AMERICAN CHEMICAL SOCIETY UPDATE

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ACS Chemistry for Life™

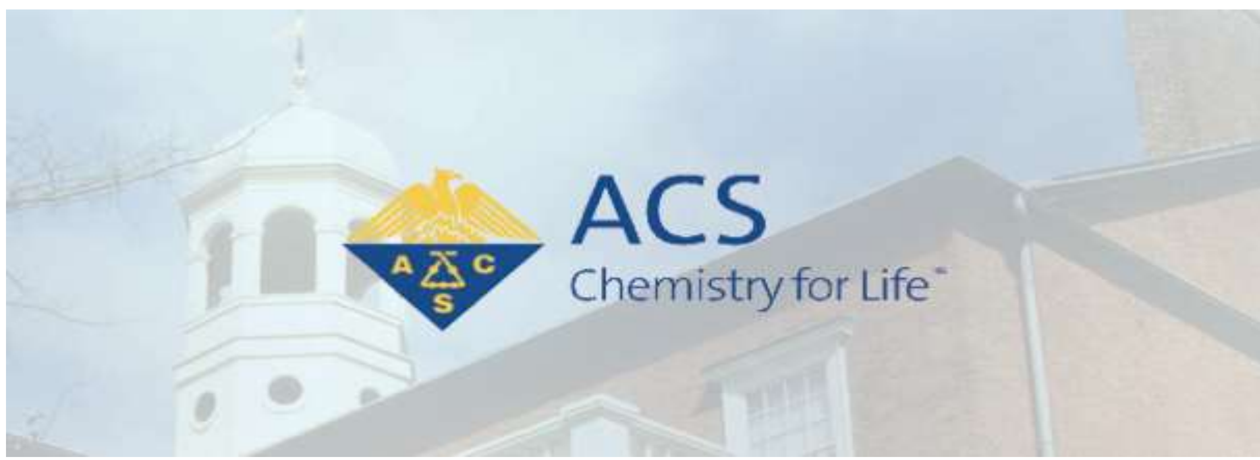




DPS

ACS Initiatives

- Safety Culture in Academic Institutions
- Laboratory Waste Management – A Guidebook
- Identifying and Evaluating Hazards in Research Laboratories
- Symposia
- Grants



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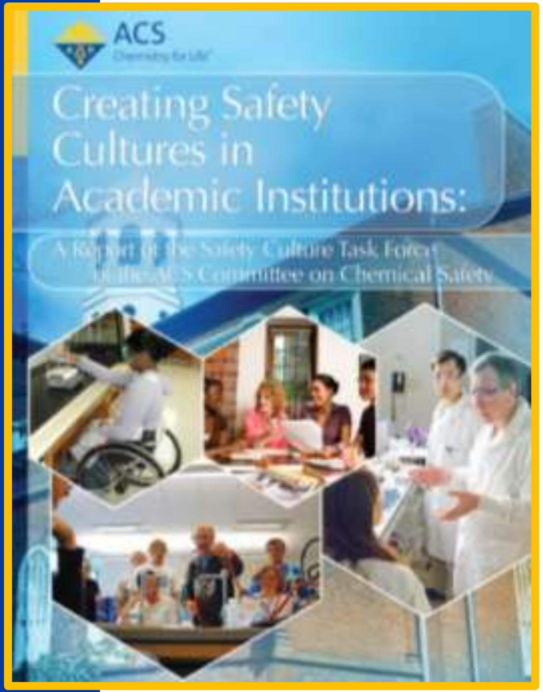
CREATING SAFETY CULTURES IN ACADEMIC INSTITUTIONS

The Safety Culture Task Force of the ACS Committee on Chemical Safety



Concerns About Safety in Academia

- **Laboratory incidents in academic laboratories**
  - Highly publicized: Serious injuries, fatalities, extensive lab damage
  - Observations that chemistry graduates lack strong safety skills
  - Calls for changes in academic safety culture and safety educational process
- **Government investigation of incidents:**
  - Cal OSHA; U.S. Chemical Safety Board
- **Criminal charges against:**
  - University administrators; Principal Investigator
- **Academicians wonders**
  - What can we do?
  - How do we prevent incidents?
- ACS Fellows/DCHAS

Safety Culture Task Force

- **Organized by:**
  - ACS Committee on Chemical Safety (CCS)
- **Goal:**
  - To develop guidance, suggestions, recommendations that can help strengthen the safety culture of two- and four-year undergraduate, graduate, and postdoctoral programs. Identify the best elements and best practices of strong safety culture.
- **Members representing:**
  - CCS
  - Society Committee on Education (SOCED)
  - Committee on Professional Training (CPT)
  - Younger Chemists Committee (YCC)
  - Division of Chemical Health and Safety (CHAS)

What is a Strong Safety Culture?

