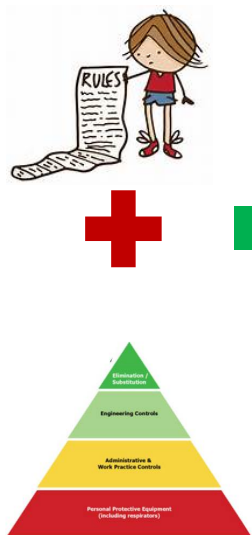


# Supporting development of chemical risk assessment skills

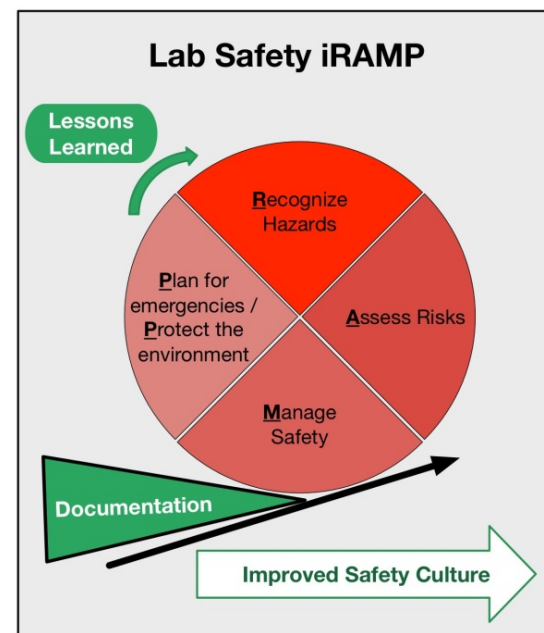
Ralph Stuart, Chemical Hygiene Officer  
Keene State College

# 21<sup>st</sup> Century Lab Safety involves both Technical and Cultural Challenges

20<sup>th</sup> Century:  
Control Based on Rules,  
guided by Chemical Intuition



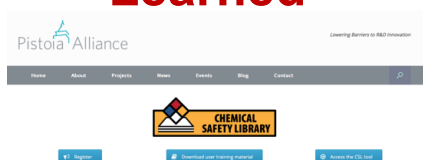
21<sup>st</sup> Century:  
a Safety System based  
on Risk Assessment



*...but there is no bright line between technical learning and cultural learning; that's why educators think in terms of **knowledge, skills and attitude (culture)***

# Modern Lab Safety Tools

## Share JHAs and Lessons Learned



## Plan



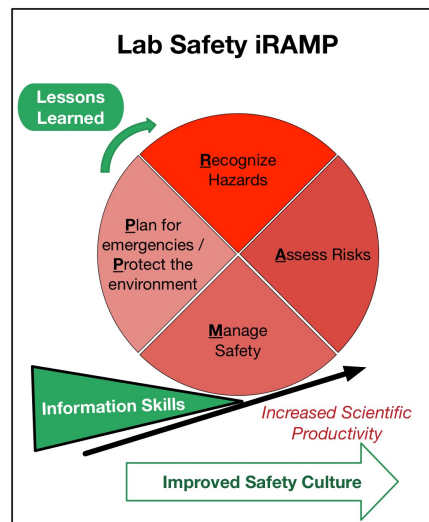
## Protect



## Recognize

Pictogram	GHS class	Signal Words	Pictogram	GHS class	Signal Words
	Explosive	Danger or Warning		Corrosive	Danger only (health)
	Oxidizer	Danger or Warning		Toxic	Danger only
	Flammable	Danger or Warning		Health Hazard	Danger or Warning
	Corrosive	Warning only (physical)		Irritant	Warning only
	Compressed Gas	Warning only		Environmental	Warning only

## Assess



## Manage

### 1 What are the Chemical and Process Hazards?

(health, physical, & environmental)  
(temperature, pressure, incompatibilities, etc.)

The GHS labelling elements (Pictograms, Signal Words and Hazard Statements) are the key to identifying chemical hazards associated with your work.

