

Chemical Security Engagement Program

Advanced Chemical Safety and Security Training

Malang, Indonesia
Sept 6–7 2012



Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.



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Introductions

- ▶ Instructors
 - Joe Hardesty, PhD
 - Christine Straut, PhD
 - Morgan Ally, PhD

- ▶ Participants

- ▶ Chemist Bingo!



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Chemist Bingo

- ▶ Get a chemist bingo sheet
 - 5 x 5 grid with different statements inside
- ▶ For each square, find someone for whom the statement is true, and write their name inside
 - Can use one person for multiple boxes,
 - cannot use yourself,
 - Can use the instructors.
- ▶ Shout “bingo” when you have a name in each square

- ▶ **Outcomes**
 1. **Each participant speaks a little bit with several others including the instructors**



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Welcome to Advanced Chemical Management Training

Objectives

- ▶ Promote the safe and peaceful use of chemistry
- ▶ Encourage the creation of networks of people interested in CSS

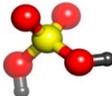
Goals:

- ▶ Train The Trainer: Propagate the Knowledge and Practices Forward
- ▶ Provide resources to enhance your future trainings



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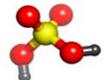
Workshop Structure



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Workshop Organization

- ▶ Day 1:
 - Overview, Organization, and Objectives
 - Fundamentals of Teaching Others
 - Introduction to Lesson Planning
 - Example Teaching Module: Risk Assessment
 - Homework: Lesson Plan
 - Lab Assessment Exercise Part 1 and 2 (Lab Layout and Hazards)
 - Chemical Storage Concepts, Storage Activity
 - Chemical Security Program (CSP) Website Demo
- ▶ Day 2:
 - Chemical Inventory Management System (CIMS)
 - Laboratory Use of Chemicals (GHS, SDS, SOP)
 - Standard Operating Procedure (SOP) Activity
 - Lab Assessment Exercise Part 3 and 4
 - Group Presentations



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Take-Aways from Workshop

- ▶ Main Focus
 - Train the Trainer
 - Lesson Planning
 - Opportunities to apply new knowledge to your home institution's situation
- ▶ Discussions and Activities
 - Provide resources to enhance training



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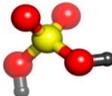
Workshop Overview: Day 1

- ▶ Brief CSSO Topics Review
 - Introduction to Chemical Management
- ▶ Fundamentals of Teaching Others
 - Introduction to Lesson Planning and Preparation
 - Example Module: Risk Assessment
- ▶ Laboratory Assessment Activity: Part 1 and 2
- ▶ Chemical Storage Concepts and Activity
- ▶ CSP Website Demonstration



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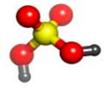
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CSSO Topics Review

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Key Concepts to recall from CSSO Training

- ▶ Chemical Safety and Security Officer
 - Duties & Roles
 - CSS Plan
- ▶ Laboratory Design
- ▶ Laboratory Ventilation/Chemical Hoods
- ▶ Chemical Toxicology & Physiology
- ▶ Safe/Secure Transport of Chemicals
- ▶ Fire Prevention & Protection in the Laboratory
- ▶ Emergency/Security Planning and Management
- ▶ Spill Cleanup
- ▶ Chemical Waste, On-site Recycling, and Waste Treatment

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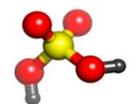


Workshop Overview

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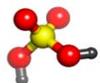
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Introduction to Chemical Management

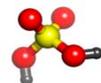
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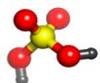
Key Principles

- ▶ Cradle to Grave
- ▶ Advance Planning
- ▶ Chemical Inventory Management System
- ▶ Access Control



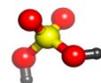
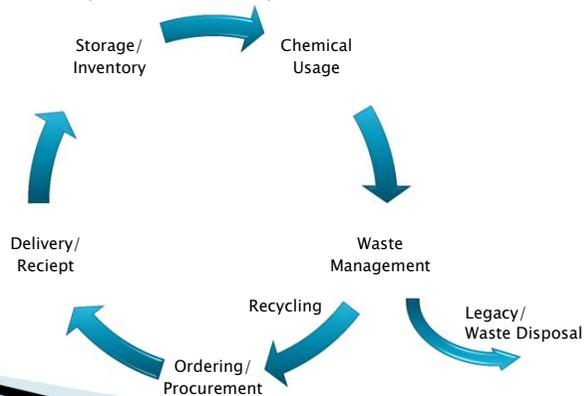
Overview: Chemical Management

- ▶ Cradle to Grave
 - Procurement
 - Storage
 - Inventory
 - Waste



Cradle-To-Grave Life Cycle of Chemicals

Control and accountability of chemicals at all times,
from procurement to disposal as waste



Key Principles: Cradle to Grave

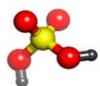
- ▶ Involves all CSS controls
 - Administrative
 - Operational
 - Engineering
 - PPE
- ▶ Essential to chemical safety and security
- ▶ Best practices in chemical management and high quality research are positively correlated
- ▶ Opportunities in the field of chemical management



Research article
An essential step for environmental protection: Towards a sound chemical management system in Malaysia
Mazin Bin Mokhtar [Author View], Goh Choo Ta [Author View], Md. Wahid Murtad [Author View]
Available online 28 November 2009.
<http://dx.doi.org/10.1016/j.jchas.2009.11.002>, How to Cite or Link Using DOI

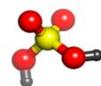


Feature
Developing a chemical and hazardous waste inventory system
Jaclyn Elizabeth R. Santos [Author View], Franz Nicolas N. Alfonso [Author View], Fernando C. Mendizabal Jr. [Author View], Fabian M. Dayrit [Author View]
Available online 12 June 2011.
<http://dx.doi.org/10.1016/j.jchas.2011.05.012>, How to Cite or Link Using DOI



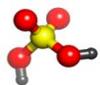
Benefits of Chemical Management Best Practices

- ▶ Reduces costs
 - Smaller and fewer purchases
 - Less storage space
 - Reduce waste
- ▶ Saves time
 - Surplus sharing
 - Less searching
- ▶ Improves research and teaching
 - Track expiration
 - Teaches industry standards, expectations
- ▶ Environment and Community Friendly
 - Reduces hazards and waste
 - Regulatory compliance
 - Emergency response
- ▶ Safety and Security
 - Hazard Identification
 - Appropriate procedures
 - Prevent incidents
- ▶ Opportunities for Recognition
 - Publications
 - Presentations
 - Awards



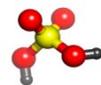
Chemical Management Elements

- ▶ Proper chemical management program has several essential elements
 - Source reduction
 - Procedure for chemical ordering and disposal
 - Inventory and tracking
 - Storage in stockrooms
 - Access control
 - Waste management
 - Recycling of chemicals, containers and packages



Procurement

- ▶ Planning
- ▶ Substitution
- ▶ Source reduction
- ▶ Surplus sharing
- ▶ Ordering Chemicals
- ▶ Receiving Chemicals



Procurement: Planning

- ▶ Think “Cradle to Grave” before purchasing or accepting chemicals
 - What chemicals are needed?
 - How much are needed?
 - How/where will they be stored?
 - How will they be handled/used?
 - How will disposal take place?

“Extra” chemicals are not usually a good idea

Donated chemicals are not always “free”



Storage: General Guidelines

- ▶ Separate incompatible chemicals
- ▶ Separate flammables and explosives from ignition sources
 - flammable storage cabinets
- ▶ Use secondary containment
 - Label with compatibility group
- ▶ All containers properly labeled and closed
- ▶ Do not store chemicals:
 - On top of cabinets
 - On the floor
 - In hoods
 - In hallways
 - With food
 - Where there is wide variations in temperature, humidity, or sunlight



Storage: Access Control

- ▶ Access limitations depend on the material or information
 - More control of access if chemicals of concern (COCs) are present
- ▶ Lock areas, rooms, cabinets
 - Control of keys/access
 - Double lock (2 key holders) for high access control
- ▶ Label areas "Authorized Personnel Only"
 - Means of identifying authorized personnel
 - Challenge unfamiliar people in restricted areas
- ▶ Authorized personnel
 - Trusted, background check
 - Trained
 - Legitimate need



Inventory

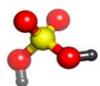
- ▶ Database of chemicals
 - Computer/web-based
 - Barcodes/readers
 - ID, location, owner, hazards, etc.
 - ▶ Control access to database
 - Different degrees of access
 - ▶ Maintain with inspections & verification
 - ▶ Ensure control and accountability
 - No orphan chemicals
- ▶ Benefits
 - Saves time
 - Improves research
 - Improves safety
 - Improves security
 - Saves money
 - Regulation compliance
 - Earn recognition



Waste

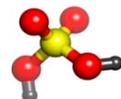
- ▶ Plan ahead
 - Minimize amount and hazards
- ▶ Separate during collection and storage
- ▶ Recycling and/or disposal
- ▶ Prevent orphans and unknowns



