Approved canister mask for high vapor concentrations; safety goggles; rubber gloves.
MaxiSoft, Inc.

Cryogenic Materials…

Wear **face shields** during transfers, loose fitting, dry leather or **cryogenic gloves** and long pants

Chemical Disposal

Lab policy or university policy

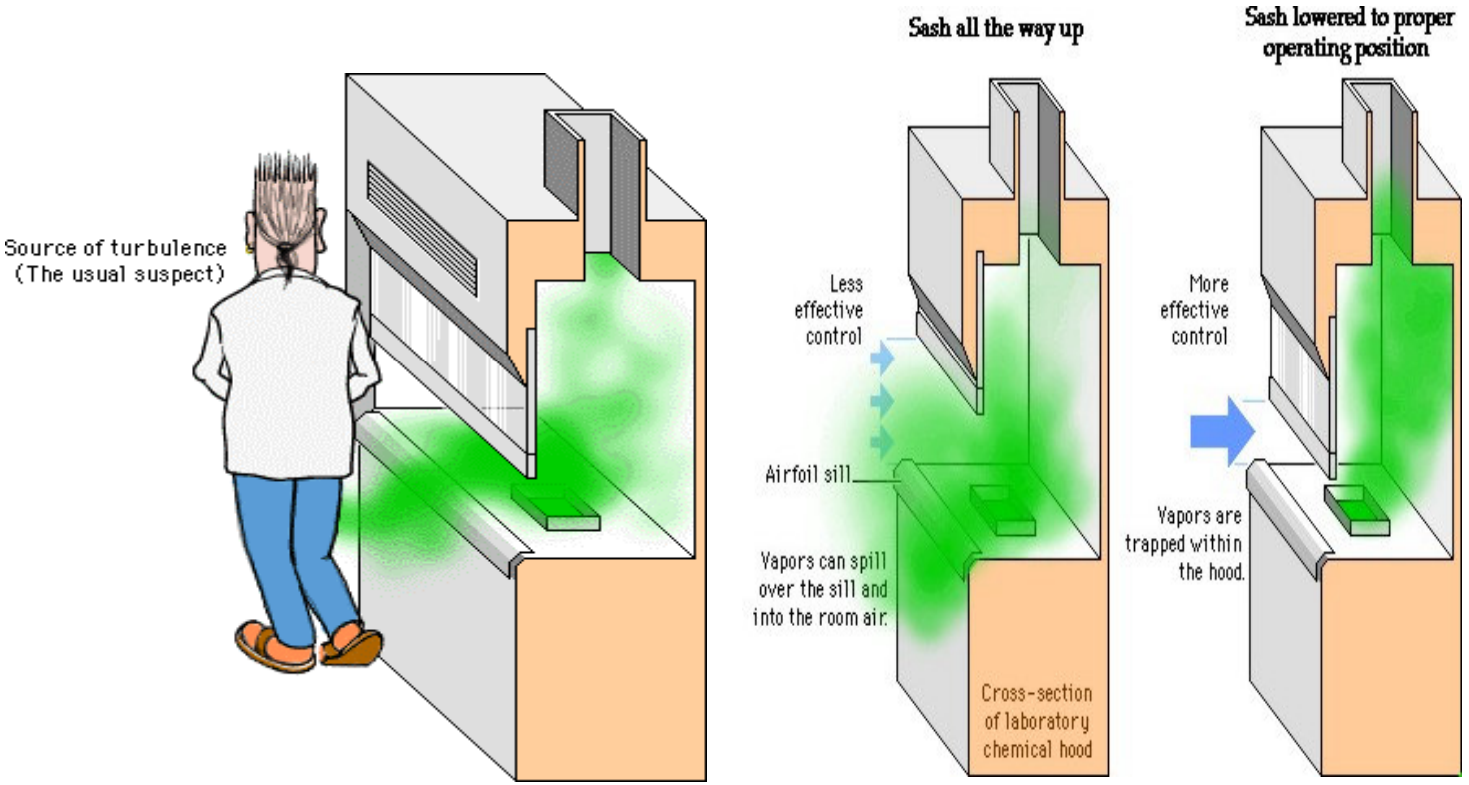
On site disposal

(hydrochloric, sulfuric, nitric)

Dilute with water 1:10 (Always A:W)

add sodium carbonate or calcium carbonate solution to drain solid trash

Fumigation Hood



Performance improves as sash opening decreases.