Look especially for the "DANGER" signal word to identify high hazard chemicals – these are chemicals that require special planning.

### 2 What Ventilation Do I Need?

How much ventilation you need will depend on the fire and toxicity hazards are associated with the demonstration or experiment.

The room ventilation choices are:

1. No Lab Ventilation Required (0-3 air changes/hour)
2. General Lab Ventilation (8 or more air changes/hour)
3. Local Ventilation or Fume Hood (>40 ACH for gases)
4. Outdoor Settings (variable air changes, dependent on wind speed and direction)

• Lab ventilation means that there is no air recirculated

### 3 What PPE Do I Need?

Selecting Personal Protective Equipment (PPE) requires balancing three factors:

1. The hazards of the chemicals being controlled
2. The scenario of concern (the environment)
3. The fit of the PPE on the person using it

According to the NFPA, PPE is not only for the presenter, but for any audience members who are within 10 feet of the demonstration.

### 4 What Emergencies Should I Plan For?

**Planning Tips**

- Fires
- Medical Emergencies
- Hazmat Spills
- Unexpected Crowd Actions

✓ If anyone is in danger, call 911 for assistance

✓ Be sure that the demonstrator appoints a "safety officer" to take control should an unplanned incident occur

✓ If your emergency plan includes a fire extinguisher, be sure to have hands-on training before the event

✓ Ensure the spill kit is stocked with appropriate materials

✓ Make sure exits are accessible

### 5 What Will I Do With Wastes?

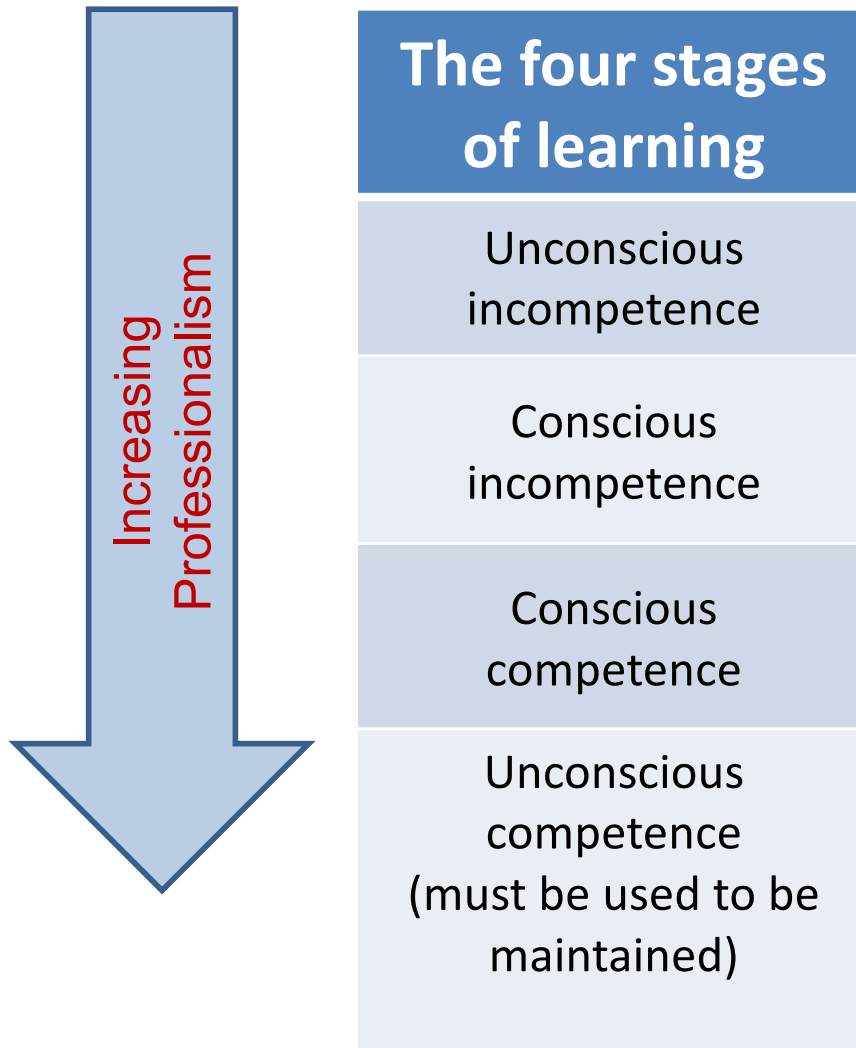
It is important to check with the host of the demonstration before the event to know what waste streams they are prepared to accept.

