



# Laboratory Safety

## Protecting People and Property

Elizabeth MacPherson, CSP, ARM  
Chubb Loss Control, Northern California



## Please Note the fine print

This presentation is for informational purposes only and has an edition date of February, 2010. This presentation is necessarily general in content and intended to provide an overview of certain aspects of life science property exposures and controls. No liability is assumed by reason of the information this document contains.

Chubb refers to the insurers of the Chubb Group of Insurance Companies. Coverage may not be available in all jurisdictions. This presentation is the property of Chubb. Any use of this presentations without Chubb's prior, written consent is prohibited.



# Course Objective

***To provide a general understanding of the fundamental areas of laboratory safety for people and property and the most common loss scenarios***



# Agenda

- **Types of Laboratories**
- **Property Safety**
- **Laboratory Animals**
- **Worker Safety**
- **Resources**
- **Questions**



# Types of Laboratories

- **R&D Labs**

- Wide scope of voluntary and involuntary oversight
- Biotech companies, Universities
- Can have anything

- **Clinical or “CLIA” labs**

- Runs assays (tests) on samples for human health or clinical studies

- **Production Labs**

- Produces materials for use in preclinical or clinical trials, for industry
- Makes reagents, APIs, potent compounds, synthesize nucleic acids or enzymes, etc.
- Often highly regulated (GLPs or GMPs)

- **Animal Labs**





# What Makes Labs Challenging?

- **Labs are Dynamic**
- **Complacency around hazardous materials**
- **Variable Safety Culture**
- **Academic Mindset: The “Nutty Professor”**
- **Who’s in Charge?**
- **Focus is often on Industrial Hygiene and regulations, not Safety or fire protection**





# Common Sources of Loss in Laboratories

- **Property**
  - Spoilage/change in temperature
  - Water damage
  - Explosions
  - Fires and smoke damage
  - Contamination
- **Employee Injury**
  - Repetitive motion
  - Material handling
  - Slips trips and falls
  - Chemicals/biohazard Exposure
- **Laboratory Animals**
  - Perishable
  - Ergonomics
  - Infectious/Allergic exposures



# Laboratory Property Protection

- **Change in Controlled Environment**
- **Water Damage**
- **Explosions**
- **Fire Exposures**
- **Electrical Safety**
- **Fire Controls and Protection**
- **Security**

# Change in Controlled Environment

- **Stored Frozen**
  - Cell Lines
  - Tissue Samples
  - Reagents
- **Freezers**
  - Cryogenic (N<sub>2</sub>)
  - -80°
- **Incubators**
- **BioReactors**
- **Stability Chambers**
- **Vivariums**





# Change in Controlled Environment

## What Goes Wrong?

- **Rental Units Fail,**
  - not alarmed
  - Not identified
- **Alarms**
  - False alarms
  - Audible alarm battery runs out
  - Alarm signal fails to work
  - Wrong setting on temperature sensor
- **Mechanical Failure**
  - Not plugged in
  - Compressor goes
  - Valve Cracks
  - Backup power fails





# Change in Controlled Environment

- **Redundancy**
  - **Critical Cell lines**
    - Duplication
    - Off-site storage
  - **Spare Freezer**
- **Temperature Controls and Alarms**
- **Back-up Power to Critical Equipment**
- **Test and Audit**





# Water Damage

- **Boilers, Water Heaters, HVAC**
- **Plumbing in Labs**
- **DI Water**
- **Humidity Chambers**
- **Exposure to Expensive/Difficult to replace Equipment**
- **Roof Leaks**
- **Sprinkler Leakage**
- **Basements**





# Explosions

- Big problem, often overlooked
- Mishandling of chemicals
  - Some chemicals are inherently dangerous
    - Picric Acid
    - Pyrophoric material
    - Hydrophoric materials
    - Air Sensitive
  - Some are violently reactive
    - Acids
    - Bases
    - Oxidizers
- Lack of knowledge or understanding
- Lack of respect



# Fire Experience

- **Small bench-top and fume hood fires are *common***
- **Large lab fires are *rare* but devastating**
- **Fuel load and hazard levels in labs are often high.**
- **Labs using solvents have high potential for flash fires, explosion, rapid fire spread, and toxic smoke**