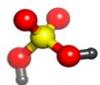


Conclusions: Chemical Management

- ▶ Key to chemical safety and security
- ▶ Involves all CSS controls
 - Administrative
 - Operational
 - Engineering
 - PPE
- ▶ Many issues addressed by planning ahead
- ▶ Best practices in chemical management and high quality research are positively correlated
- ▶ Opportunities for those willing to pioneer improvements

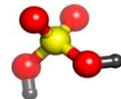


Break

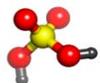


Workshop Overview

- Brief CSSO Review
 - Introduction to Chemical Management
- ▶ **Fundamentals of Teaching Others**
 - Introduction to Lesson Planning and Preparation
 - Example Module: Risk Assessment
- ▶ Laboratory Assessment Activity: Part 1 and 2
- ▶ Chemical Storage Concepts and Activity
- ▶ CSP Website Demonstration

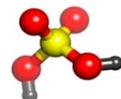


Fundamentals of Teaching Others

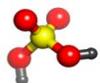


Overview

- ▶ Introduction to Lesson Planning
- ▶ Example Module



Introduction to Lesson Planning



Introduction to Lesson Planning: Overview

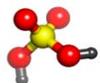
- ▶ **Select a topic** for your group
- ▶ Define the desired **learning outcomes**
- ▶ Identify **training methods**
- ▶ Prepare to **evaluate learning**
- ▶ Create detailed plan
 - Return to previous steps to **refine** as needed
- ▶ **Present** the plan



Select a Topic

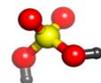
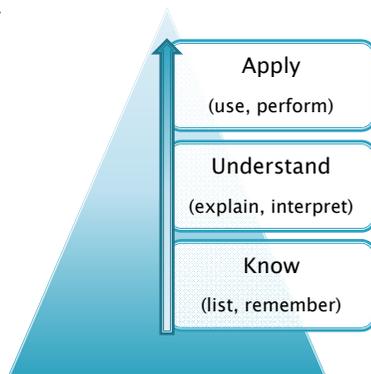
- ▶ Consider scope of what will be taught
 - Breadth - what will be taught,
 - Depth - to what level of learning
- ▶ Consider required resources
 - Time
 - Materials
- ▶ Example topics
 - Safe and secure chemical transportation
 - Chemical procurement
 - Storage and inventory management
 - Hazardous waste management
 - Controlling access to dual-use chemicals
 - Creating a culture of safety and security:
the role of training





Define Desired Learning Outcomes

- ▶ One way to organize levels of learning is according to “Bloom’s Taxonomy”
 - Foundation levels are most appropriate for shorter-term training
- ▶ Finish a series of statements that **quantitatively** define the scope of the lesson
 - “After this lesson, trainees should...”



Define Desired Learning Outcomes

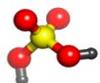
- ▶ Consider requiring personal goal setting from trainees

“After this module, I would like to learn/know about...”

Learning	Metric	Future Action
Lab hazards and GHS symbols	Identify hazards according to category	Post hazard signs in my laboratory

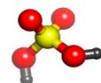
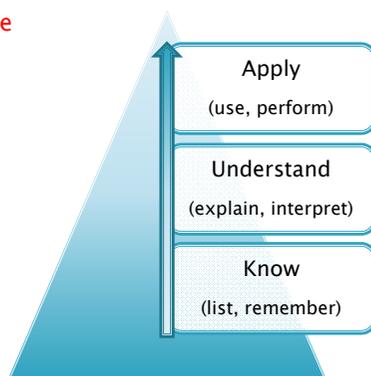
- ▶ Learning: What will I learn?
- ▶ Metric: How will I know that I have learned it?
- ▶ Future Action: How will I put the learning to use?

Encourages trainees to become invested in the learning process

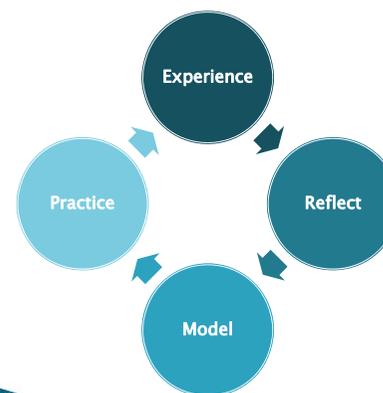


Identify Training Methods

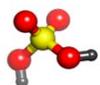
- ▶ Desired **learning outcomes** are the basis for lesson content and training methods
- ▶ “After this lesson, trainees should...”
 - know... → give a lecture
 - understand... → guide a discussion
 - be able to... → engage in an exercise/activity



Identify Training Methods

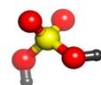
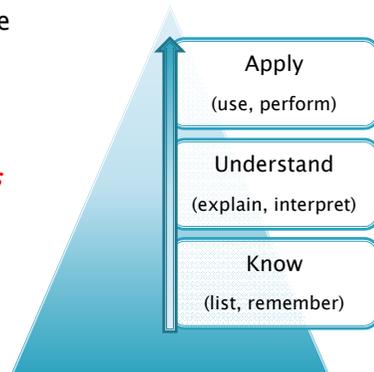


Discussions and exercises/activities are forms of **experiential learning**¹

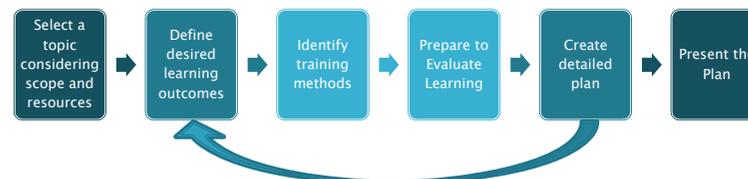


Prepare to Evaluate Learning

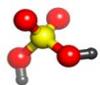
- ▶ How will trainer and trainee know whether desired learning outcomes have been reached?
- ▶ **Desired *learning outcomes* are also the basis for evaluation methods**



Create a Detailed Plan

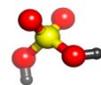


- ▶ Agenda
 - **Topic broken down into outline form**, times for each subtopic
- ▶ **Learning outcomes overall and for each subtopic**
- ▶ **Training methods** for each subtopic
- ▶ **Evaluation strategy** for each learning outcome



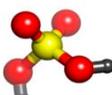
Homework: Present your Lesson Plan

- ▶ Describe to the class
 - Your written lesson plan
 - Agenda
 - Learning outcomes
 - Training methods
 - Evaluation strategy
 - Your process in creating the lesson plan
 - Challenges
 - Solutions



Workshop Overview

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 - **Example Module: Risk Assessment**
- ▶ Laboratory Assessment Activity: Part 1 and 2
- ▶ Chemical Storage Concepts and Activity
- ▶ CSP Website Demonstration



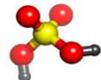
Chemical Safety and Security Risk Assessment



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Module Overview: Chemical Safety and Security Risk Assessment

- ▶ Module Learning Outcomes
- ▶ Risk Basics
- ▶ Chemical Safety Risk Assessment
- ▶ Chemical Security Risk Assessment
- ▶ Summary, Conclusions, and Evaluations



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Module Learning Outcomes

- ▶ Having seen the overview of this module, come up with your own learning outcomes

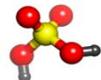
Learning	Metric	Future Action
At end of this module, what would I like to have learned?	How will I know when I have learned it?	How will I use this new learning after the workshop?

- ▶ Write your learning outcomes in your worksheet in the space provided



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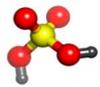
Module Outcomes: After this module, you should...

- ▶ Understand the definition of risk and the difference between hazard and risk
- ▶ Understand how other factors can influence risk perception
- ▶ Be able to assess and characterize the safety risks associated with chemical laboratories
- ▶ Be able to assess and characterize the security risks associated with chemical laboratories



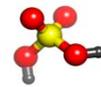
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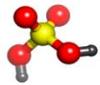
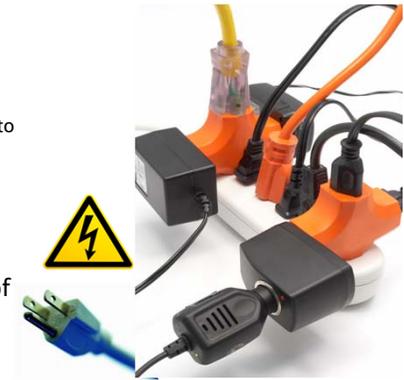
Risk Basics Overview

- ▶ Hazard vs. Risk
- ▶ Definition of Risk
- ▶ Activity: Risk Perception
- ▶ Safety and Security
- ▶ Risk Characterization
- ▶ Risk Reduction



Risk Basics: Hazard vs. Risk

- ▶ There is a difference between **hazard** and **risk**
 - Hazard
 - Something that has the **potential** to do harm
- ▶ Is there a hazard in this picture? If so, what type?
- ▶ Is it a risk? If so, how much of a risk?
 - Depends on the situation
 - **Probability** that harm will result
 - **Consequence** is a factor



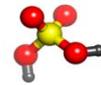
Risk Basics: Hazard vs. Risk

- ▶ What is wrong?
 - Overloaded circuit
- ▶ What are the possible scenarios?
 - Blown fuse
 - Electrical shock
 - Fire
- ▶ What is the likelihood?
 - Factors that lead to an event
 - Plugged in, broken/frayed cords, near oily rags
- ▶ What are the consequences?
 - Other factors and things that follow an event
 - Voltage, fire alarms, evacuation