**Consider These Wastes:**

- Chemicals
- Biological materials
- Contaminated lab materials
- Broken glassware
- General trash & recycling

# Safety Education

---



## The Goal:

Move expectations from the ***bureaucratic approach (i.e. blame and train)*** focused on roles and responsibilities to a ***learning culture*** based on **leadership and empowerment**

This learning culture relies on people being comfortable giving and receiving feedback about where they are in this scale of safety learning.

# The *Assessing* Challenge: Both Knowledge and Judgement are involved



## KNOW THE DIFFERENCE BETWEEN A HAZARD AND A RISK

"Hazard" and "risk" are NOT the same.

### Hazard

- A hazard causes harm.
- A hazard can be eliminated, but not reduced.

### Risk

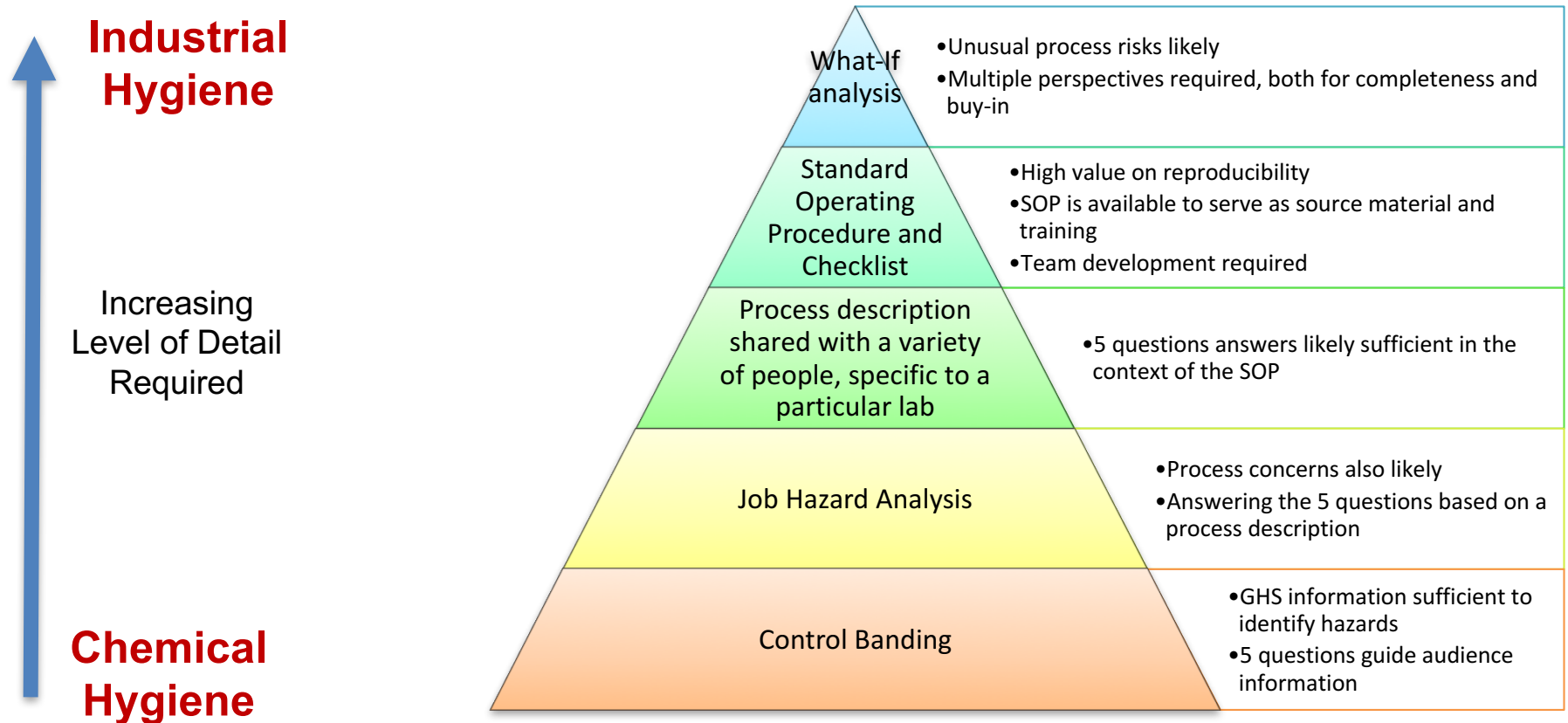
- Risk is the probability that a hazard will cause harm.
- Risk associated with a hazard can be reduced.