# Ordinary Combustibles



- High Combustible Loading
- Notebooks
- Absorbent Paper
- Lab Supplies
- Boxes and Packaging
- Clutter and Crowding
- Pack Rats!
- Academic Mindset
- Ordinary combustibles used around hazardous materials

# Flammable Liquids/Gases

- **Use Varies Depending on Lab**

- Chemistry Labs
- HPLCs
- DNA and Protein Synthesis
- Fume hood storage
- Gases -- H<sub>2</sub>, O<sub>2</sub>, Anesthetics



- **Typical controls**

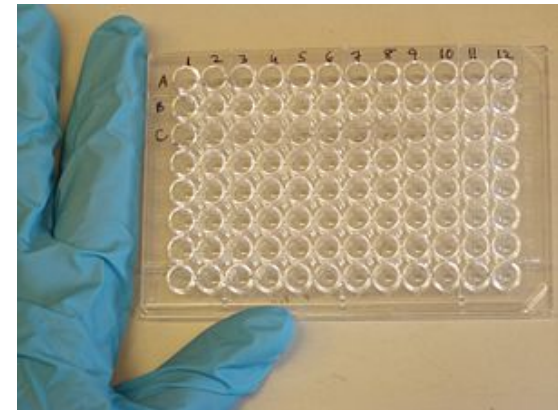
- NFPA 30 & 45
- Flammable Liquid Cabinets
- Separation of Hazardous Chemical
- Spill containment
- Explosion Proof Fixtures
- Chemical handling procedures
- Ventilation Controls



## Lots of Plastic Lab Supplies



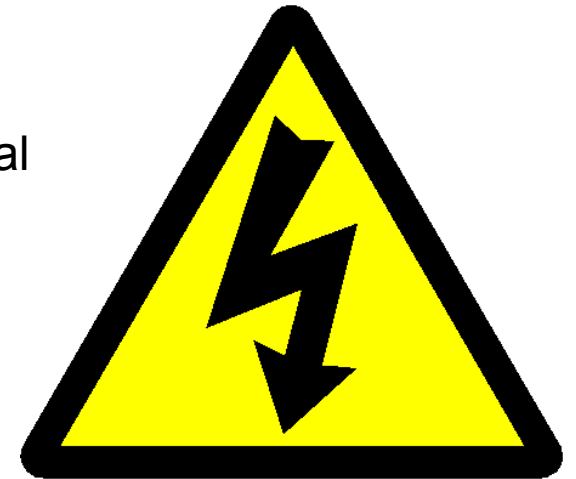
- **Microtiter plates**
- **Acrylic cases**
- **Polypropylene tubing**
- **Proprietary polymer materials**
- **Pipette tips,**
- **Plastic wrappers**
- **Popcorn packaging**
- **Plastic Pallets**
- **Etc.**





# Electrical Safety

- **Keep electrical rooms and panels clear**
- **Fire Extinguishers – inspection and training**
- **Combustible Loading / clutter**
- **Reliable Electrical Service**
  - Will equipment work with existing electrical system?
    - Delta-Delta
    - Delta Wye
  - Some equipment draws lots of juice
  - Equipment added over time
  - Is old electrical service or transformer up to the task?
  - Thermographic imaging done regularly?





# Fire Controls



- **Good housekeeping**
- **Minimize solvent use, label and store properly**
- **Keep barriers in place (shields, hood doors, lab doors)**
- **Proper and documented training**
- **Written and practiced emergency plan**
- **Appropriate fire extinguisher and training**
- **Enforce safety Practices**