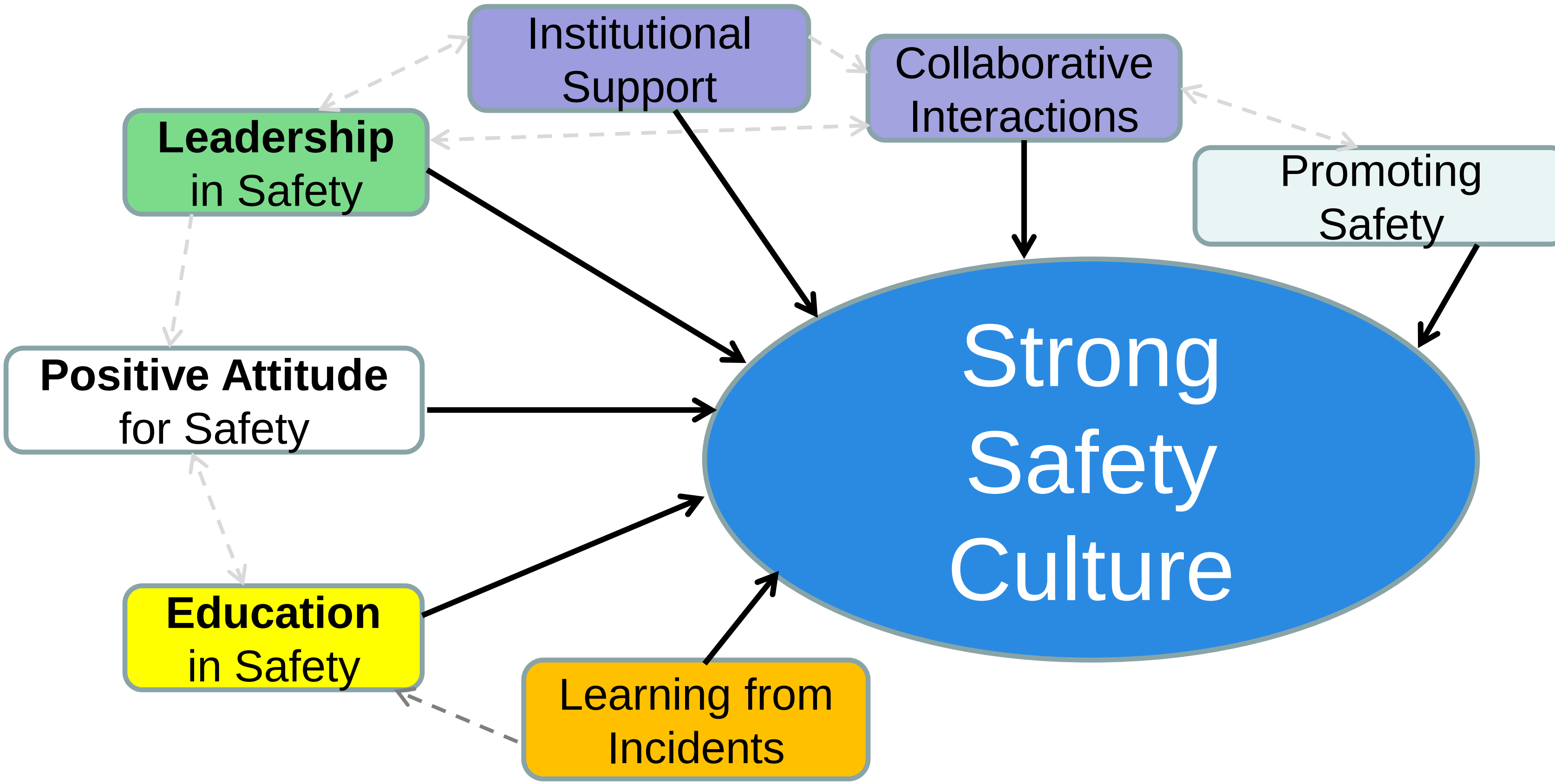
- U.S. Nuclear Regulatory Commission (NRC)
- U.S. Occupational Health and Safety Administration (OSHA
- National Research Council's *Prudent Practices in the Laboratory*[1]

[1]National Research Council, *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards – An Update. Washington, DC, National Academies Press, 2011*

Barriers to Strong Safety Cultures

- Safety - low priority and fragmented
- Safety supervision lacking; responsibility, accountability for safety unclear
- Inadequate safety education, no instructional materials
- Incoherent safety program as undergraduates advance
- Safety seen as set of rules, regulations; not ethical obligation or essential part of curriculum
- Insufficient resources, time allocation for safety
- Safety training for faculty, staff, advanced students missing
- Systemic review of incidents missing
- Collaborative interactions missing

Building Strong Safety Cultures

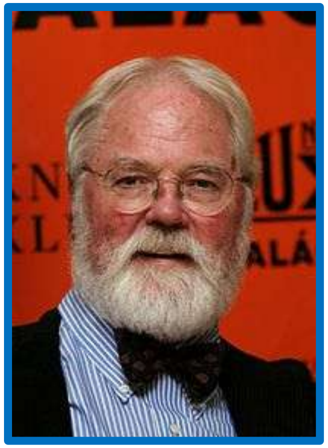


Safety Leadership and Management

- **Leaders determine direction, strength for safety culture**
- **Academic authority :**
  - President ⇨ Provost ⇨ College Deans ⇨ Department Chairs ⇨ Faculty, Principal Investigators, Staff
  - Not always observed or enforced
- **Department Chairs, senior-tenured faculty, research directors, lab supervisors, principal investigators**
  - Set tone for safety
  - Responsible, accountable for safety
  - Ensure faculty, staff, postdoctoral scholars, that teach and oversee research, are educated in safety
  - Ensure early-career faculty mentored in safety
  - Not just the technical aspects, but the management

Safety Leadership and Management

- **Department Chairs, senior-tenured faculty, research directors, lab supervisors, principal investigators**
  - Responsible for safety education
  - Ensure students:
    - Develop strong safety skills, strong safety ethics
    - Learn how to apply principles of safety throughout curriculum
    - Continually learn safety during all labs
    - Capable of using safety skills to work independently in labs



Don't worry that [students] never listen to you; Worry that they are always watching you!