**Risk = hazard x exposure**

Knowledge  
(including  
uncertainties)

Estimate based on  
scenarios










# The Technical Assessment Process

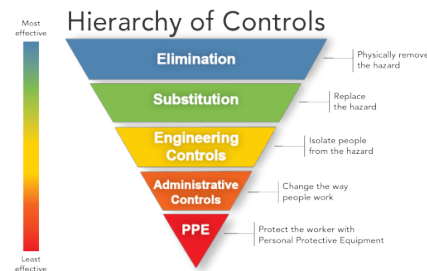


Methods from *Identifying and Evaluating Hazards in Research Laboratories*

# Conducting a Job Hazard Assessment

Identify hazards → Analyze risks → Select controls

Health Hazard 	Flammables 	Oxidizers 
Irritant 	Gasses Under Pressure 	Explosives 
Corrosives 	Environmental Toxicity 	Acute Toxicity 



# Current Academic Lab Risk Assessment Practices

---

- Information Literacy needs to be applied to SDS's and other safety information sources
- Physical hazards are often overlooked because they are so well controlled in teaching labs











# The Managing Safety Step: Control Bands and Job Hazard Analysis

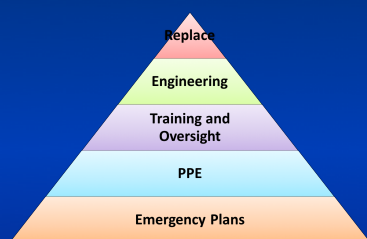
Use of **Chemicals of Special Concern** require process specific **job hazard analysis** to establish appropriate practices

**Chemicals of Special Concern**

## GHS Danger Chemicals

Pictogram	GHS class	Signal Words
	Explosive	Danger or Warning
	Oxidizer	Danger or Warning
	Flammable	Danger or Warning

Pictogram	GHS class	Signal Words
	Corrosive	Danger only (health)
	Toxic	Danger only
	Health Hazard	Danger or Warning