Hazard



Risk

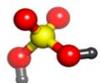


Risk Basics: Definition

- ▶ Risk is a function of
 - Probability that an incident will occur (**likelihood**)
 - Severity if the event occurs (**consequence**)



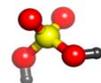
$$\text{Risk} = f(\text{Likelihood, Consequence})$$



Activity: Risk Perception

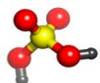
- ▶ Find the page for this activity*
- ▶ Rank each action or technology according to your perception of its RISK
 - A rank of 1 means most risky
 - A rank of 15 means least risky

Take about 10 minutes to do this



Activity: Risk Perception

- | <u>College Students¹</u> | <u>Experts²</u> |
|-------------------------------------|------------------------------------|
| 1. Nuclear power | 1. Motor vehicles |
| 2. Smoking | 2. Smoking |
| 3. Pesticides | 3. Alcoholic beverages |
| 4. Motor vehicles | 4. X-rays |
| 5. Alcoholic beverages | 5. Pesticides |
| 6. Police work | 6. Nonnuclear electric power |
| 7. Spray cans | 7. Swimming |
| 8. Traveling by commercial flight | 8. Bicycles |
| 9. X-rays | 9. Travelling by commercial flight |
| 10. Nonnuclear electric power | 10. Police work |
| 11. Prescription antibiotics | 11. Railroads |
| 12. Mountain climbing | 12. Nuclear power |
| 13. Railroads | 13. Prescription antibiotics |
| 14. Bicycles | 14. Spray cans |
| 15. Swimming | 15. Mountain climbing |



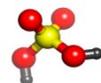
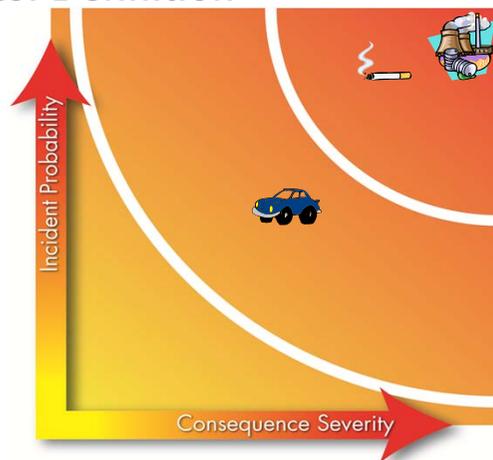
Risk Basics: Definition

College Students

1. Nuclear Power
2. Smoking
4. Motor Vehicles

Experts

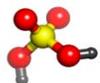
1. Motor Vehicles
2. Smoking
12. Nuclear Power



Activity: Risk Perception

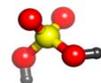
- ▶ What do you think may have influenced your risk assessment besides your best guesses regarding *likelihood* and *consequence*?
- ▶ Emotional Risk Perception Factors (examples)
 - Involuntary vs. Voluntary
 - Immoral vs. Moral
 - Unfamiliar vs. Familiar

What *should* be the basis for your professional Risk Assessment of Chemical Safety and Security?



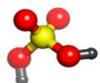
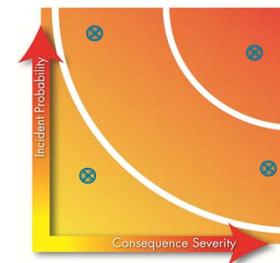
Risk Basics: Safety and Security

- ▶ Risk concept
 - Applies to both Chemical **Safety** and Chemical **Security**
- ▶ Safety Incident
 - Spill
 - Accidental exposure
 - Uncontrolled reaction
- ▶ Security Incident
 - Theft or diversion of dual-use chemicals
 - Intentional release
 - Sabotage



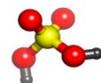
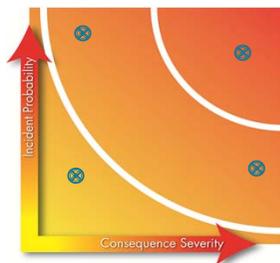
Safety Risk Characterization

1. Low
 - Laboratory procedures are routine; staff is trained and experienced; materials used are mostly benign and/or present in microscale amounts only
 - An incident would not likely be an emergency
2. Moderate
 - Procedures are not routine; staff may be partially trained or have limited experience; materials are reactive, flammable, toxic, and/or present in moderate quantity
 - An incident could constitute or develop into an emergency
3. High
 - Procedures are novel or extremely delicate; staff may be untrained or inexperienced; materials are highly reactive, toxic, explosive and/or present in large quantities
 - An incident would be a life and facility-threatening emergency



Security Risk Characterization

1. Low
 - Assets are possibly targets for theft or diversion
 - Consequences of loss or release are minimal
2. Moderate
 - Assets are attractive for theft or diversion due to monetary value or dual-use
 - Consequences could threaten the public; misuse could be harmful or even lethal to a small number of people, and would certainly damage the institution, its programs, and reputation
3. High
 - Assets are very valuable or hard to acquire dual-use materials
 - Consequences of misuse could result in harm or death to many people



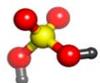
Safety and Security Risk Characterization

- ▶ What are the benefits of characterizing risks?
- ▶ Can risks ever be reduced to zero?
- ▶ What does it take to reduce CSS risk?
 - Are resources for risk reduction limitless?

Characterizing CSS risks is a necessary step toward responsible and effective allocation of finite resources to reduce risk to acceptable levels

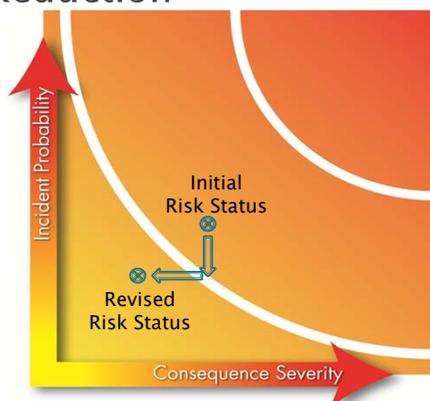
Risk reduction measures should always be applied in a graded manner

**Large effort made to reduce high risks
Smaller effort made to reduce low risks**

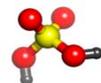


Risk Basics: Reduction

- ▶ Types of CSS Controls
 - Administrative
 - Operational
 - Engineering
 - PPE
- ▶ Decrease likelihood
- ▶ Decrease consequence

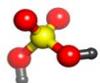


$$\text{Risk} = f(\text{Likelihood, Consequence})$$

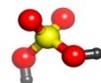


Module Overview: Chemical Safety and Security Risk Assessment

- Module Learning Objectives
- Risk Basics
- ▶ **Chemical Safety Risk Assessment**
- ▶ Chemical Security Risk Assessment
- ▶ Summary, Conclusions, and Evaluations

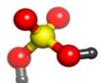


Chemical Safety Risk Assessment: Overview of the Process



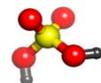
Chemical Safety Risk Assessment

1. Examine jobs and processes
 - ▶ Analyze for each step in the process
 - Who, what, where, when, and how?
 - Could exposure occur?
 - Could an accident occur?



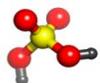
Chemical Safety Risk Assessment

1. Examine jobs and processes
 - ▶ Example: Precipitation of gold from cyanide solution
 - 2 junior researchers in the laboratory with only minimal training and not accustomed to using PPE
 - About twice a week, zinc powder is added to 100 mL of an aqueous, 0.10 M sodium cyanide solution containing dissolved gold
 - The gold precipitates and is collected by filtration
 - Work is performed on a crowded open benchtop alongside work on another project that involves preparing numerous HCl solutions



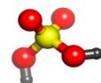
Chemical Safety Risk Assessment

2. Identify hazards
 - ▶ On the basis of materials and equipment present
 - ▶ Consider your group laboratory layouts
 - This is what you already accomplished
 - ▶ Example: 100 mL of a 0.10 M sodium cyanide solution
 - Acute toxin
 - Harmful exposure can occur through ingestion, absorption through broken skin, or inhalation upon conversion to HCN gas by reaction with an acid



Chemical Safety Risk Assessment

3. Characterize safety risks
 - ▶ Example: regular work with sodium cyanide solutions
 - What are the factors affecting the likelihood of exposure?
 - Do you think the likelihood of exposure is low, moderate, or high?
 - What are the factors affecting the consequences of exposure?
 - Do you think the consequences of exposure are low, moderate, or high?

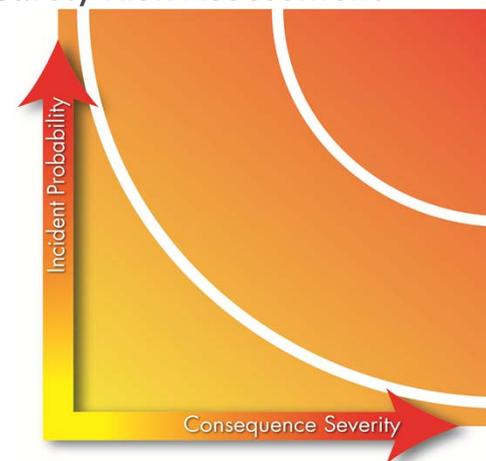


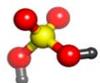
Chemical Safety Risk Assessment

3. Characterize safety risks

On the basis of *likelihood* and *consequence*, are the risks of exposure to NaCN low, moderate, or high?