Chemical spill

Chemical Categories

1. Acids
2. Bases
3. Flammable
4. Oxidizers
5. Pyrophoric Substances
6. Light-Sensitive Chemicals
7. Carcinogens

Acids

Chemical Categories: Acids

Some pointers for safe storage of strong acids:

- **Store large bottles of acids on low shelf or in acid cabinets.**
- **Segregate oxidizing acids from organic acids, flammables and combustible materials.**
- **Segregate acids from bases and active metals such as sodium, potassium, etc.**
- **Use bottle carrier for transporting acid bottles.**
- **Have spill control pillows or acid neutralizers available in case of spill.**

Chemical Categories: Acids

Examples of strong acids:

Strong Oxidizing Acids	Organic Acids
Chromic Acids	Acetic Acid
Nitric Acid	Phenol
Hydrobromic Acid	Benzoic Acid
Perchloric Acid	Trichloroacetic
Iodic Acid	
Sulfuric Acid	

Bases

Chemical Categories: Bases

Some pointers for safe storage of strong bases:

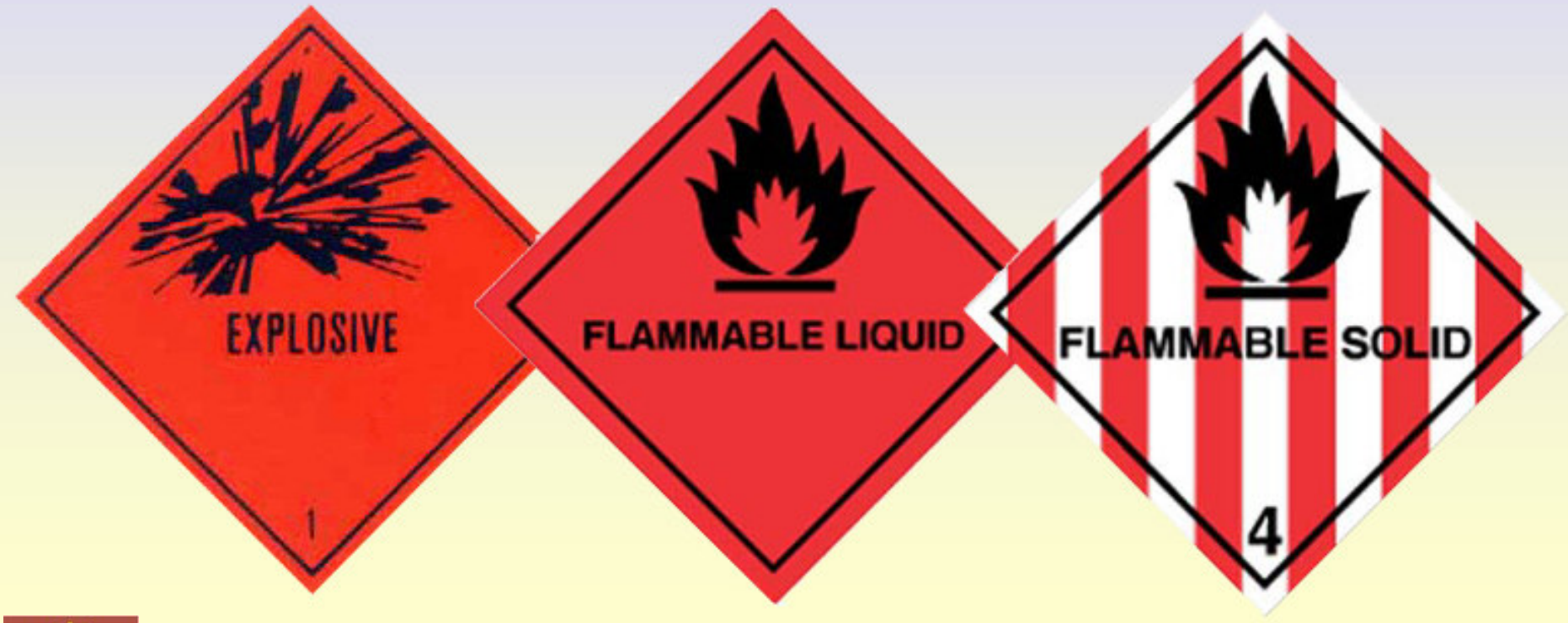
- **Store bases and acids separate from one another.**
- **Store solutions of inorganic hydroxides in polyethylene containers.**
- **Have spill control pillows or caustic neutralizers available for spills.**