Standard uses of “service” chemicals can rely on

**control bands** to assign:

- Ventilation requirements
- Training and Oversight
- PPE
- Emergency Plans

**Routine “Service” Chemicals**

## GHS Warning Chemicals

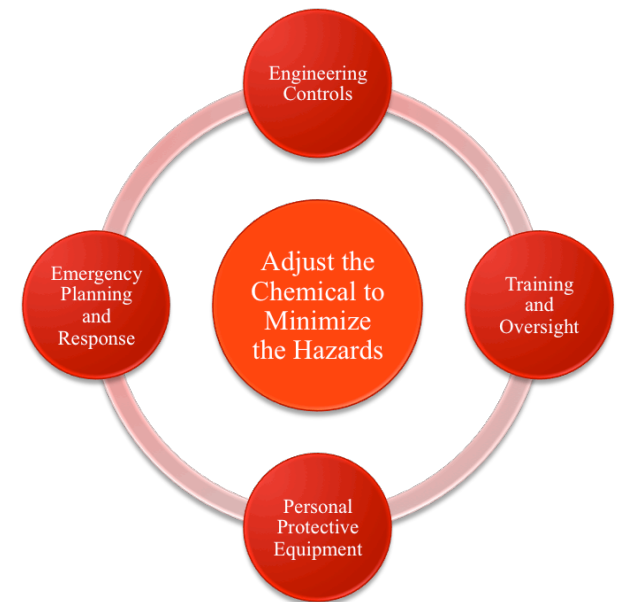
	Corrosive	Warning only (physical)
	Compressed Gas	Warning only

	Irritant	Warning only
	Environmental	Warning only

# Theoretical Considerations in Control Banding

---

1. Control bands operate best within a specific layer of the hierarchy of controls, when based on specific hazards
2. Successful control banding programs are:
  - Scalable
  - Transferable
  - Sustainable
3. It is important to remember control bands throw away some information to support risk management judgements



# Types of Control Bands

Control bands will be different for different hazards, depending on physical aspects of the hazards

Control	Hazard	Properties of Concern
General Laboratory Ventilation	Flammability; odor; inhalation toxicity	Airborne concentration relative to LEL, odor threshold, OEL
Inspection frequency	Unusual hazards	GHS Danger signal word
Training	Standard hazards	GHS classification
Personal protective equipment	Contamination, emergency releases	Concentration of solids or liquids
Waste disposal options	Ignitable, corrosive, reactive	Regulatory status (RCRA is what happens when industrial hygiene is applied to labs)
Emergency Planning	Significant scenarios	Chemical reactivity

# Developing a Control Banding System

Control Banding Programs should be built around ANSI Z.10, specifically defining:

## 1. **Boundaries** of the program

- OSHA lab standard quantities of chemicals
- Rooms with single pass general ventilation
- Chemicals with GHS hazard information available

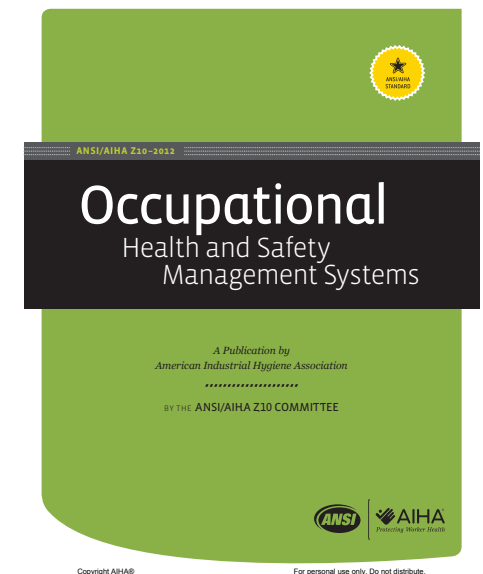
## 2. **Stakeholders**

- Roles (Powers)
- Responsibilities (Leadership)

## 3. **Indicators** and **Goals**

- Availability of chem inventory information (leading)
- Exposure concentrations (lagging)
- Availability of GHS hazard information (leading)
- Frequency and effectiveness of management of change program (lagging)