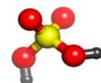
Why?





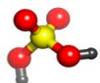
Chemical Safety Risk Assessment

4. Are risks acceptable?
 - ▶ Would you feel safe if you were doing this work?
 - Why/why not?
 - ▶ Are current controls and practices reducing risk of exposure to acceptable levels?
 - Why or why not?
 - ▶ Are there national standards for occupational exposure to cyanide?
 - ▶ Are there other limits imposed by the institution?
 - If you don't know, how can you find out?
 - What do you do if there are not established limits?



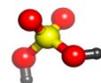
Chemical Safety Risk Assessment

5. Implement additional control measures where needed to reduce safety risks to acceptable levels
 - ▶ What controls are needed to reduce the risk of exposure?
 - Administrative
 - Operational
 - Engineering
 - PPE



Chemical Safety Risk Assessment

6. Follow up with periodic repeat of steps 1-5
 - ▶ Have practices or people changed?
 - ▶ Could further improvements be made?
 - ▶ How often should follow-up assessments be performed?



Chemical Safety Risk Assessment: Overview of the Process





Activity: Chemical Safety Risk Assessment

- ▶ Get in your lab assessment activity groups
- ▶ Identify one job or process that occurs in that laboratory
- ▶ Perform a safety risk assessment
- ▶ Be prepared to discuss your results with the whole group

Take about 20 minutes



Module Overview: Chemical Safety and Security Risk Assessment

- ☑ Module Learning Objectives
- ☑ Risk Basics
- ☑ Chemical Safety Risk Assessment
- ▶ **Chemical Security Risk Assessment**
 - Dual-Use Chemicals
- ▶ Summary, Conclusions, and Evaluations

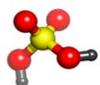


Chemical Security Risk Assessment: Overview of the Process



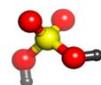
Chemical Security Risk Assessment

1. Evaluate threat potential
 - ▶ Adversaries
 - Motive
 - Means
 - Opportunity
 - Outsiders—no authorized access
 - Insiders—authorized access
 - Collusion—between Outsiders and Insiders
 - ▶ Actions
 - Sabotage
 - Theft
 - ▶ Assets



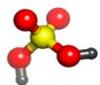
Chemical Security Risk Assessment

2. Identify security hazards – Assets
 - ▶ Information
 - ▶ Equipment
 - ▶ Expertise
 - ▶ Dual-use materials
 - Need a working inventory
 - Need an understanding of dual-use materials
 - Likelihood and Consequences of malicious use
 - Ease or difficulty
 - Quantity
 - Location
 - How they are used



Chemical Security Risk Assessment: Dual Use Chemicals

- ▶ Long history of people misusing chemicals
- ▶ Information on how to use chemicals maliciously is easy to get



Chemical Security Risk Assessment: Dual Use Chemicals

Example 1 of 5: Pseudoephedrine

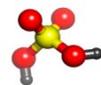
Legitimate use

- ▶ A common ingredient in cold medicines



Misuse

- ▶ Synthesis precursor to crystal methamphetamine
- ▶ USA, 2002, clandestine meth labs
 - Caused 194 fires, 117 explosions, and 22 deaths
 - Cost \$23.8 million for cleanup
 - Dumped chemicals harm environment
- ▶ Processing illegal drugs requires a variety of chemicals
 - Global terrorism can be funded by illegal drug activity



Chemical Security Risk Assessment: Dual Use Chemicals

Example 2 of 5: Cyanide

Legitimate use

- ▶ Mining and metal plating industries



Misuse

- ▶ Poison and precursor to HCN, a CW agent
 - Popular with criminals and terrorists because it is relatively easy to obtain
- ▶ USA, 1982, cyanide added to Tylenol capsules
 - Killed 7 people
 - Led to tamper-proof packaging



Chemical Security Risk Assessment: Dual Use Chemicals

Example 3 of 5: Chlorine Gas

Legitimate use

- ▶ Water purification
- ▶ Oil industry



Misuse

- ▶ Chemical weapon
 - Iraq, 2007, explosives coupled with chlorine gas
 - Several attacks caused fatalities and sickened many including peaceful locals
 - Pictured: truck seized by Iraqi police with 5 tons of chlorine and 2 tons of explosives

http://www.longwarjournal.org/archives/2007/03/al_qaedas_chlorine_w.php accessed Jan 2008.



Chemical Security Risk Assessment: Dual Use Chemicals

Example 4 of 5: Ammonium Nitrate

Legitimate use

- ▶ Agriculture
- ▶ ANFO ingredient (industrial explosive)



Misuse

- ▶ ANFO ingredient (used maliciously, FO = fuel oil)
- ▶ USA, 1995, bombing of federal building in Oklahoma City
 - 168 killed, including 19 children, and almost 700 injured
 - Timothy McVeigh, an antigovernment extremist
- ▶ Also used by other groups around the world

<http://www.fbi.gov/about-us/history/famous-cases/oklahoma-city-bombing>



Chemical Security Risk Assessment: Dual Use Chemicals

Example 5: Acetone, Hydrogen Peroxide, and Acid

Legitimate uses

- ▶ Too numerous to list



Misuse

- ▶ Precursors to TATP (Triacetone Triperoxide)
- ▶ London, 2005, bus and subway suicide bombings
 - 52 killed, over 770 injured
- ▶ Multiple other bomb plots around the world
 - Invisible to detectors for nitrogen-based explosives

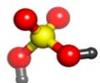
http://en.wikipedia.org/wiki/Acetone_peroxide



Chemical Security Risk Assessment

3. Characterize security risks

- ▶ Create and analyze scenarios
 - Adversary (protesters?, criminals?, terrorists?)
 - Action
 - Asset
 - What are the factors affecting the likelihood of a security incident?
 - Do you think the likelihood is low, moderate, or high?
 - What are the factors affecting the consequences of a security incident?
 - Do you think the consequences are low, moderate, or high?

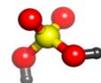
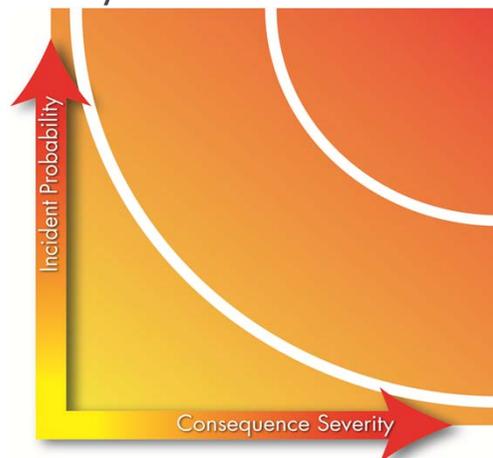


Chemical Security Risk Assessment

3. Characterize security risks

On the basis of *likelihood* and *consequence*, are the security risks low, moderate, or high?

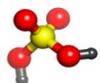
Why?



Chemical Security Risk Assessment

3. Characterize security risks

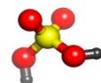
- ▶ Is it possible to analyze, protect against, or even think of every possible scenario?
 - No
- ▶ So what should be done?
 - Identify credible threats
 - Current and future threats
 - Assume worst-case for unknowns



Chemical Security Risk Assessment

4. Are risks acceptable?

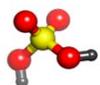
- ▶ If you are accountable for the security of the assets, how do you establish an acceptable level of security risk?
 - Are there national security standards?
 - Are there other limits imposed by the institution?
 - If you don't know, how can you find out?
 - What do you do if there are not established limits?



Chemical Security Risk Assessment

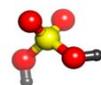
5. Implement additional control measures where needed to reduce security risks to acceptable levels

- ▶ What controls are needed to reduce the security risks?
 - Administrative
 - Operational
 - Engineering

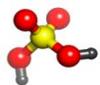


Chemical Security Risk Assessment

6. Follow up with periodic repeat of steps 1–5
 - ▶ Have scenarios changed?
 - ▶ Could further improvements be made?
 - ▶ How often should follow-up assessments be performed?