Chemical Categories: Bases

Examples of strong bases:

Ammonium Hydroxide
Calcium Hydroxide
Bicarbonates
Potassium Hydroxide
Carbonates
Sodium Hydroxide

Flammable Chemicals



Chemical Categories: Flammable

Some pointers for storage of flammable materials:

- **Store in approved safety cans or cabinets**
- **Segregate from oxidizing acids and oxidizers.**
- **Keep away from any source of ignition: flames, heat or sparks.**
- **Know where fire fighting equipment is stored and how to use.**
- **If volatile flammable liquids are stored in a refrigerator it must be in an explosion-proof (lab-safe) refrigerator.**

Chemical Categories: Flammable

Examples of flammable chemicals:

Flammable Solids	Flammable Gases
Benzoyl peroxide Phosphorus (yellow) Calcium Carbide Picric Acids	Acetylene Ethylene Oxide Butane Hydrogen Ethane Propane Ethylene

Oxidizers

Chemical Categories: Oxidizers

Some examples of oxidizers:

- **Store in a cool, dry place.**
- **Keep away from flammable and combustible materials, such as paper or wood.**
- **Keep away from reducing agents such as zinc, alkaline metals, formic acid.**

Chemical Categories: Oxidizers

Examples of oxidizers:

Ammonium Dichromate
Nitrates
Ammonium Perchlorate
Periodic Acid
Ammonium Persulfate
Permanganic Acid
Benzoyl Peroxide

Pyrophoric Substances

Chemical Categories: Pyrophoric Substances

Safety pointers for pyrophoric substances:

- **Store in a cool place.**
- **Store in containers that omit air.**
- **Beware of low humidity circumstances in which static electricity may be high.**

Chemical Categories: Pyrophoric Substances

Some examples of pyrophoric substances:

Boron
Cadmium
Calcium
Phosphorus (yellow)
Diborane
Dichloroborane
2-Furaldehyde

Light-Sensitive Chemicals

Composition can change if exposed to light

Chemical Categories: Light-Sensitive Chemicals

Safety pointers for light-sensitive chemicals:

- **Avoid exposure to light.**
- **Store in amber bottles in a cool, dry place.**

Chemical Categories: Light-Sensitive Chemicals

Some examples of light-sensitive chemicals:

Bromine
Oleic Acid
Ethyl Ether
Potassium Ferricyanide
Silver Salts
Hydrobromic Acid
Sodium Iodide

Carcinogens

Chemical Categories: Carcinogens

Safe storage pointers for carcinogens:

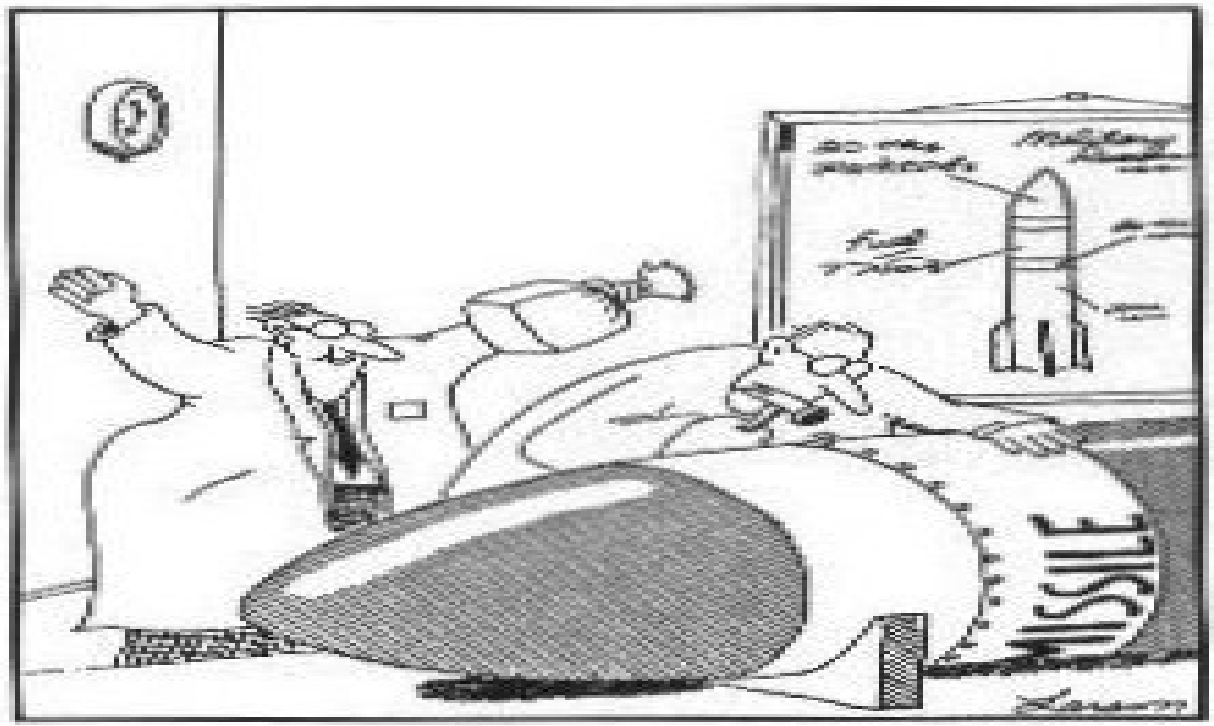
- **Label all containers as Cancer Suspect Agents.**
- **Store according to hazardous nature of chemicals, e.g., flammable, corrosive.**
- **When necessary, store securely.**

Chemical Categories: Carcinogens

Some examples of carcinogens:

Antimony compounds
Acrylonitrile
Arsenic compounds
Benzene
Chloroform
Dimethyl sulfate
Dioxane
Vinyl chloride

Lab Ergonomics



Pipetting Risk Factors

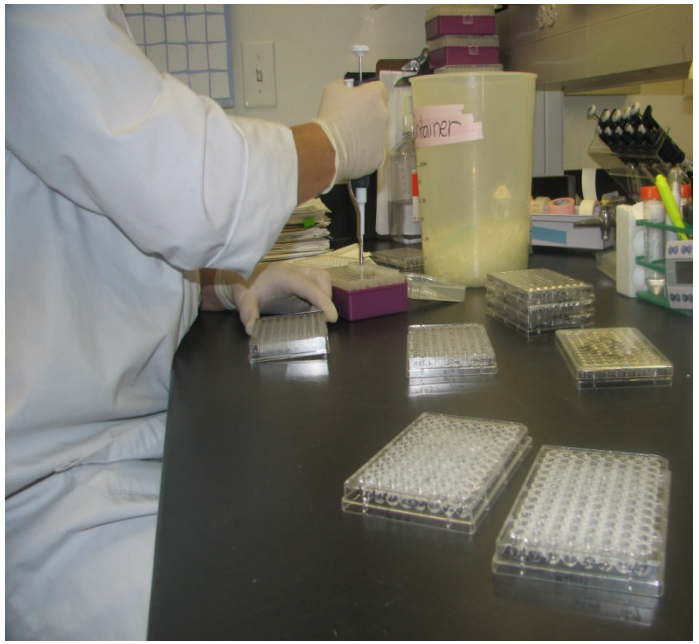
- Repetitive motion of the hands, forearm and thumb, or fingers
- Pinch grip when handling pipette tips, or opening vials
- Bending and twisting of the wrist
- Working with "winged" elbows (elbow held at an elevated position away from the body)
- Neck bent forward or to the side and/or jutted chin
- Awkward and static postures
- Excessive force of the thumb

Pipetting Tips

- Alternate between sitting and standing .
- Minimize awkward body posture.
- Avoid resting arms on sharp workstation and lab bench edges. Pad edges if necessary.
- Take frequent microbreaks of 1-2 minutes at least every 30 minutes. Alternate activities to minimize continuous pipetting for long periods.
- Maintain straight wrists. Keep the elbows close to the body.
- Share the workload between the right and left hands. Rotate pipetting tasks with other qualified lab colleagues.