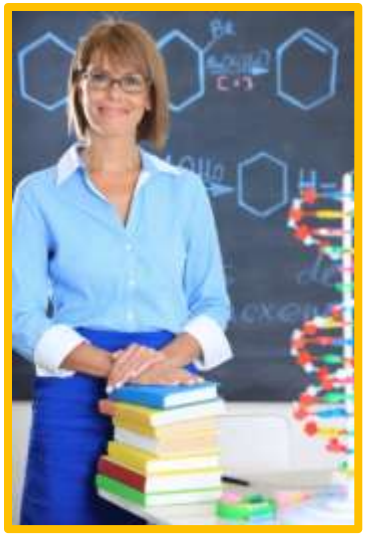
Robert Fulghum

Safety Leadership and Management

- **Recommendations**
  - *Establish lines of authority for safety, develop a safety policy that includes lab safety, safety responsibilities in job descriptions and performance plans for all employees*
  - *Encourage every leader to become proponent of safety and safety education, to demonstrate this care for safety in their actions with other staff members and students*
  - *Establish a strong, effective safety management system and safety program for the institution, including lab safety*

Teaching Lab and Chemical Safety

- **Teaching should build safety skills in undergraduate**
  - Taught throughout curriculum – continuous, spiral safety education
  - Enable students to understand safety principles, their application
  - Teach students to “think critically” about safety
- **Teaching approaches**
  - Best: teach safety topics in each lab session throughout 4 yrs
  - Stand alone lab safety course(s)
    - Combined with safety topics in lab sessions during 1st , 2nd yrs
    - Basic safety course in 3rd yr; Advanced safety course in 4th yr



Four Organizing Principles of Safety

- Remember the acronym – ***RAMP***[2]

- **<u>R</u>ecognize** hazards
- **<u>A</u>ssess** the risks of hazards
- **<u>M</u>inimize** the risks of hazards
- **<u>P</u>repare** for emergencies

[2]R Hill, D Finster. *Laboratory Safety for Chemistry Students,* Hobenken, NJ, John Wiley, 2010

Teaching Lab and Chemical Safety

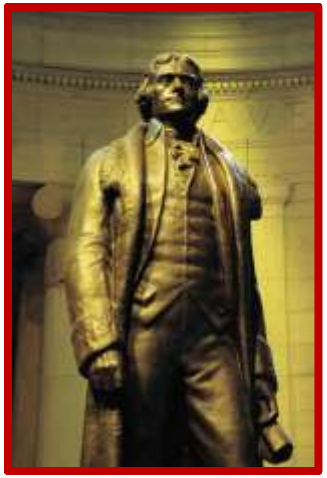
- **Teachers/researchers need good understanding of safety**
  - Safety education needed for: faculty, graduate students, teaching assistants, postdoctoral scholars, lab managers/coordinators
- **Resources for preparing lab safety lessons available**
  - Books, journals, websites available
- **Hazards Analysis - used for evaluating risks of research**
  - U.S. Chemical Safety Board (CSB) investigated 2010 Texas Tech University explosion
  - Concerned about frequency of laboratory incidents in academia
  - Findings apply to all universities and colleges in general
  - CSB asked ACS to develop hazard assessment tools for academic researchers

Teaching Lab and Chemical Safety

- **Recommendations**
  - *Ensure graduating chemistry undergraduates have strong skills in laboratory safety and strong safety ethics by teaching safety lessons in each laboratory session, and by evaluating and testing skills throughout the educational process (Table1)*
  - *Ensure all faculty, staff, and graduate and undergraduate students involved in teaching, managing, or overseeing students in laboratory courses and sessions have successfully completed a course in safety*
  - *Implement hazards analysis procedures in all new lab work, especially laboratory research*

Safety Attitudes, Awareness, Ethics

- A positive attitude toward safety is critical
- Negative or ambivalent attitudes toward safety put us all at risk
- Building a positive attitude toward safety requires:
  - A belief that safety really is important
  - Repeated and continuous education about safety over the long term
  - Working under leadership that emphasizes the importance of safety
  - Being held accountable for safety



Nothing can stop the man with the right attitude from achieving his goal; nothing on earth can help the man with the wrong mental attitude.

Thomas Jefferson

The Safety Ethic

- Value safety
  - Positive, integral part of all activities, cannot to be compromised (unlike priorities that can and do change)
- Work safely
  - Being educated in safety, striving to learn safety, using RAMP
- Prevent at-risk behavior
  - Learning to recognize at-risk behavior
- Promote safety
  - Setting as an example; teaching others about safety
- Accepting responsibility for safety
  - Recognizing and accepting your role in safety for yourself and others – coworkers, family, employees

Safety Attitudes, Awareness, Ethics

- **Recommendations**
  - *Build awareness and caring for safety by emphasizing safety throughout the chemistry curriculum*
  - *In the preparation of grant proposal, researchers should include in their plans safety education and training (for undergraduate students, graduate students, and postdoctoral scholars participating in proposed research) and oversight of research for safety*
  - *Adopt a personal credo: the "Safety Ethic" – value safety, work safely, prevent at-risk behavior, promote safety, and accept responsibility for safety*

Learning from Incidents

- **Investigate laboratory incidents**
  - Determine direct, indirect, root causes
  - Measures that minimize, prevent future incidents
- **Use incidents in teaching as case studies**
  - Captures interest of students
  - Forces them to think about safety measures
- **Establish system for reporting, investigating, sharing information about incidents**
  - Includes not only employee, but student incidents
  - Includes all incidents, near-misses
  - Incidents and lessons learned are shared

Learning from Incidents

- **Recommendations**
  - *Establish and maintain an Incident Reporting System, an Incident Investigation System, and an Incident Database that should include, not only employees, but students also – graduate students, postdoctoral scholars, and other nonemployees*
  - *Establish an internal review process of incidents and corrective actions with Departmental Safety Committee (faculty, staff, students, graduate students, and postdoctoral scholars), and provide periodic safety seminars on lessons learned from incidents*
  - *Publish or share the stories of incidents and the lessons learned (case studies) to your institution's website, a public website or an appropriate journal where students and colleagues from other institutions may also use these as case studies for learning more about safety*
  - *Listening tour*

Collaborative Interactions

- **Collaborative interactions build strong safety cultures**
  - Campus-wide effort required
- **System of safety councils and committees**
  - Top-level council (managers, faculty)
    - Reports to highest possible level
    - Develops policies; oversees safety effort of safety committees
  - Committees (faculty, staff, students, researchers)
    - Lab safety, chemical safety, radiation safety, security, etc.
    - Reviews all matters, incidents, oversight of area
- **Partnership with environment, health, safety (EHS), other departments**
- **Establish relationship with emergency responders**