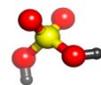
Chemical Security Risk Assessment: Overview of the Process



Activity: Chemical Security Risk Assessment

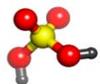
- ▶ Get in your lab assessment activity groups
- ▶ Identify one asset that could represent a security hazard
- ▶ Perform a security risk assessment
- ▶ Be prepared to discuss your results with the whole group

Take about 20 minutes



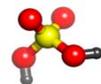
Chemical Security Risk Assessment

- ▶ Main points
 - Likelihood of a security threat scenario may be higher than you think
 - Out of chemical, biological, nuclear, and radiological materials, *chemicals* are used maliciously *the most often*
 - Consequences can range from low to high



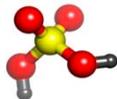
Module Summary: Chemical Safety and Security Risk Assessment

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- ☑ Risk Basics
- ☑ Chemical Safety Risk Assessment
- ☑ Chemical Security Risk Assessment
- ▶ Summary, Conclusions, and Evaluations

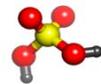


Conclusions

- ▶ Risk is a function of Likelihood and Consequence
 - Applies to both safety and security
- ▶ Labs need to be *safe, secure, and productive*
 - Assessing and characterizing CSS risks allows controls to be applied in a graded manner
 - Larger efforts toward reducing high risks
 - Smaller efforts toward reducing low risks

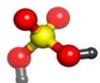


Activity: “Tear Me Up”



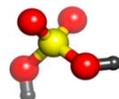
Activity: “Tear Me Up”

- ▶ Each person grab a blank piece of paper
- ▶ Rules: You can talk but you **Can Not** ask or answer any questions
- ▶ Directions will only be repeated twice

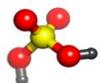


Activity: Conclusions

- ▶ Was the activity difficult?
- ▶ What did you observe during this activity?
- ▶ What did you learn from this activity?
- ▶ Would this activity be useful in your teaching?

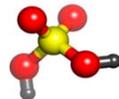


Break



Workshop Overview

- Brief CSSO Review
 - Introduction to Chemical Management
- Fundamentals of Teaching Others
 - Introduction to Lesson Planning and Preparation
 - Example Module: Risk Assessment
- ▶ **Laboratory Assessment Activity: Part 1 and 2**
- ▶ Chemical Storage Concepts and Activity
- ▶ CSP Website Demonstration



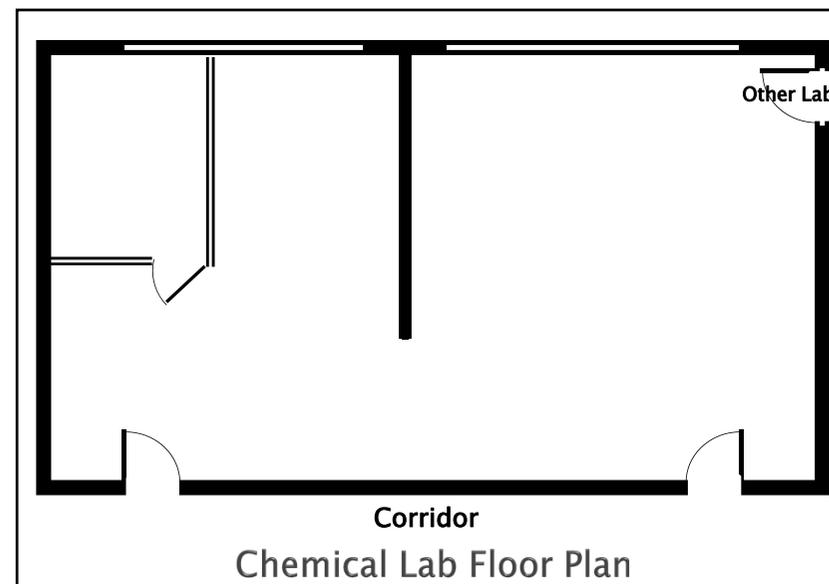
Laboratory Assessment Exercise,
Part 1



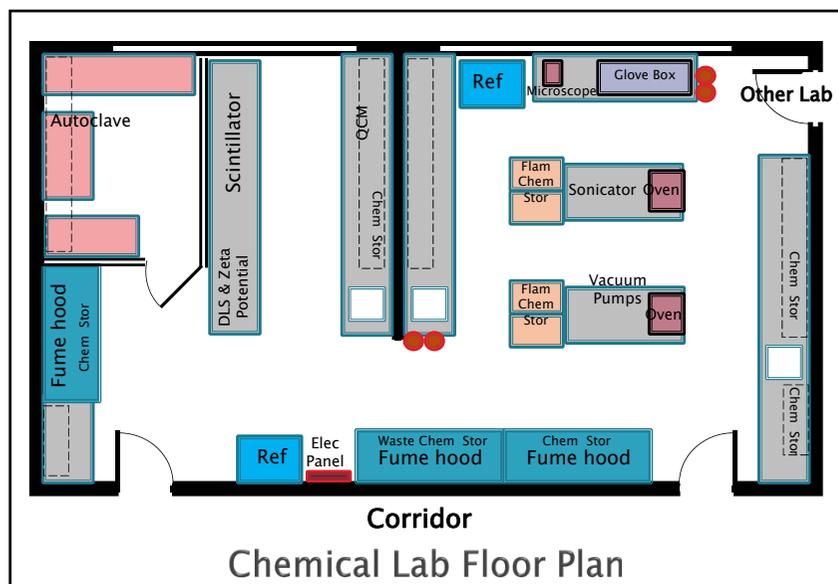
Activity: Laboratory Assessment Exercise

- ▶ Form groups of 3–5 people per group
 - Will continue to work with these groups later as well
- ▶ Draw the floor plan of a laboratory on a large sheet of paper
 - Use an actual floor plan of a laboratory that someone in the group works in, if possible
 - Identify the main laboratory features such as doors, windows, lab benches, refrigerators, chemical hoods, instruments and other equipment, etc.

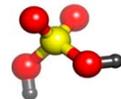
Take about 30 minutes to do this



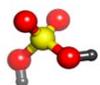
Corridor
Chemical Lab Floor Plan



Corridor
Chemical Lab Floor Plan



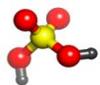
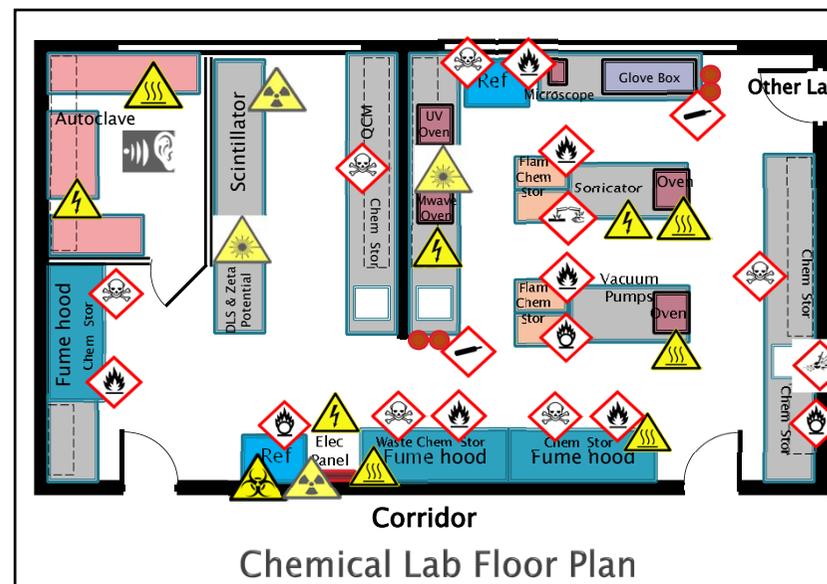
Laboratory Assessment, Part 2



Part 2: Laboratory Assessment Exercise

- ▶ Once the floor plan is done, get hazard stickers from an instructor and apply them to the appropriate places in your laboratory floor plan
- ▶ Write down a list of the hazards present
- ▶ Keep everything you create in this activity, it will be used later on

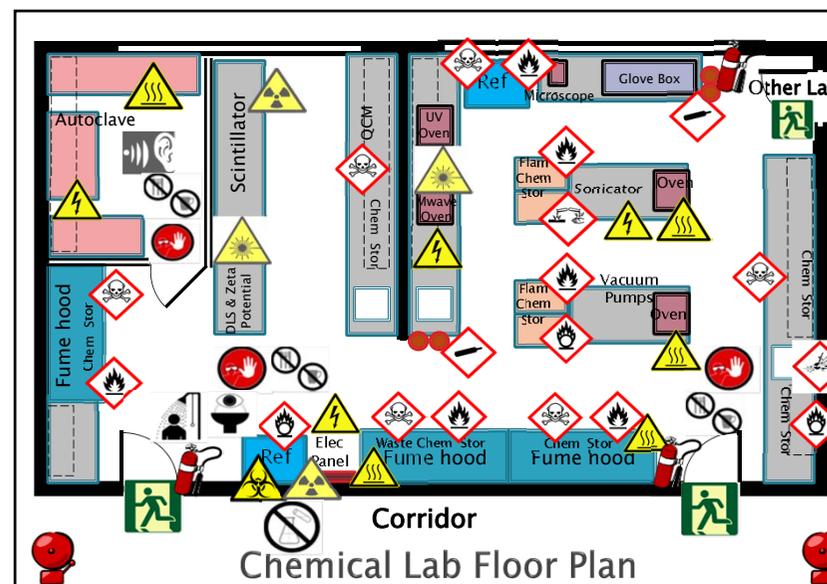
Take about 30 minutes to do this

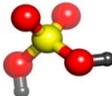


Part 2: Laboratory Assessment Exercise

- ▶ Identify the CSS controls present in your laboratory
- ▶ Apply stickers describing the CSS controls to your laboratory floor plan
- ▶ Identify any control measures present in your laboratory
 - Even if we don't have stickers for them