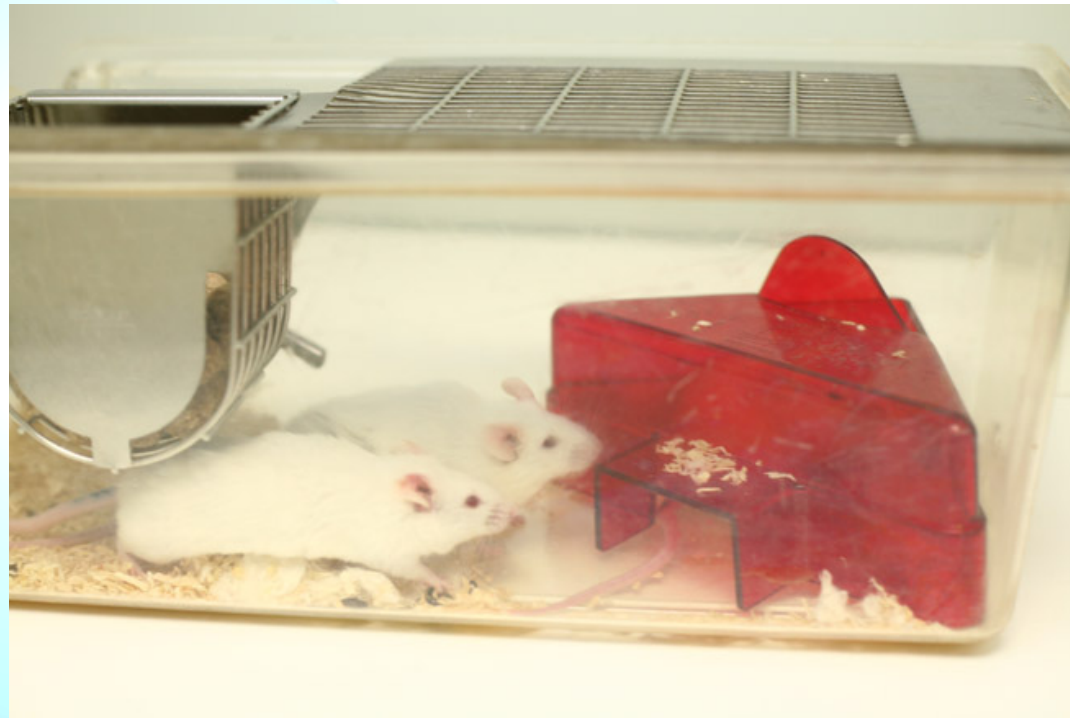
# Fire Protection

- **Sprinkler system/ fire suppression**
- **Hood suppression systems**
- **Appropriate electrical fixtures**
- **Smoke detectors**
- **Compartmentalization**
- **Independent / zoned HVAC**
- **Duct dampers**
- **Fire department coordination**





# Laboratory Animals



# Laboratory Animals

- **Most Common are Rodents**
- **Larger Animals**
  - Used in PreClinical Drug Studies
  - Used in development and test of medical devices
- **Value Varies**
  - Healthy – e.g. used in clinical labs
  - Genetically Altered
  - Immune Deficient
  - Specialty –Research Models
- **AAALAC Certification**
- **Federal, State and Local Regulations**



# Vivariums

- **Animals highly sensitive to loss**
- **Protect in place: High level of compartmentalization/ segregation, Separate HVAC**
- **Avoid Basements**
- **Temperature/Humidity/Smoke Controls with Alarms**
- **Alarms on Automated Feeders**
- **Protect from contamination**
- **Security -- Subject to Animal Rights Groups**
- **Building Management System**



# Animal Safety

- **Repetitive Motion Injuries**
  - Animal husbandry
  - Clinical Labs
- **Bites and Scratches**
  - Puncture wounds
  - Infection
- **Allergies –**
  - To animal dander
  - To latex
- **Zoonoses**
  - Rare, but serious
  - Herpes B Virus – shed by monkeys and fatal



# Worker Safety in Labs

- **Ergonomic Injuries**
- **Material Handling**
- **Slips and Falls**
- **Chemical Exposures**
  - Eye Splashes
  - Dermatitis
  - Allergies and Sensitivities
  - Radioisotopes
- **BioHazards**
  - Bloodborne Pathogens
  - Airborne infectious agents
  - Toxins
- **Car Crashes** (field workers)





# Common Laboratory Ergonomic Risk Factors

- **Repetition**
- **Awkward Body Postures**
- **Force**
- **Contact Stress**
- **Extreme Temperatures**
- **Lack of Breaks, Exercises Stretching**





# Common Laboratory Ergonomic Risk Factors

- **Pipetting**
- **Computer Workstations**
- **Microscopy**
- **Animal Handling**
- **Glove Boxes & Biosafety Cabinets**
- **Bench Work**



# Pipetting

- Usually repetitive task
- Forceful exertion of the fingers/thumb
- Awkward positioning of fingers, arm and shoulder
- Working in BSC can increase problems