Pipetting Correctly

- Keep waste bins, beakers, and other frequently used items as close as possible.
- Relax your grip on the pipette.
- Use shorter pipettes and pipette tips.
- Choose pipettes that require minimal hand and finger effort and comfortably fit your hand.
- Utilize automated processes or multi-channel pipettes for highly repetitive jobs.
- Clean pippettors on schedule basis to reduce sticking.
- Use an adjustable chair or stool.



Microscopy Risk Factors

- Awkward and static posture of the lower back
- Wrist and palm contact pressure in the carpal tunnel area
- High repetition
- Eye strain and fatigue
- Awkward and static posture of the neck and head

Microscopy Tips

- Use a fully adjustable ergo-task chair or stool with built-in solid foot rest. Adjust the chair to fit you properly.
- For prolonged standing alternate between feet, wear low-heeled shoes with good cushioning or use anti-fatigue floor mats.
- Pull the microscope to the front edge of the work surface for upright posture and elevate if needed.
- Adjust the eyepieces and angle of observation to prevent neck strain. Use adjustable microscope stands.
- Provide armrests to support forearms during knob adjustments.

Microscopy Tips

- Do not rest forearms on the edge of workstation; use padding
- Take stretch and eye breaks and rotate tasks.
- Don’t use a microscope for more than 5-hours a day.
- Maintain straight wrists and keep elbows close to the body.
- Ensure that sufficient knee and leg space is available.

Fume Hoods and Biological Safety Cabinets Risk Factors

- Constrained knee and leg space, especially in older BSCs
- Contact pressure on the forearms, wrists and knees, or legs
- Awkward and static posture of the neck, back, legs, arms and wrists
- Constrained body position, overloading muscles, tendons, and joints in asymmetrical manner
- Working with elbows winged
- Overreaching

Fume Hoods and Biological Safety Cabinets Tips

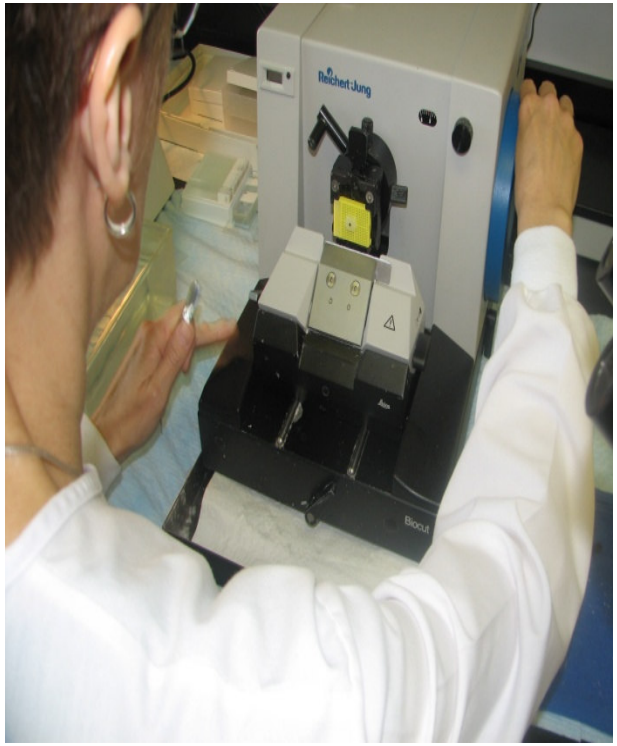
- Adjust the chair properly before you start work so it provides adequate back support. Remove the chair arms if they interfere with the ability to get close to your work. Sit back in the chair for lumbar support.
- Prevent extended reaching. Place materials as close as possible to you.
- Avoid resting arms on the sharp edges of the hoods or cabinets. If possible apply closed-cell foam padding to the front edge of the hood or cabinet.
- Remove drawers, supplies, refrigerators from under the cabinet or hood to provide leg room.