Take about 15 minutes to do this



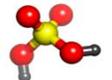


Break

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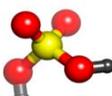


Workshop Overview

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- ☑ Laboratory Assessment Activity: Part 1 and 2
 - ▶ **Chemical Storage Concepts and Activity**
 - ▶ CSP Website Demonstration

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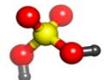


Chemical Storage

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Storing Your Chemicals

- ▶ General Guidelines
- ▶ Reactive Chemicals
- ▶ Compressed Gas Cylinders
- ▶ Examples
- ▶ Access Control
- ▶ Activity: Chemical Storage



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Storage: General Guidelines

- ▶ Separate incompatible chemicals
- ▶ Separate flammables and explosives from ignition sources
 - flammable storage cabinets
- ▶ Large containers on bottom shelves
- ▶ All containers properly labeled and closed



Storage: General Guidelines

- ▶ Wipe-off outside of container before returning to storage area
- ▶ Secure COCs
- ▶ Use secondary containment
 - Label with compatibility group
- ▶ Fasten storage shelves to wall or floor
- ▶ Shelves should have a lip and/or rod



Storage: General Guidelines

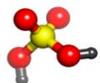
- ▶ **Do Not Store Chemicals**
 - On top of cabinets
 - On the floor
 - In hoods
 - Where there are wide variations in temperature, humidity or sunlight
 - In hallways
 - With food



Storage: Reactive Chemicals

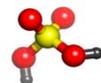
- ▶ Water reactive, pyrophoric, oxidizers
- ▶ Peroxide-forming
 - Ethers, butadiene, others
 - Store in tightly closed original container
 - Avoid exposure to light, air, heat
 - Crystals or discoloration? Do not move or open container
 - Test for peroxides before using
 - Especially if distilling/concentrating
 - Know when to dispose
 - Mark when opened
 - Dispose even if unused





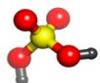
Storage: Compressed Gas Cylinders

- ▶ Secure (chain/clamp) and separate gas cylinders
- ▶ Screw down cylinder caps
- ▶ Store in well-ventilated area
- ▶ Separate and label empty cylinders
- ▶ Separate incompatible gases



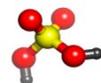
Compressed Gases: Building Layout

- ▶ Install tanks outside building and pipe into lab
 - Long-term, frequent use of same gas
 - Highly hazardous gases
 - Restrict access
 - Out-building or outdoors, depending on conditions
- ▶ Tanks inside labs
 - Wide variety of gases
 - Low use rates
 - Strap to wall or bench
 - Transport safely



Storage: Refrigeration

- ▶ Types
 - Ordinary, household refrigerator/freezers
 - **NOT safe for flammables**
 - Flammables-safe refrigerator/freezer
 - May contain flammables, but are NOT safe to be in areas with flammable vapors
 - Explosion-proof storage
- ▶ Proper refrigerator/freezer labeling
- ▶ Precautions
 - Stable power
 - Not all refrigerants are completely safe
 - Toxicity, flammability, and physical hazards
- ▶ Do not store peroxide formers in a refrigerator
- ▶ Defrost occasionally to prevent chemicals from becoming trapped in the ice formations



Storage: Access Control

- ▶ Access limitations depend on the material or information
 - More control of access if COCs are present
- ▶ Lock areas, rooms, cabinets
 - Control of keys
- ▶ Label areas "Authorized Personnel Only"
 - Means of identifying authorized personnel
 - Challenge unfamiliar people in restricted areas
- ▶ Authorized personnel
 - Trusted, background check
 - Trained
 - Legitimate need



Storage: Examples



Activity: Chemical Storage

- ▶ Find one or two partners
- ▶ Use the hazard and compatibility information to optimize chemical storage
- ▶ Rules:
 - 4 bottles per shelf maximum
 - Note that only one cabinet has a vent
 - Only one cabinet can be secured (padlock)

You may have to make some compromises or hard choices

- ▶ When finished, discuss the following and write comments in your workbook:
 - Was there one "perfect" way to store the chemicals?
 - Did you have to make compromises? What were they?
 - In making compromises, what were your main priorities?



Activity: Chemical Storage

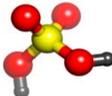
Conclusions

- ▶ Can make chemical storage safer and more secure
- ▶ Safe and secure chemical storage requires
 - Space
 - Time
 - Training
 - Equipment
- ▶ Difficulties may be mitigated by operational controls
 - Substitution
 - Source reduction
- ▶ Can get help from a computer/web-based inventory system that tracks hazard classes



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 - ▶ **Activity: Hazardous Waste Label**
 - ▶ HW: Lesson Planning
 - ▶ CSP Website Demonstration

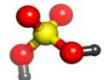


Activity: Hazardous Waste Tags and Labeling

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Activity: Hazardous Waste label

- ▶ You have completed an experiment involving:
 - Chemical 1
 - Chemical 2
 - Chemical 3
 - Chemical 4
 - Chemical 5
- ▶ Fill out your Waste Label Tag
- ▶ Discuss your considerations and differences with your group

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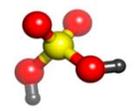
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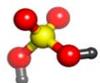
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Home Work

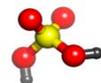
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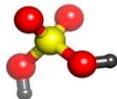
HW: Lesson Plan

- ▶ Describe to the group
 - Your Written lesson plan
 - Agenda
 - Learning outcomes
 - Training methods
 - Evaluation strategy
 - Your process in creating the lesson plan
 - Challenges
 - Solutions

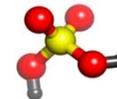


Workshop Overview

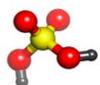
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- HW: Lesson Planning
- ▶ **CSP Website Demonstration**



Website Demonstration

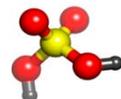


Day 2

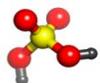


Day 2: Overview

- ▶ **Activity: Policy Statement**
- ▶ Chemical Inventory Management System (CIMS)
- ▶ Laboratory Use of Chemicals (GHS, SDS, SOP)
 - Standard Operating Procedure (SOP) Activity
 - Activity: Glove Selection
- ▶ Lab Assessment Exercise Part 3 and 4
- ▶ Group Presentations

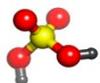


Policy Statement Activity



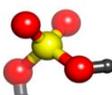
Activity: Policy Statement

- ▶ Each person is given a policy statement on a card
- ▶ Your goal is to create a group of people with **different** statements
- ▶ How many different statements did you find?



Day 2: Overview

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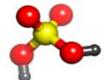


Chemical Inventory Management System (CIMS)

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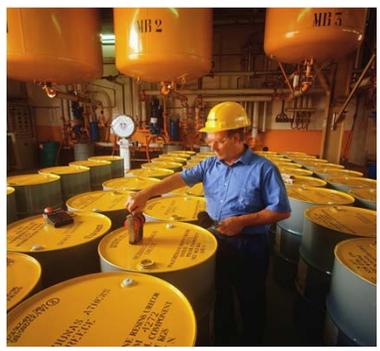
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Key Principles: Chemical Inventory Management System (CIMS)

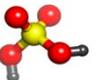
- ▶ Set of policies, procedures, and tools for chemical management
- ▶ “Living” database of chemical inventory
 - Updated with procurement, transport, use, and disposal
- ▶ Requires training, maintenance, and inspection
- ▶ Important for small scale research labs and large scale industry



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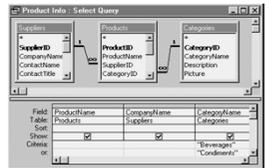
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Key Principles: Chemical Inventory Management System (CIMS)

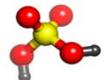
- ▶ Computer/web-based system
 - Access or Excel
 - Commercially available software
- ▶ Inventory Tracking
 - Unique identifier
 - Barcodes
- ▶ Many desirable functions
 - Improve laboratory work
 - Reduce inventory




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Chemical Inventory Basics

- ▶ **Inventory fields**
 - Chemical or tradename
 - CAS number
 - Hazards
 - Ingredient list
 - Owner/ purchaser
 - Location/organization
 - Dates:
 - Order/received/expiration
 - Amounts: ordered, remaining, used
- ▶ **Searches and Reports:**
 - Find an (M)SDS
 - Chemical Inventory Search
 - Chemical Regulatory Reports
 - Find Chemical Storage Locations
- ▶ **Alerts generated by system**
 - Expiration
 - Quantity Re-order





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Inventory: Example and Demonstration

Barcode	Location	Date In	Name	Cas #	State	Quantity	Units	Container	Hazards/Alerts
AQ879816	124/2	2/12/2011	Sulfuric Acid	7664-93-9	Liquid	500	mL	Glass	acid
AQ879817	122/1	5/24/2003	Ferric Chloride	7705-08-0	Solid	500	gram	Metal Can	toxic, corrosive
AQ879818	124/3	1/1/2001	Oxygen	7782-44-7	Gas	5	m ³	Gas Cylinder	flammable
AQ879819	121/A	6/24/2005	Acetone	67-64-1	Liquid	1	L	Plastic	flammable
AQ879820	122/2	2/7/1998	Diethyl Ether	60-29-7	Liquid	1	L	Plastic	peroxide former
AQ879821	124/1	5/8/1996	Magnesium	7439-95-4	Solid	100	gram	Metal Can	flammable
AQ879823	121/B	5/30/2005	Pinacoyl Alcohol	464-07-3	Liquid	26	kg	Glass	CWC sch 2
AQ879824	121/A	10/24/2002	Sodium Cyanide	143-33-9	Solid	5	gram	Glass	toxic

- ▶ What information is missing?
 - Depends on what you need!
 - Compatibility groups?
 - Expiration dates?
 - Owner?
 - Waste Inventory too?



