Quantitative and Qualitative Indicators of Safety Culture Evolution in the Joint Safety Team

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JOINT SAFETY TEAM

The Joint Safety Team (JST): A Researcher-Led Organization





= Lasting Changes

Initiation of JST in 2012 Through Industrial Support

Partnership:





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Offered suggestions and demonstrated industrial safety values





Defining Goals Towards Improving Safety Culture



<u>Mission Statement</u>: **increase safety awareness** and **improve the safety culture** in the Departments of Chemistry (CHEM) and Chemical Engineering & Materials Sciences (CEMS) at the University of Minnesota

Design committees to organize and achieve our goals

	Compliance	Define and enforce standard roles and expectations through biannual lab audits
	Awareness	Enhance safety through signage, safety moments, posters, and email communication
	Resources	Provide easy access to information and establish a system for maintaining records
	Education	Provide frequent and relevant training
V	Spread	Connect work to local chemical industry, PUIs, and high schools.

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JST Organization



Analysis & Compliance

• Lab walkthroughs & surveys

Public Relations

Social media, stall walls, safety moments, & safety posters

Education & Resources

Bi-monthly educational meetings & safety resources (templates, guidebook)

Community Connections

• Educational events with industry, high school teachers, and PUIs

Compiled of Lab Safety Officers (LSOs) (~ 90 people) as well as volunteer undergraduates, graduates, and postdocs.



Analysis & Compliance: Safety Surveys

- Semesterly surveys gauge the:
 - Graduate student and postdoc views on safety in their labs and department
 - Evolving safety concerns
 - JST efficacy
- Results are used to:
 - Investigate safety culture and sentiments evolution
 - Develop new or adjust JST initiatives

Safety Culture in Lab	
These questions address how your research group approaches and discusses lab safety.	
If you see a labmate participating in unsafe lab practices, which of the following reasons would prevent you from discussing better lab practices with that labmate? Check all that apply	*
 seniority 	
personality differences	
on't want to disrupt labmate	
lab practice isn't too dangerous	
It's not my responsibility to regulate others.	
· I've said things in the past, but it hasn't helped.	
· I'll definitely say something.	
Other:	



Survey Evolution Over the Decade

- OS = Original Survey
 - Demographic
 - PPE
 - Unsafe practices
 - JST posters
 - Lab cleanliness & organization
 - Advisor support
- Inclusion of new categories and questions over time
 - Dynamic approach to evaluating safety
 - Not detrimental to participation



Average participation ~ 120 respondents

Interplay Between JST Initiatives & Survey Results (2019-2021)





- Survey results inspire JST initiatives based on researcher needs, resulting in a reduction of reported uneasiness with safety item of interest
 - Issue & strategy: Increase in TA and RA waste concerns led to a E&R waste talk and spill carts in scavenger hunt
 - Resolution: Concern regarding waste (RA & TA), spills (TA), and injury/illness (RA) decrease

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Analysis & Compliance: Lab Safety Walkthroughs



- Groups of 2-4 LSOs walk through and evaluate each other's lab spaces with a rubric
 - Participation from >45 labs
 - Hazard-specific and mixed hazard (generic) walkthroughs and rubrics
 - Fall Hazard-specific, Spring Mixed
 - Hazard classes: Organic, Inorganic, Polymers, Lasers, ChemBio, and Physical Hazards
- Semesterly walkthroughs aims:
 - Engage LSOs with each other and other lab spaces with emphasis on safety
 - Evaluation of lab spaces & feedback for improvement
 - Distinguish common, unaddressed safety items in the departments
 - Provide JST with safety items to focus on for future educational content

General Walkthrough Rubric Categories



- PPE
- Food & Drink
- Eyewash
- Clutter
- Electronics
- Hood Sashes
- Documentation
- Safety Kits

- Secondary Containment
- Segregation by Hazard
- Labelling of Samples
- Secure Placement
- Waste Labelled and Capped
- Waste Lifetime (< 90 days)
- Chemical Transport

Safety Item	Score	Possible Scores	Comments
Proper lab documentation (emergency contacts, PPE requirements, SOPs)		(1,3,5)	
Researchers wearing correct PPE		(1,2,3,4,5)	
No food or drink in lab		(1 or 3)	
Eyewash checked		(1,3,5)	
Aisles and hallways clear of chemicals and clutter		(1,3,5)	
Electronics neatly organized		(1,2,3,4,5)	
Hood functionality is optimized		(1,2,3,4,5)	
Secondary containment of samples and chemicals as needed		(1,2,3,4,5)	
Segregation of samples and chemicals by hazard		(1,2,3,4,5)	
Labeling of samples and chemicals (name, date, hazards)		(1,3,5)	
Secure placement of chemicals and samples		(1,2,3,4,5)	
Waste labeled and capped		(1,2,3,4,5)	
Waste less than 90 days old		(1,2,3,4,5)	
Knowledge of appropriate transportation for chemicals and hazardous materials		(1,3,5)	
Safety Kits		(1,3,5)	