Fume Hood and Biological Safety Cabinet Tips

- If you must stand to work at the hood or cabinet alternate between feet, wear low-heeled shoes with good cushioning or use anti-fatigue floor mats.
- Take short breaks to relieve forearm and wrist pressure caused by leaning on front edge of hoods/BSCs.
- Maintain straight wrists and keep elbows close to the body.

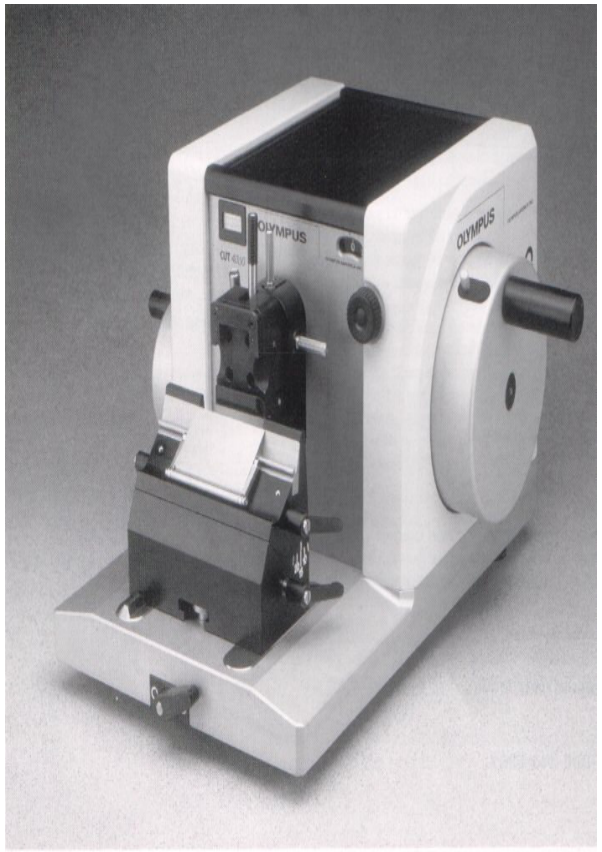
Microtome & Cryostat Risk Factors

- Older equipment may not be serviced, lubricated or maintained properly.
- Older equipment has more repetitive, force and stress issues.
- Workstation surface height at sitting or standing position.
- Proper sitting position and posture.
- Constrained knee and leg space, especially in older labs.
- Contact stress on the forearms, wrists, elbows.
- Awkward and static posture of the neck, back, arms and wrists.
- Working with elbows winged.
- Overreaching



Microtome & Cryostat Tips

- Ensure older equipment is serviced, lubricated and maintained properly. When possible update equipment.
- Retrofit older equipment to lessen repetitive movement, force and stress risks.
- Consider use of an automatic foot operated cryostat when frequent cryosectioning is performed.
- Adjust the workstation height to keep arm closer to the body in both the sitting and standing positions.
- Prevent extended reaching. Place materials as close as possible to you. Don’t work with elbows winged.
- Remove drawers, supplies, refrigerators that interfere with knee and leg space.



Microtome & Cryostat Tips

- Apply padding to the front edge of the workstation to prevent contact stress on the wrists, forearms, elbows.
- Eliminate awkward and static posture to the neck, back, arms and wrists by ensuring proper sitting position and posture with chair or stool adjustments.
- Take frequent rest breaks and do stretching exercises.
- Rotate tasks during the day.
- Use both the right and left hands when possible.
- Keep slides, cassettes, tweezers, brushes , water baths and other equipment within reach to prevent reaching.