Collaborative Interactions

- **Recommendations**
  - *Establish a series of safety councils and safety committees from the highest level of management to the departmental level or lower. Each of these committees reports, in turn, to a committee that is higher in the hierarchy of the institution*
  - *Establish a close working relationship with EHS personnel at every departmental level seeking their advice and experience in safety and offering departmental and faculty advice to EHS based upon their experience with knowledge of chemistry*
  - *Establish a close working relationship with local emergency responders so they are prepared to respond to emergencies in laboratories*

Promoting and Communicating Safety

- **Promote safety through personal example**
  - Always following safety procedures, protocols, rules
  - Especially important for faculty, staff (students follow examples)
- **Promote safety programs**
  - Advertising, intranet/internet safety websites, safety newsletter, social networking, campus-wide emails, posters, safety reports
  - Seminars – topical safety issues, incidents; safety component in research seminars
  - Safety week
- **Recognition of individuals for following safe processes**
- **Soliciting suggestions for improving safety, identifying safety concerns**

How Do You Start A Fire?

- *Management Safety Observations*
- Ask laboratory scientists
  - Explain your work
  - Your hazards? Minimizing hazards?
  - Do you have any concerns?
- Learned about change in analytical method
  - Used heating block; changed process to oven
  - Using ordinary refrigerator
- Make this part of the inspection/audit process

Promoting and Communicating Safety

- **Recommendation**
  - *Establish a system to promote safety in an institution or department that encompasses: electronic communications; printed materials; special seminars or events discussing or promoting safety; a recognition system for good safety performance; and a process to solicit, review, and act on suggestions for improving safety and identifying safety issues.*

Encouraging Institutional Safety Support

- **New, innovative approaches for building safety culture require funding**
- **Expert consultants require funding**
- **Recurring costs**
  - Information technology, incident tracking system, chemical waste management, chemical inventory, upgrading/maintaining safety equipment, EHS, inspections, safety education/training for CHOs, faculty, staff, researchers
- **Identify responsibilities to determine costs**
- **Recommendation**
  - *Identify the ongoing need to support a strong safety culture and work with administrators and departmental chairs to establish a baseline budget to support safety activities on an annual basis*

CCS Welcomes

- **Comments concerning**
  - Elements of safety culture
  - Recommendations
  - Other safety education topics
  - Other safety education resources
  - Nominations for “Bright Spots
- **Suggestions or ideas**
  - Implementation of recommendations
  - Other ways to help build strong safety cultures

CONTACT INFORMATION FOR THE COMMITTEE ON CHEMICAL SAFETY :

Email: Safety@acs.org

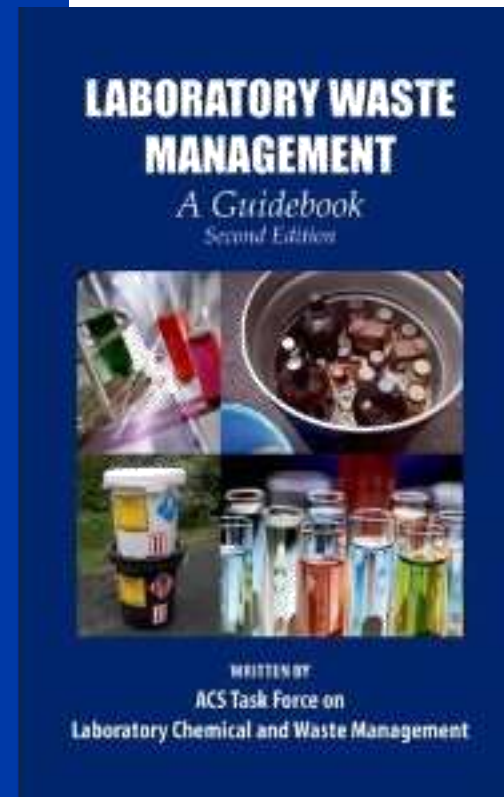
Website: www.acs.org/safety

American Chemical Society

ACS Chemistry for Life

LABORATORY WASTE MANAGEMENT: A GUIDEBOOK

Laboratory Chemical and Waste Management Task Force



Lab Waste Management: A Guidebook

1. Introduction
2. Management Obligations
3. Laws and Regulations
4. Using Information Resources
5. Training Requirements
6. Identification and Characterization of Hazardous Wastes
7. Pollution Prevention, Waste Minimization, and Green Chemistry
8. Other Laboratory Waste
9. Managing Multihazardous ("Mixed") Wastes
10. Hazardous Waste Accumulation
11. Managing Hazardous Waste and Disposal
12. Inspections
13. Liability and Enforcement
14. Self-Disclosure
15. Management Systems Approach to Laboratory Waste

Laboratory Waste Management: A Guidebook

- Updated from the 1994 version
- Available through Amazon and Oxford Press
- Discount information on ACS website: http://portal.acs.org/portal/PublicWebSite/about/governance/committees/chemicalsafety/CNBP_030472