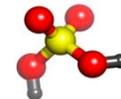
Activity: Inventory Reconciliation

- ▶ Guided demonstration of an inventory reconciliation
- ▶ Handout: CIMS Basics and several scenarios you can use in your trainings



Day 2: Overview

- Activity: Policy Statement
- Chemical Inventory Management System (CIMS)
 - ▶ **Laboratory Use of Chemicals**
 - Labeling
 - GHS
 - (Material) Safety Data Sheets
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 - Activity: Glove Selection
 - ▶ Lab Assessment Exercise Part 3 and 4
 - ▶ Group Presentations



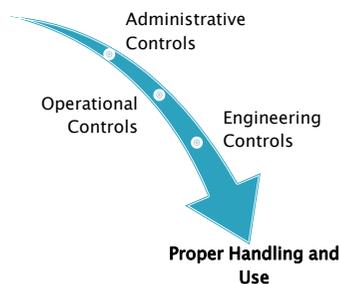
Laboratory Usage of Chemicals



Key Principals of Chemical Usage

- ▶ Prevent Accidents/Harm
- ▶ Prevent Environmental Exposure

- ▶ Topics Discussed:
 - Labeling
 - (Material) Safety Data Sheets (SDS)
 - Standard Operating Procedure (SOP)
 - Personal Protective Equipment (PPE)



Labeling Basics

- ▶ Proper Labeling of Laboratory Hazards

- Chemical
- Physical
- Biological
- Radiological



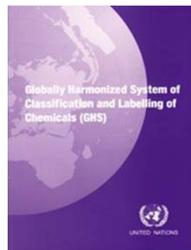
Just ignore the label...
The worst stuff isn't listed anyway.

- ▶ Globally Harmonized System (GHS) Hazard Labels



The Globally Harmonized System (GHS) of Classification and Labeling of Chemicals

- ▶ A system for standardizing and harmonizing the classification and labeling of chemicals
- ▶ Not a regulation or a standard.
 - establishes agreed hazard classification and communication provisions with explanatory information on how to apply the system
- ▶ GHS Labels and Safety Data Sheets (SDS)

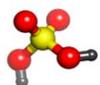


<http://www.osha.gov/dsg/hazcom/ghs.html>



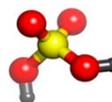
Globally Harmonized System (GHS) Hazard Labels

Corrosive 	Irritant 	Health Hazard 	Acute Toxicity
Flammable 	Explosion 	Oxidizer 	Compressed Gas

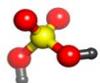


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(Material) Safety Data Sheet (SDS) Overview



(M)SDS Basics

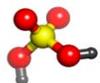
- ▶ Can use videos to demonstrate concepts and basics
 - <http://www.youtube.com/watch?v=yFHvuDnEEK0&feature=related>



GHS Safety Data Sheets

- ▶ Serve the same function as an MSDS does in ISO, EU and ANSI requirements
- ▶ Most comprehensive source of information
 - Hazards, including environmental hazards
 - Advice and safety precautions
 - Transportation, emergency responders, poison centers
- ▶ Product related and not specific to workplace or task
 - Written and supplied by manufacturer
- ▶ Only for pure substances and some mixtures

<http://www.osha.gov/dsg/hazcom/ghs.html>

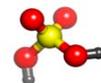


SDS Format

16 Sections

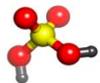
- | | |
|---|-------------------------------------|
| 1. Identification | 9. Physical and chemical properties |
| 2. Hazard(s) identification | 10. Stability and reactivity |
| 3. Composition/information on ingredients | 11. Toxicological information |
| 4. First-aid measures | 12. Ecological information |
| 5. Fire-fighting measures | 13. Disposal considerations |
| 6. Accidental release measures | 14. Transport information |
| 7. Handling and Storage | 15. Regulatory information |
| 8. Exposure controls/personal protection | 16. Other information |

Look at Sulfuric Acid SDS provided in Booklet, as we describe some of the important sections



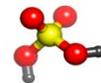
SDS Section 2: Hazards

- ▶ GHS classification of the substance/mixture and any national or regional information 
- ▶ GHS label elements, including precautionary statements. 
 - Pictograms, black and white reproduction of the symbols, or the name of the symbol, e.g., flame, skull and crossbones. 
- ▶ Other hazards which do not result in classification (e.g., dust explosion hazard) or those not covered by the GHS. 

SDS Section 4: First-aid Measures

- ▶ Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion.
- ▶ Most important symptoms/effects, acute and delayed.
- ▶ Indication of immediate medical attention and special treatment needed, if necessary.



SDS Section 6 and 7

Section 6: Handling and Storage

- ▶ Precautions for safe handling.
- ▶ Conditions for safe storage, including any incompatibilities.

Section 7: Exposure controls/ personal protection

- ▶ Control parameters, e.g., occupational exposure limit values or biological limit values.
- ▶ Appropriate engineering controls.
- ▶ Individual protection measures, such as personal protective equipment (PPE).



SDS Section 10: Stability and reactivity

- ▶ Reactivity
- ▶ Chemical stability
- ▶ Possibility of hazardous reactions
- ▶ Conditions to avoid (e.g., static discharge, shock or vibration)
- ▶ Incompatible materials
- ▶ Hazardous decomposition products



SDS Section 13 and 15

Section 13: Disposal Considerations

- ▶ Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.
 - May be region, country specific

Section 15: Regulatory Information

- ▶ Safety, health and environmental regulations specific for the product in question.
 - May be region, country specific



GHS Safety Data Sheets (SDS)

- ▶ Drawbacks
 - Not always current
 - Lack of toxicity information for most chemicals
 - Industry focus, not specific to laboratory scale
 - Sometimes inconsistent

SDS contains comprehensive information for chemical management in one place

Keep SDS for each chemical in your inventory



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- ▶ Lab Assessment Exercise Part 3 and 4
- ▶ Group Presentations



Standard Operating Procedure (SOP)

- ▶ Definition: describes how your lab will handle a hazardous chemical
- ▶ Should Include
 - Amount and concentration used,
 - How you obtain or create the working solution
 - Special handling procedures, engineering controls, and personal protective equipment
- ▶ Required for any work with hazardous chemicals in laboratories
- ▶ *No specific Format*
- ▶ Can be written into a protocol for describing the steps in an experiment
- ▶ Example Templates:
<http://www.safety.duke.edu/OHS/chemsopsTemplates.htm>



Standard Operating Procedures (SOPs), cont'd.

- ▶ SOPs are:
 - Dated
 - When issued
 - When reviewed
 - When revised
 - Have: subject, title and identification code
 - Officially reviewed by management
 - Signed by all responsible parties
 - May include forms
 - Written in a consistent and official format with numbered pages



Standard Operating Procedures (SOPs)

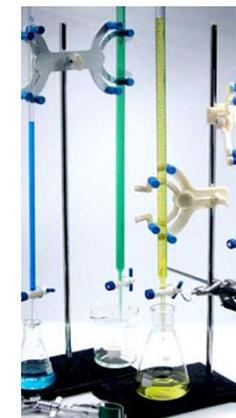
Consider written SOPs on:

- Security clearance and visitor access
- Employee training
- Medical surveillance
- Respiratory protection and fit
- Eye protection
- Ventilation system maintenance
- Storage, receipt, transport and shipping of hazardous materials
- Accident and emergency response including natural disasters
- Spill cleanup
- Waste management
- Hazardous material handling
- Special operations, radiation, biosafety, lasers, infectious agents

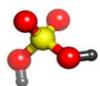


Activity: Standard Operating Procedures (SOPs)

- ▶ Scenario: You are a chemist in a Quality Control (QC) lab
- ▶ Goal: Develop an SOP for preparing a standard acid solution for titration
- ▶ Get in groups of 4-5 people per group

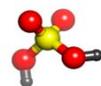


Buret photograph courtesy of Indigo® Instruments



Activity: Standard Operating Procedures (SOPs)

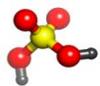
- ▶ Refer to the *SDS* for H_2SO_4 , and the *partially completed SOP*
- ▶ In your groups, discuss
 - Hazards
 - Chemicals, reactions, and products
 - Equipment
 - Storage
 - Disposal
 - Security
 - Controls
 - Operational
 - Engineering
 - PPE
- ▶ Fill in the blanks to complete the SOP
 - Be prepared to discuss with the whole class



Activity: Standard Operating Procedures (SOPs)