Walkthrough Scoring System

•	Scores	of	1-5	where:
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- 1 = "Needs Attention"
- 2 = "Not Very Acceptable"
- 3 = "Acceptable"
- 4 = "Very Acceptable"
- 5 = "Exemplary"

	(1,2,3,4,5)	1	Lack of secondary containment.	
			Spills might create a serious hazard.	
		2	Some chemicals (especially larger than 0.5 L)	
			are not in secondary containment or secondary	
			containment is inadequate to contain a spill of	
			the sample/chemical being stored.	
		3	Most chemicals stored in correctly sized	
			secondary containment (especially those greater	
			than 0.5 L).	
Secondary containment of			Some smaller sample vials are also stored in	
samples and chemicals, as			secondary containment.	
needed		4	All liquids > 0.5 L and most chemicals are stored	
			in appropriate secondary containment.	
			Most smaller sample vials are in secondary	
			containment as well.	
		5	All chemicals stored in appropriate secondary	
			containment.	
			All smaller samples are also in secondary	
			containment.	
			All glass solid containers are also in secondary	
			containment.	

- For later analyses, 1 & 2 = "Needs Attention" and 3 & 4 = "Acceptable"
- Some safety items only have 1, 3, 5 (e.g. Eyewash) or 1, 3 (e.g. Food and Drink)

Hazard-Specific Walkthrough Rubrics Inclusive of Unique Safety Items



Introduced in Fall 2020

Hazard Class	Hazard-Specific Items
Organic	Glove box
ChemBio	Bio-workspace(s), biohazardous waste
Inorganic	Glove box
Polymers	Schlenk line, liquid nitrogen, glove box
Lasers	Beam control
Physical Hazards	Glove box, furnaces

- Computational hazard class recently included
 - Rubrics are short and need further development.
- For Lasers, a few general safety items regrouped into a broader category.
- Details added to some items to include hazard-specific details
 - Example: high-voltage equipment and circuitry for physical hazards

Normalized Average Walkthrough Scores Over Time

- Normalization accounts for changes to rubric and scoring over time
- COVID-19 pandemic has not significantly affected lab safety
- Fall semesters typically have a lower average
 - Summer off from JST & higher volume of researchers in lab
 - Transition of LSOs



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Summed % of "Needs Attention" Scores Over the Decade



- Decrease in "Needs Attention" scoring since 2012
- Trend of lower number of "Needs Attention" scoring in the spring
- Fall 2020 sees significantly lower "Needs Attention" scoring vs other fall semesters
 - Self-guided
 - LSOs may be more lenient on themselves and/or resolving the issue during the walkthrough



A Closer Look Into the Fall Walkthrough Results Over Time





- Many safety items experience a decrease in "Needs Attention" items during self-guided walkthroughs
 - Increase the following year with grouped walkthroughs

Hazard-Specific Rubrics Effect on Walkthrough Scores



Average Normalized Walkthrough Scores by Hazard Class (Fall 2021)

All Safety Items Common Safety Items Hazard Specific Items 100% 100% 100% 92% Average Normalized Scores 90% 87% 82%_{82%} 81% 78%77% 80% 77%77 75% 73% 72% 72% 70% 71% 70% 70% 60% ChemBio Inorganic Mechanical Organic Polymers Lasers

Hazard Class

- Find overall score to be swayed up to 2% from hazardspecific items
 - Any bias introduced from rubrics is minimal
- Some classes score 100% due to 1 or 3 scoring
 - E.g. glove box functioning properly vs not



Conclusions & Future Work

- The JST utilizes metrics from walkthroughs and surveys to evaluate our success as a safety resource and educator for CEMS and CHEM
- Results indicate improvements in handling of safety items in research labs
 - Effects from COVID-19 are minimal
 - Self-guided walkthroughs may not be as effective
- JST initiatives outside of A&C also improve researcher sentiments on safety in research and teaching labs

• A deeper evaluation of survey results can provide greater insight into JST influence on safety while revealing common, unaddressed, or arising safety items



Acknowledgements

Joint Safety Team Advisory Committee



& all LSOs and JST volunteers!

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Email us at jst@umn.edu

Visit our website jst.umn.edu



Thank you!

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A Closer Look Into the Spring Walkthrough Results Over Time







Participation in Surveys Over Time



- Steady # of respondents over time
- Gift card incentives have had no effect on the # of respondents