Identifying and Evaluating Hazards in Research Laboratories

Hazard Assessment Task Force

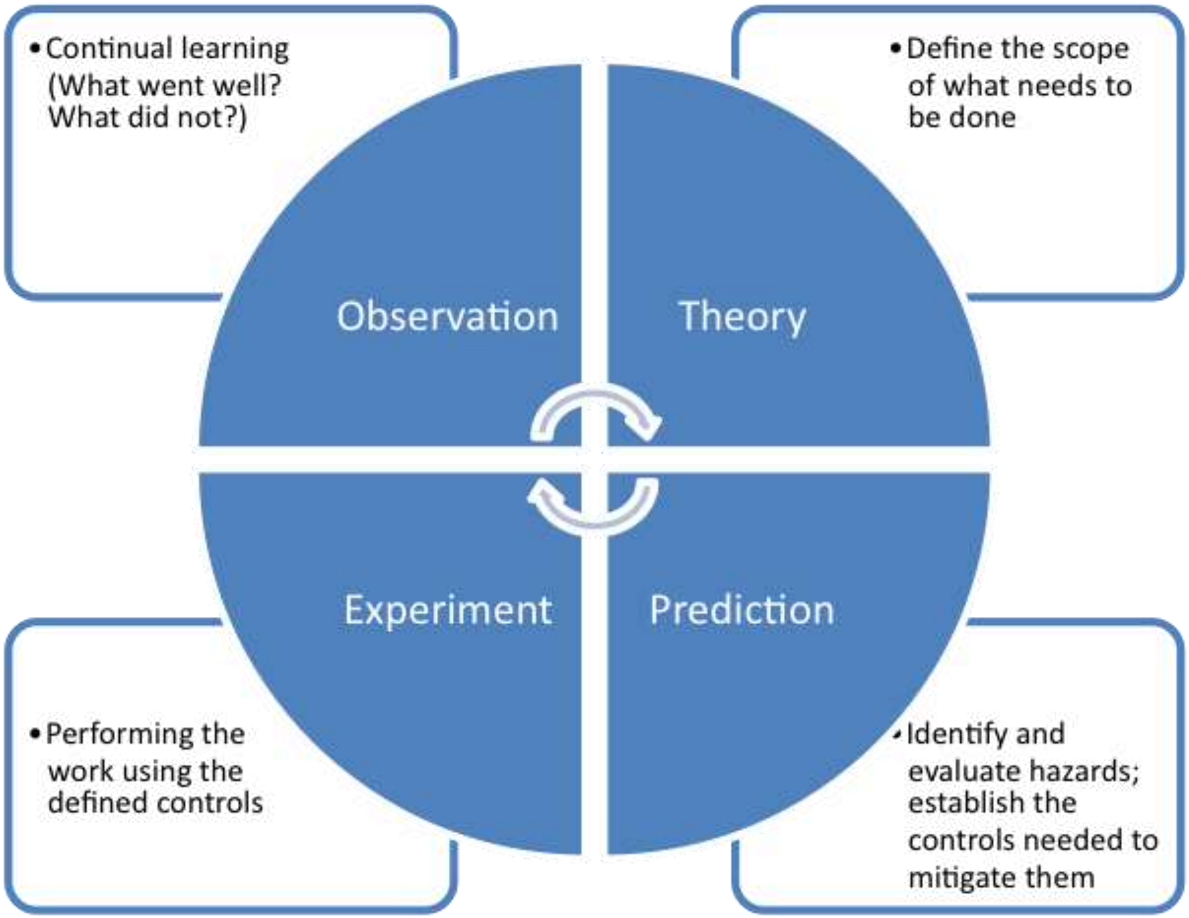
Hazard Assessment Task Force – Core Members

Name	Organization
Kim Jeskie, Chair	Oak Ridge National Labs
Peter Ashbrook	Director of EHS, University of Illinois Urbana-Champagne
Dominick Casadonte	Chemistry Professor, Texas Tech University
Debbie Decker	Chemical Hygiene Officer, University of California – Davis
Laurence Doemeny	Retired, NIOSH
Todd Houts	Assistant Director of EHS, University of Missouri
Robin Izzo	Associate Director of EHS, Princeton University
Ken Kretchman	Director of EHS, North Carolina State University
Samuella Sigmann	Lecturer and CHO, Appalachian State University
Erik Talley	Director of EHS, Weill Cornell Medical College

Guiding Principles

- For the researcher without deference to the point in their career (student, post-graduate, instructor, principal investigator, department chair).
- Provide techniques to ensure hazard and risk information has been gathered and analyzed.
- Assist a researcher in determining when they need to include others with varying experiences in the process.
- Provide techniques that can be used with different types of activities (routine procedures, modifications to current research, or entirely new activities)
- Consider the variable nature of research tasks and provides tools for helping researchers recognize and respond to change – both large and small.
- Attempts to account for different kinds of thinkers who may resonate with different kinds of tools.

Integration of Hazard Identification and Evaluation with the Scientific Method



Steps to Identifying and Assessing Hazards

1. Define the scope of risk
2. Identify hazards:
   - agent (toxic, carcinogen, etc)
   - activity (lifting, chemical mixing, long term use of dry boxes)
   - condition (pressure, electrical, pinch points)
3. Assess hazard and determine risk mitigation
4. Select hazard controls
5. Perform work within controls
6. Continuous learning

Whose job is it anyway?

- Need to establish roles and responsibilities
- Administration/Department
  - Ensure hazard assessment tools are in place
  - Make hazard identification and assessment an expectation
  - Make training and support available
  - Determine the acceptable level of risk
- Principal Investigator
  - Clarify responsibilities
  - Make hazard identification and assessment required
  - Set expectations that participating in lab work requires following established controls
  - Provide training and supervision

Whose job is it anyway?

- Researcher and lab workers
  - Perform hazard assessments, as needed
  - Perform their work in accordance with appropriate controls
  - Communicate changes in scope or research
  - Challenge others who are practicing risky behaviors
  - DOCUMENT
- Support staff
  - Includes EHS, CHOs and others
  - Partner with researchers, faculty and others to conduct hazard identification, analysis and mitigation methods
  - Disseminate new information both to their academic community and to peers
  - Check and consult on compliance issues

Getting the most out of the process

- Involve the appropriate level of expertise
  - For higher hazard potential, there is an increased need for persons with process experience to participate in the hazard review.
- Remember the four steps of learning:

Unconscious Incompetence – You don't know what you don't know

Conscious Incompetence – You realize you don't have adequate knowledge

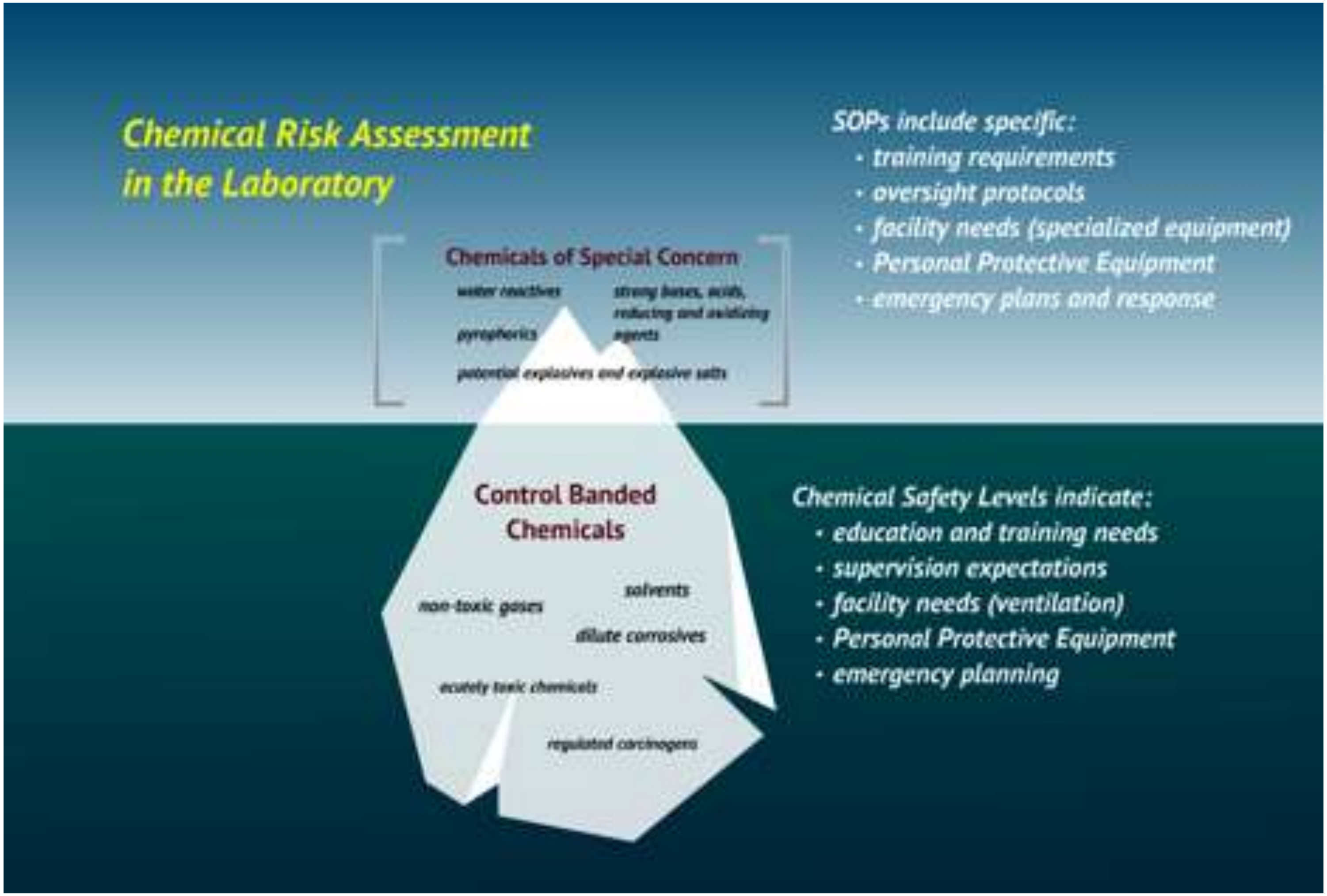
Conscious Competence – You are able to function safely and effectively

Unconscious Competence - You are very knowledgeable and experienced regarding the subject at hand

5 Methodologies

- Chemical Safety Levels
- Job Hazard Analysis
- What If Analysis
- Checklists
- Barrier Analysis

Chemical Safety Levels



Chemical Safety Levels

- **Level 1:** Minimal chemical/physical hazard. Minimal hazardous chemicals. No fume hood required. Examples: undergraduate teaching laboratories, laser laboratories (below Class 2B), and microscopy rooms.
- **Level 2:** Low chemical/physical hazard. Small amounts hazard chemicals. May need a fume hood for some activities. Examples: standard biomedical research laboratories.
- **Level 3**: Moderate chemical/physical hazard. Special hazards in limited quantities. Fume hood or local exhaust intensive. Examples: chemistry research, pathology laboratories
- **Level 4**: High chemical/physical hazard. Work with explosives/potentially explosive compounds. Use of large quantities and/or extremely high hazard. Use of glove box for pyrophoric/air reactive chemicals, high vacuum or high pressure synthesis systems. Examples: synthetic organic/inorganic chemistry laboratories, high power laser laboratories, and certain clean rooms (micro/nanofabrication facilities).