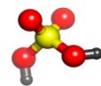
Hazards in this SOP

Preparation of solutions	 
Equipment	 
Waste/disposal	
Security	



Activity: Standard Operating Procedures (SOPs)

- ### Controls?
- ▶ Operational
 - SOP
 - Substitution
 - Scale down
 - ▶ Engineering
 - ▶ PPE
 - Quantity dependent

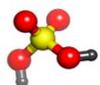


Activity: Standard Operating Procedures (SOPs)

Conclusions

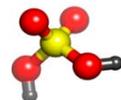
- ▶ SOP is a set of steps for carrying out a laboratory task safely and securely
- ▶ Should be part of a formal training procedure
 - Update regularly
- ▶ Protects students/workers, faculty, administrators, chemicals/info



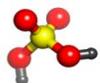


Day 2: Overview

- ☑ Activity: Policy Statement
- ☑ Chemical Inventory Management System (CIMS)
- ☑ Laboratory Use of Chemicals
 - ☑ Labeling
 - ☑ GHS
 - ☑ (Material) Safety Data Sheets
 - ☑ Standard Operating Procedure (SOP) Activity
 - Activity: Glove Selection
- ▶ Lab Assessment Exercise Part 3 and 4
- ▶ Group Presentations



Activity: Glove Selection



Activity: Glove Selection

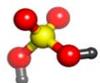
- ▶ In your groups discuss **which PPE is/are required for the given scenarios below**
 - PPE available in the lab are provided in the packet.
- ▶ Scenario 1:
 - Cleaning glassware in a 10% nitric acid bath
- ▶ Scenario 2:
 - Pouring concentrated sulfuric acid into a beaker
- ▶ Scenario 3:
 - Creating a 65:45 Acetonitrile/Methanol solution
- ▶ Scenario 4:
 - Weighing out 10 mg of aluminum trichloride

Take about 15 minutes to do this



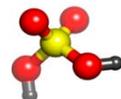
Activity: Conclusion

- ▶ Was there any difficulty in this activity?
- ▶ Answers and Discussion
 - Scenario 1-?
 - Scenario 2-?
 - Scenario 3-?
 - Scenario 4-?
- ▶ Would this activity be useful in your teaching?

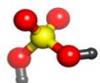


Day 2: Overview

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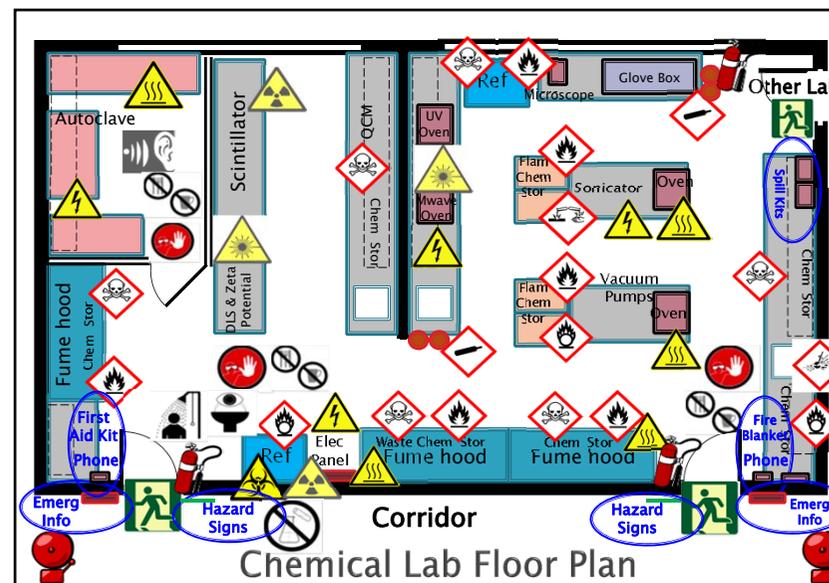
Laboratory Assessment: Part 3

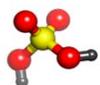


Part 3a: Laboratory Assessment Exercise

- ▶ Create a list based on the hazards and controls that are present
 - What does your laboratory do well?
 - Mark or list these on your layout in blue pen

Take 10-15 minutes to do this

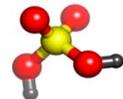
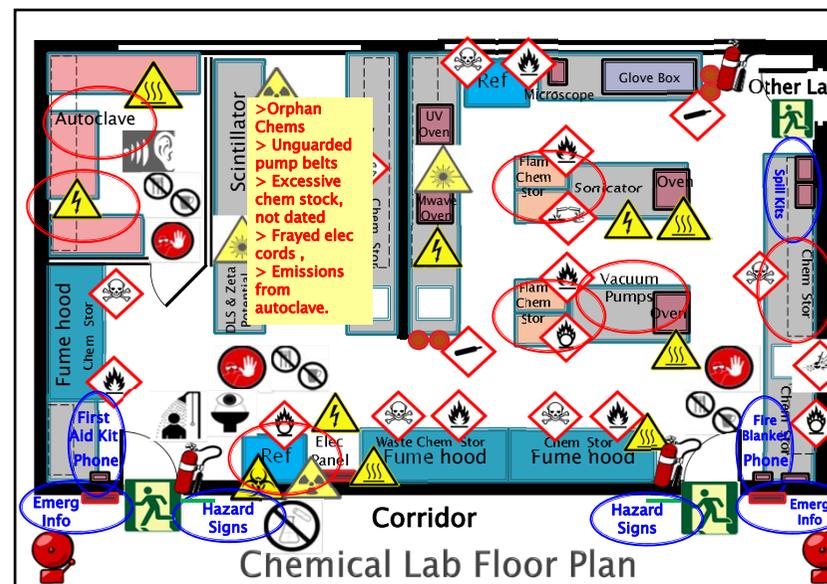




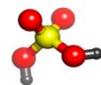
Part 3b: Laboratory Assessment Exercise

- ▶ Create a second list based on the hazards and controls that are present
 - What could your laboratory do better?
 - Mark or list these on your layout in **red** pen

Take 10–15 minutes to do this



Lunch



Day 2: Overview

- Activity: Policy Statement
- Chemical Inventory Management System (CIMS)
- Laboratory Use of Chemicals
 - Labeling
 - GHS
 - (Material) Safety Data Sheets
 - Standard Operating Procedure (SOP) Activity
 - Activity: Glove Selection
- ▶ Lab Assessment Exercise Part 3 and 4
- ▶ Group Presentations



Part 4: Laboratory Assessment Exercise

Develop an action plan

► Prioritization:

- **Easiest** →
 - inventory
 - check actual
 - remove spent chems
 - separate groups
 - secondary containment
- **Medium** →
 - fire storage cabinets
 - develop SOPs
- **Difficult**
 - new fume hood
 - proper waste disposal

- **CSS leadership team:**
 - training
 - collect MSDS info

► CSS leadership team:

- You, fellow labmate? fellow professor? EHS specialist? department director? others?

► Timeline & commitment:

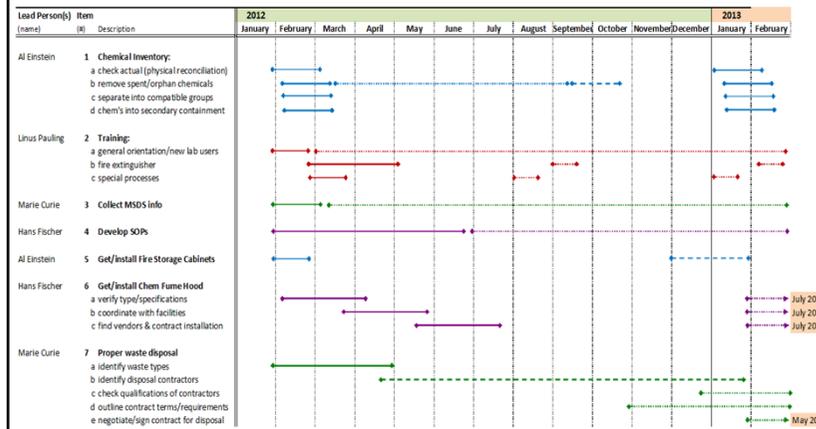
- initiate actions, complete actions, ongoing actions, persons responsible



CSS Action Plan

► Timeline & commitment:

- initiate & complete actions, ongoing actions, persons responsible



Group Presentations

CSP
CHEMICAL SECURITY
ENGAGEMENT PROGRAM
SAND 2012-5234C

Sandia
National
Laboratories



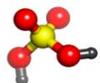
Present the Plan

► Describe to the group

- Your written lesson plan
 - Agenda
 - Learning outcomes
 - Training methods
 - Evaluation strategy

◦ Your process in creating the lesson plan

- Challenges
- Solutions



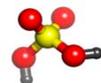
Workshop Conclusions

Objectives

- ▶ Promote the safe and peaceful use of chemistry
- ▶ Encourage the creation of networks of people interested in CSS
 - Culture of Chemical Safety and Security

Goals:

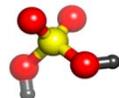
- ▶ Train The Trainer: Propagate the Knowledge and Practices Forward



Evaluations

- ▶ Please find and fill out the evaluations for this workshop

Thank you for your participation!



Thank You!!

Drs. Joe, Christine, and Morgan