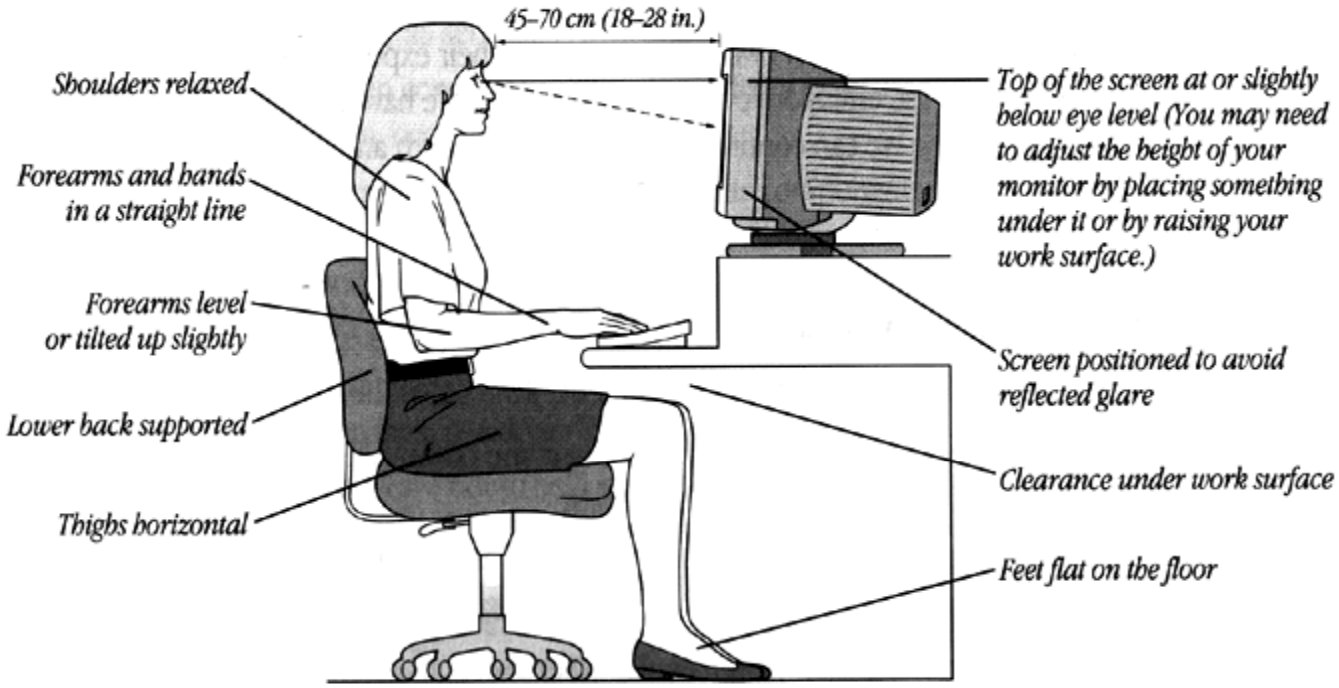
Test Tube Handling Tips

- Adjust the chair properly before you start work so it provides adequate back support. Remove the chair arms if they interfere with the ability to get close to your work. Sit back in the chair for lumbar support.
- Arrange tubes to minimize reaching and twisting by placing them as close as possible to you.
- Use container to raise test tube racks when necessary.
- Use both hands to open and close test tubes.
- Use cap removers to minimize pinch grip.
- Use a vortexer mixer rack instead of holding tubes by hand.

Test Tube Handling Tips

- Avoid resting arms on the sharp edges of the workstation or lab bench.
- Remove drawers, supplies, refrigerators from under the cabinet or hood to provide leg room.
- If you must stand to work at the hood or cabinet alternate between feet, wear low-heeled shoes with good cushioning or use anti-fatigue floor mats.
- Take short breaks to relieve forearm and wrist pressure.
- Maintain straight wrists and keep elbows close to the body.

Computer Ergonomic Risk Factors



If your computer workstation is not set up ergonomically correct it will cause MSD risk factors to the eyes, neck, shoulders, upper and lower back, elbows, wrists, fingers and legs.

- Be aware of hazardous materials in your workplace
- Know where to find information
- Use safe practices and procedures
- Ask questions before not after…..
- What happens can have a lasting effect!

…….Be safe stay and safe