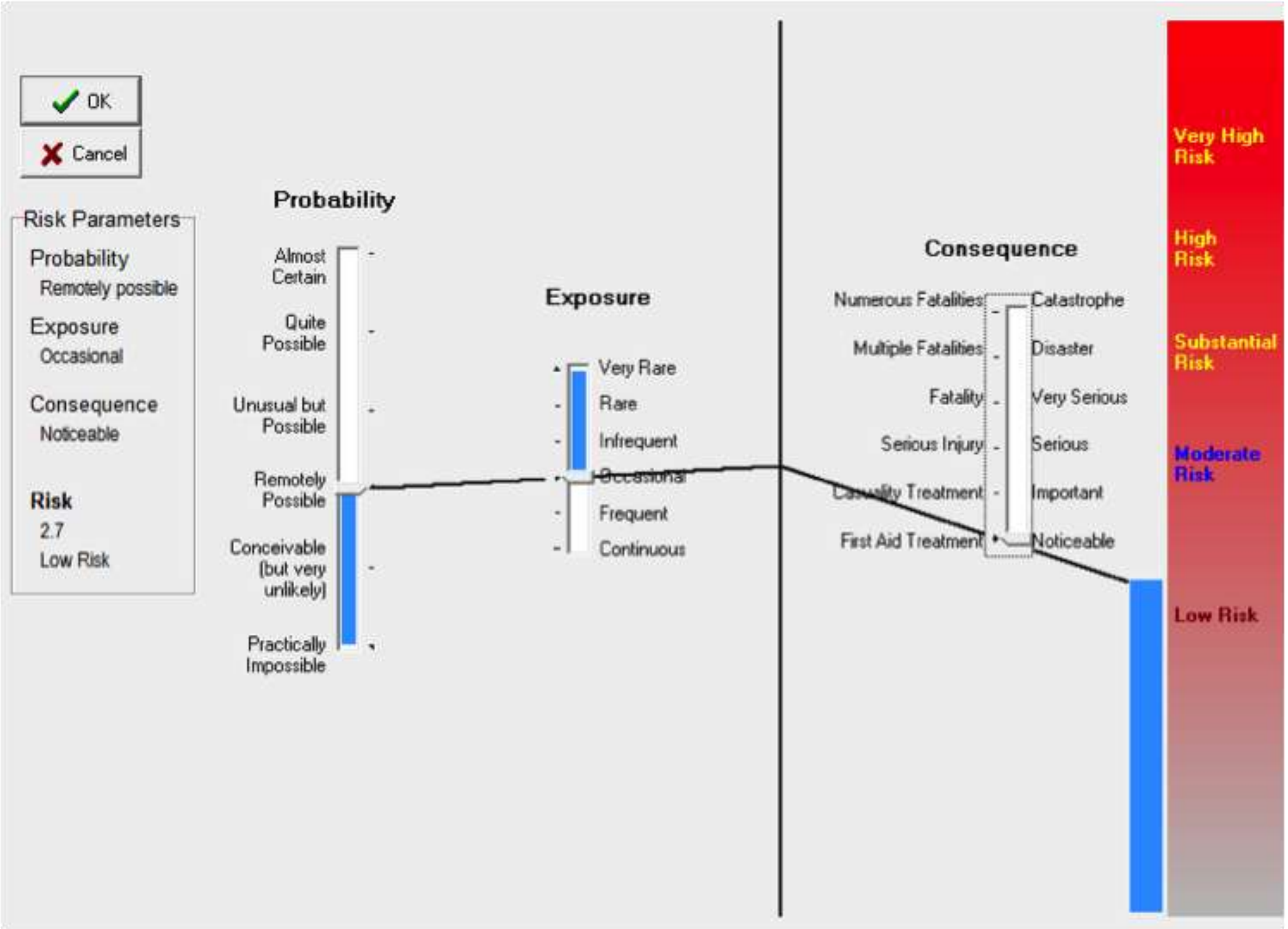
Job Hazard Analysis

- Focuses on the relationship between the researcher, the task to be done, the tools needed to complete the task, and the work environment where the task will be performed
- Identifies the hazards associated with the task.
- Determines controls to effectively mitigate or eliminate those hazards, according to the accepted institutional risk level

Job Hazard Analysis (JHA)

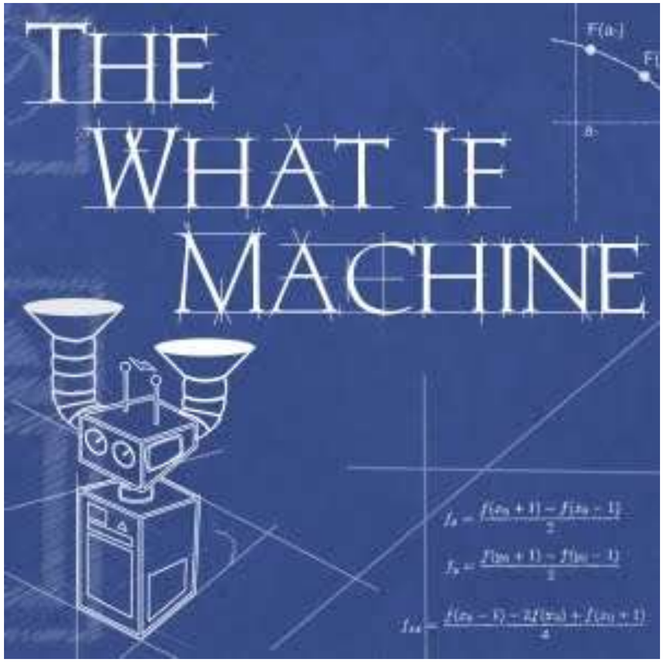
- An effort in detective work to determine
  - What can go wrong with the reaction, the equipment, or in the environment?
  - What are the potential pathways which may be taken during this task?
  - What would the consequences be if something did go wrong with any of the above?
  - How could the conditions arise that would enable something to go wrong?
  - What are other contributing factors?
  - Based on the answers above, how likely is it that the hazard will occur?

JHA – Risk Scores



What If Analysis

- Brainstorming method
- Main Steps
  1. Develop list of questions, e.g.
     - Failure to follow procedures or procedures followed incorrectly
     - Operator inattentive or operator not trained
     - Process conditions deviations
     - Equipment failure
     - Utility failures such as power, steam, gas
  2. Determine the result of those situations occurring
  3. Make judgments regarding the level of risk and it’s acceptability