## 4. **Change Management**



# A Clash of Control Bands

---

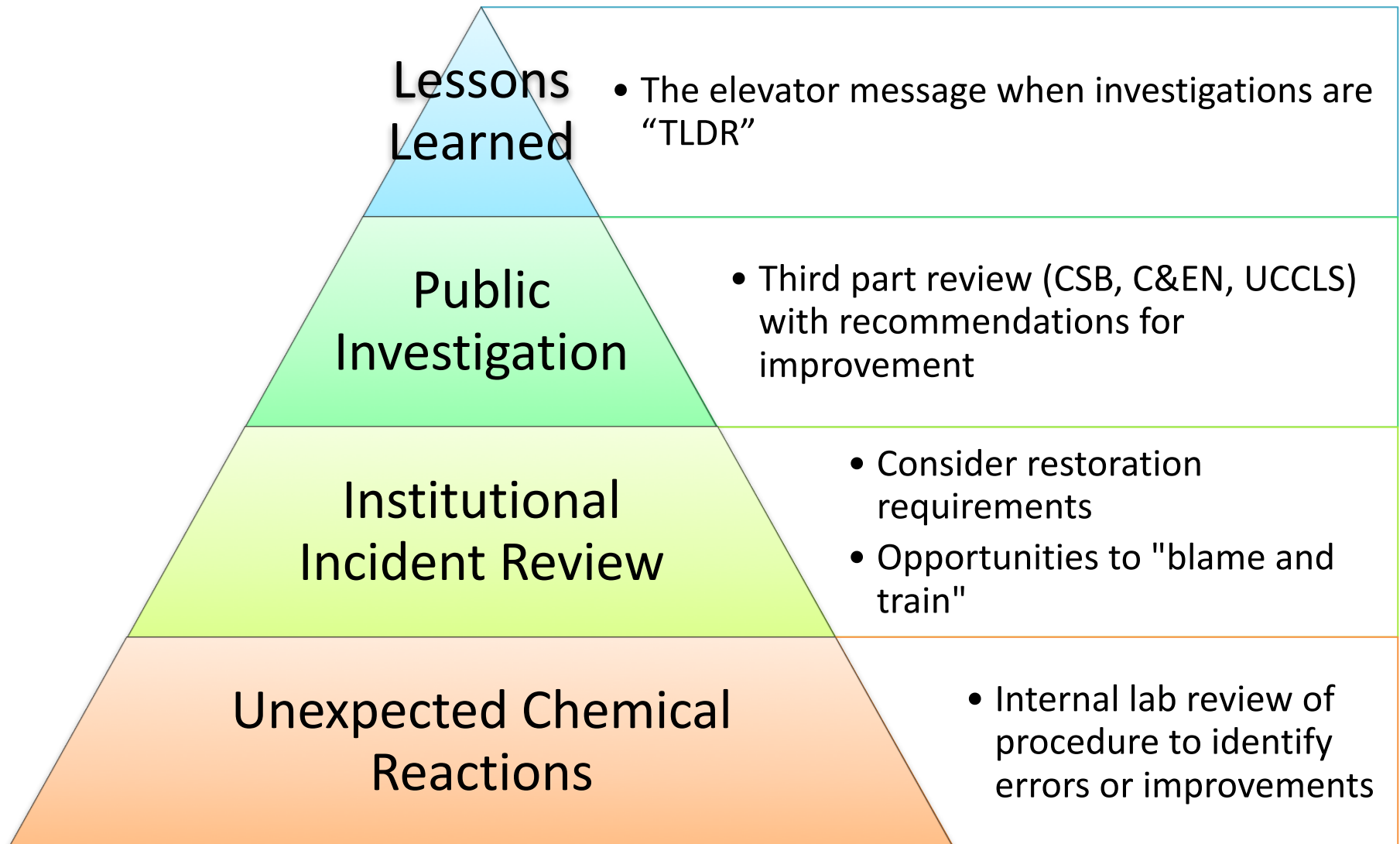
*“My chemical safety folks are upset with the below photo of a researcher in a BSL-2 lab. They say a face shield alone offers insufficient splash protection. They say that a face shield should only be used for splash protection when the user is ALSO using goggles or safety glasses.*

*“But my biosafety folks quote the BMBL for BSL-2, which says, “Eye and face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials when the microorganisms must be handled outside the BSC or containment device.” They claim that the face shield alone is sufficient, appropriate and correct, as is the photo.”*



# Different Types of Accident Follow up

---



# Questions?

---



# Questions?

---

GHS + Assessment -> Lab Management + Institutional Support