# Pipetting Controls

- **Select**
  - pipettes with low force triggers.
  - optimal for hand size.
- **Schedule mini breaks throughout the task.**
- **Alternate hands or use both hands.**
- **Use supports**
- **Automate if possible**





# Computer Use

- **Computers used in labs and in cubes**
- **Data entry in labs**
- **Share workstation**
- **“Ad Hoc” set up / Not adjustable computer furniture**
- **Amount of use may depend on project**
- **Same issues as office ergonomics**



# Microscopy

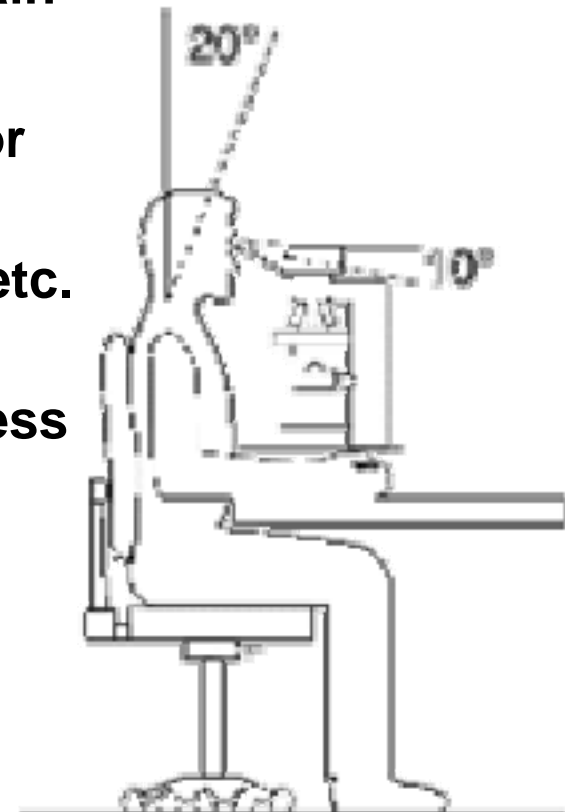
- **Usually Involves Static Posture**
- **Head Forward Posture**
- **Awkward Reaching**
- **Intense Visual Changes**
- **Contact Stress**
- **May be difficult to get close to the microscope**
  - Clutter
  - No knee wells





# Microscopy Controls

- **Adjust Eyepieces and Angle of Observation to Reduce Neck Strain**
- **Use Neutral Posture**
- **Alternate Right and Left hands for Manipulating Controls**
- **Remove Clutter, Cabinet Doors, etc. Allow Knee Room**
- **Use Pads to Reduce Contact Stress**
- **Use TV/computer screens for viewing**





# Glove Boxes & Biosafety Cabinets

- **Static Posture/Limited Movement**
- **Awkward Reaching**
- **Leg, Shoulder & Neck Fatigue**
- **Glare/Eyestrain**





# Biosafety Cabinet/Glovebox Controls

- **Make frequent postural or task changes**
- **Place items within a comfortable reach**
- **Use anti-fatigue floor mats if standing**
- **Use a footrest to alternately elevate a foot**
- **Use footrests and foot rings for leg support**
- **Eliminate sources of glare**
- **Use edge padding on edges of sharp surfaces.**
- **Alternate hands and tools.**
- **Avoid continuous tight grasp of object and awkward postures in the neck, back and shoulders**



# Bench Work

- **Shared Workstations**
- **Benches at Fixed Height**
- **Equipment at Fixed Height**
- **Hard Surfaces**
  - Bench top
  - Floor



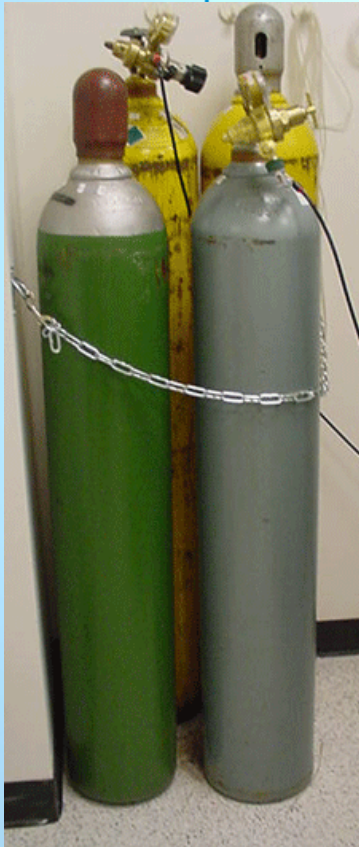


## Bench work Ergonomic Considerations

- **Use a adjustable task chair or stool with footrest.**
- **Use anti-fatigue mats if standing for long periods of time in the same spot.**
- **Should not use the leg room under bench as a storage location if work seated.**
- **Use platforms to raise work that is too low**
- **Use adjustable benches to lower work that is too high**