What If Example –

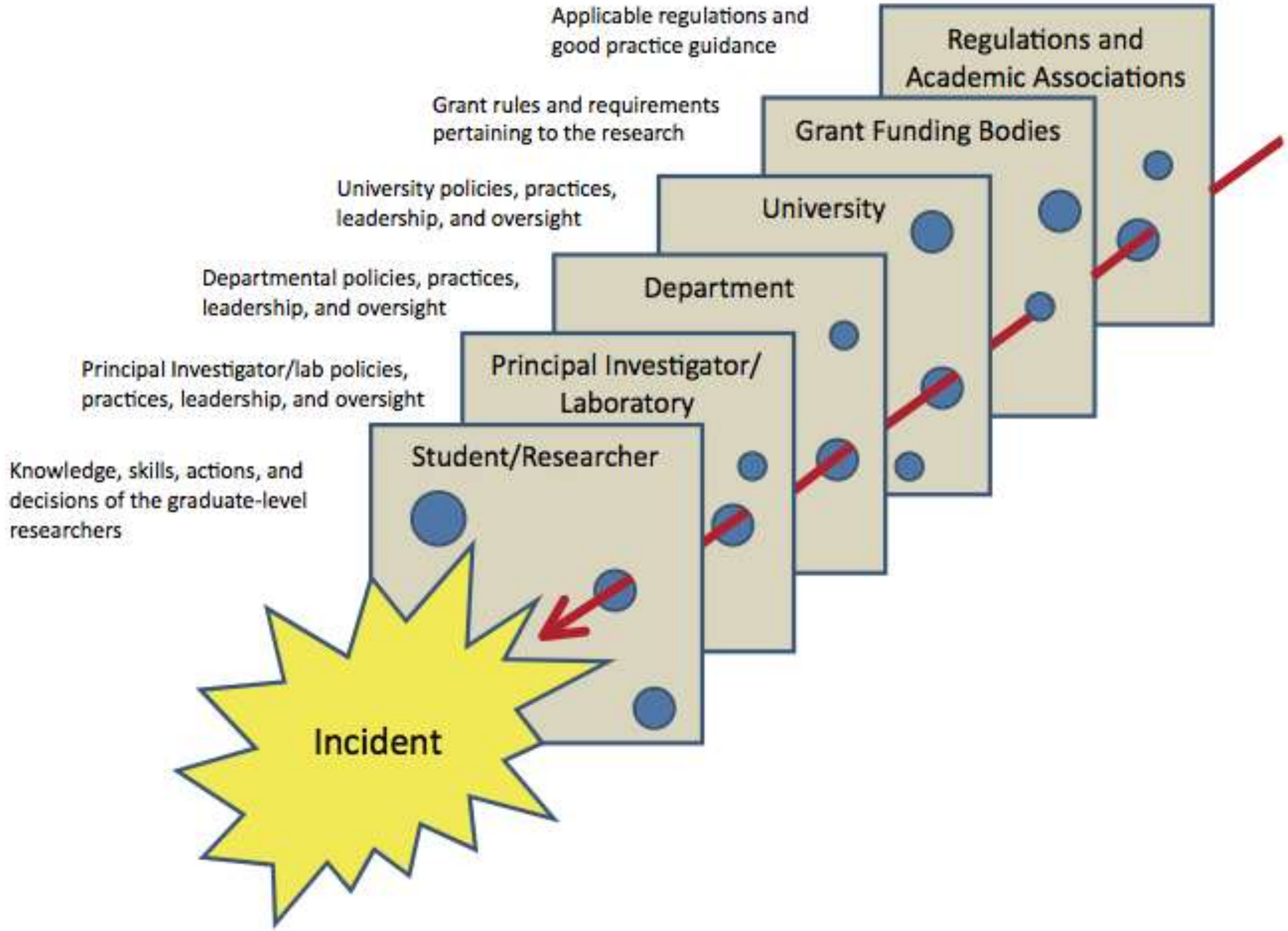
Use of Toxic / Flammable Gas in Small Cylinder in Fume Hood

What If?	Answer	Likelihood	Consequences	Recommendations
Power to exhaust fan is lost ?	Possible exposure to toxic gas if gas flow continues	Likely	Serious	Provide Emergency Power and normally closed gas valve
Mechanical Failure of Exhaust Fan ?	Same as above	Quite Possible	Serious	Same as above and consider connection to multiple fans
Regulator fails or creeps and allows full cylinder pressure to apparatus	Apparatus or tubing failure and gas release if not able to handle full cylinder pressure	Quite Possible	Minor	Use flow restricting orifice in cylinder valve to limit flow or install excess flow shutoff valve. Consider gas monitor that is interlocked to shut down gas flow
Cylinder regulator gauge blows ?	High pressure gas release and possible exposure	Low Probability	Serious	Same as above

Barrier Analysis

- BARRIER: an obstruction or hindrance that may prevent or lessen the impact of an unwanted consequence. This may include stopping, slowing down, restricting, limiting or in some other way weakening an uncontrollable process.
- Accidents occur when one or several barriers have failed.
  - Material barriers, such as shielding
  - Functional barriers – pre-conditions that must be met before the activity can occur, such as locks
  - Knowledge barriers, such as inadequate training
  - Management barriers, including supervision, rule-setting
  - Compliance barriers, such as institutional policies or federal regulations

Barrier Analysis



Checklists

- Develop checklists to step through and document a risk assessment
- Very popular in Great Britain and the European Union
- Example: Field Work

Hazard Identification: Identify all the hazards; evaluate the risks (low / medium / high) and describe all necessary control measures.

Hazard (s)	**Risk** L / M / H	**Control Measures**	**Risk after Control** L / M / H
Physical Hazards (e.g. extreme weather conditions, cliffs, caves, mountains, marshes, quicksand, fresh / seawater, mines, quarries, tides)			

Deliverables

- Living documents on web
- Main report expected early 2013
- Tools will be posted as they are complete
  - Some will be posted with the main report

Fall National Symposium

- Joint Division of Chemical Health and Safety, Committee on Chemical Safety and Committee on Chemical Education symposia:
    - Guidance on Chemical Waste Management
    - Creating a Safety Culture
- Presentations are available on the web
    - www.dchas.org
    - From top right navigation bar, choose "Downloads"
- Presentations by faculty, safety managers, national labs, and technical experts

Questions

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