# Material Handling

- **Solvent, Water, Reagent, Waste Bottles**
- **Waste Container**
- **Gas Cylinder**
- **Scientific Instruments**
- **Animal Cages**
- **Feed and bedding**





# Material Handling Best Practices

- **Eliminate, Automate or Outsource**
- **Use Wheels; cart, dolly,**
- **Make load smaller**
- **Teamwork (usually unreliable)**
- **Lifting and material handling training**





# Slips Trips and Falls

- **Glass Wash Rooms**
- **Cage Wash Rooms**
- **Hall ways**
- **Laboratory Spills**
- **Leaking Water Lines**



# Slip and Fall Prevention

- **Design safety into the lab's design and physical layout**
- **Slip-resistant flooring and floor mats in wet environments (e.g. near sinks)**
- **PM for freezers, water hoses, ice makers, Housekeeping is paramount**
  - **Eliminate clutter**
  - **Prompt water spill cleanup**
- **Enforce proper footwear**



# Chemical Exposures

- **Lack of Ownership**
  - Accumulation of chemicals
  - Chemicals kept past expiration date
  - Improper Labeling
- **Improper Storage**
  - Chemicals stored in fume hood
  - No secondary containment
  - Left out instead of put away
- **Improper PPE**
  - Safety glasses instead of goggles
  - Lab Coats
- **Changes All the Time**





# Chemical Exposures

## Injuries Seen Most Often

- Eye splashes
- Dermatitis
- Burns/Irritation
- Sensitivities
- Cuts from glassware
- Inhalation/dizziness





# Chemical Hygiene Best Practices

- **Minimize all chemical exposures**
- **Segregation of incompatible chemicals**
- **Proper labeling of ALL chemicals**
- **Adequate ventilation**
- **Stay below PELs and TLVs**
- **Enforce PPE use!**
- **Procurement and disposal Controls**
- **Training and Documentation**
- **Emergency Response**
- **THINGS CHANGE**



# Biological Hazards

- **BloodBorne Pathogens**

- Clinical Labs and R&D Tissue Culture Labs
  - Blood and Blood Fractions
  - Bodily Fluids
- Hepatitis A, B and C; HIV

- **Pathologic Agents**

- BSL 2 or 3 (or 4)
- Anti-terrorism

- **Modes of Entry**

- Needle Sticks most Common
- Broken Glass / skin penetration
- Aspiration





# Biohazard Safety Control

- **Universal precautions**
- **Appropriate biosafety level containment (1, 2, 3 or 4)**
- **Strict sharps procedures**
- **Enforce proper PPE**
- **Restrict access**
- **Reliable, documented PM for safety equipment and ventilation**





## Resources & References

- Cal/OSHA and Fed OSHA Lab Safety Regs  
<http://www.dir.ca.gov/Title8/5191.html>
- [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10106](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106)
- Laboratory Checklists (Universities are a Great Source)  
<http://www.southalabama.edu/environmental/comprehensivelabesafetychecklist.doc>  
<http://www.utexas.edu/safety/ehs/lab/labinspection.html>
- NIOSH School Chemistry Laboratory Safety Guide  
<http://www.cdc.gov/niosh/docs/2007-107/>
- CDC Laboratory Ergonomics  
<http://www.cdc.gov/od/ohs/Ergonomics/labergo.htm>
- NFPA 30 Flammable and Combustible Liquids Codes
- NFPA 45 Fire Protection for Labs Using Chemicals
- Harmonization Lab Biosafety & Biosecurity RM Standard  
<http://www.cen.eu/CEN/sectors/technicalcommitteesworkshops/workshops/Pages/ws31.aspx>
- American Biological Safety Association  
<http://www.absa.org/>



Questions?