

# The “Team Approach” to Addressing Indoor Environmental Quality, Microbial, and Traditional Industrial Hygiene Concerns in the Workplace

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# Course Objectives

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This seminar will provide an overview of the following.....

- Industrial Hygiene and the IH Method for Addressing Potential Workplace Exposures
  - ✓ IEQ
  - ✓ Biological (Microbial)
  - ✓ Traditional (**Chemical**, Physical, etc.)
- Roles and Functions of “Team” Members

# Introduction: What Is Industrial Hygiene (IH)?

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The **science and art** devoted to the ***anticipation, recognition, evaluation, and control*** of those workplace stresses, environmental factors, or other hazards, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the community. (*American Industrial Hygiene Association - [www.aiha.org](http://www.aiha.org)*)

# Introduction: “IH Program Element”

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The IH “element” of an overall workplace OH&S program is designed to assist in preventing or reducing employee exposures to **health hazards**

- ◆ Plant health and safety professionals and other company resources and staff (“the TEAM”) are responsible for addressing IH issues on a day-to-day basis.
- ◆ Airborne contaminants, indoor environmental quality/ microbial contamination, **Hazard Communication** biosafety, hearing conservation, and respiratory protection are some examples of “IH-related” program elements.

# Introduction: The “TEAM”


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Depending on your organization, the “TEAM” can include:

- ◆ Occupational nurses and physicians (in house or outsourced)
- ◆ Safety
- ◆ Security
- ◆ IHs (in house or consultants)
- ◆ Human Resources
- ◆ Safety/Health Committee
- ◆ Legal (in house or outsourced)
- ◆ Facilities and Maintenance
- ◆ Engineering/R&D
- ◆ Production/Manufacturing
- ◆ Purchasing/Finance
- ◆ Landlords/building owners
- ◆ Insurance carrier
- ◆ Contractors/Consultants
- ◆ Employees
- ◆ **MANAGEMENT!**
  - **Top and Line**

# Health Hazards: The Big “4”


**Chemical**




**Physical**

***NOISE!!!!***

**Biological  
(Microbial)**



**Ergonomic**



# Health Hazards: States of Matter

Chemical and biological hazards can present themselves in many different physical forms.

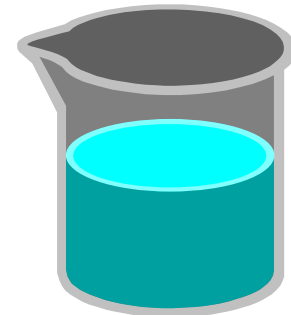
**Gases**



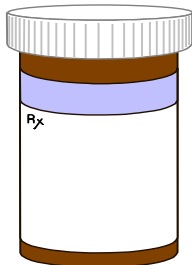
**Vapors**



**Liquids**



**Solids**



**Aerosols**



- Dusts
- Mists
- Fumes
- Smoke
- Fog

# Health Hazards: Workplace Issues

Today we will discuss some of the chemical and “biological” (e.g., mold) health hazards encountered in the following:



# Health Hazards: Hazard and Risk

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## Hazard

The inherent characteristics of a material that may cause an adverse effect. **The hazardous properties of material are always there**

## Risk

The probability of an adverse outcome. **We can manage the risk (e.g., by eliminating, reducing, and minimizing exposure)**

# Health Hazards: Toxicity

It is also important to understand the concepts of toxicity and dose.

**Toxicity**

The ability of a substance to produce an adverse effect in a biologic system(s) upon exposure

The “**dose**” differentiates a poison from a remedy”

Dose = “chemical” + concentration + time

# Health Hazards: Routes of Exposure

When evaluating health hazards, routes of exposure and toxicity are closely related.

**Inhalation**

**Skin  
Absorption**

**Ingestion**

**Injection**



# Health Hazards: Dose Response

What do these chemicals have in common?

Allyl isothiocyanate

Acetaldehyde

**Aflatoxin**

**Aniline**

**Benzene**

**Benzo(a)pyrene**

Caffeic acid

**Ethyl alcohol**

Furan

Furfural

Heterocyclic amines

**Hydrazines**

Methyl eugenol

Psoralens

Quercetin glycosides

Safrole

*Answer: They are all animal or human carcinogens or mutagens and you had them for dinner last week!*

# Health Hazards: Dose Response

Remember that the “*dose makes the poison.*”

## Thanksgiving Menu

### ***Appetizers***

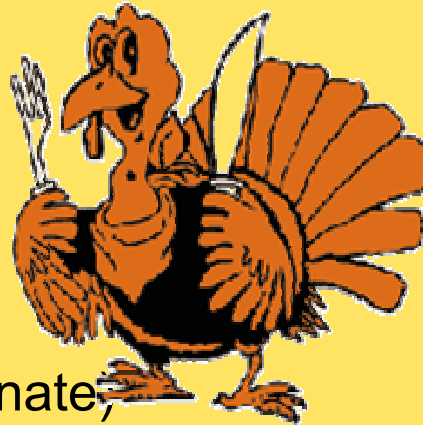
Cream of mushroom soup (hydrazines)

### ***Vegetables***

Baked potato (ethyl alcohol, caffeic acid)  
Broccoli (allyl isothiocyanate,  
Celery (caffeic acid, furan derivatives, psoralens)

### ***Entrees***

Roast Turkey (heterocyclic amines)  
Cranberry sauce (furan derivatives)



### ***Bread***

Rolls with butter (acetaldehyde, benzene, ethyl alcohol, benzo(a)pyrene, furan derivatives, furfural)

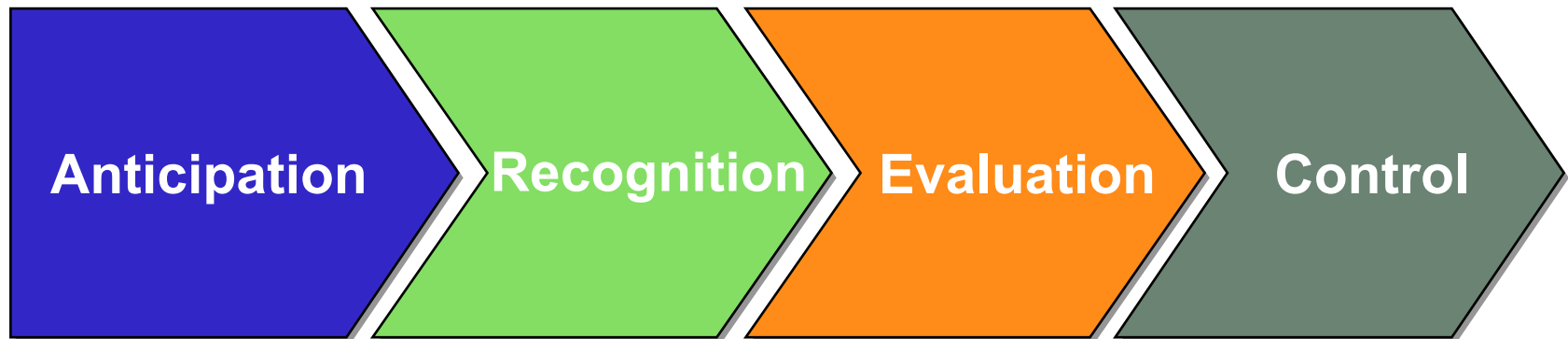
### ***Dessert***

Apple Pie (acetaldehyde, caffeic acid, ethyl alcohol, methyl eugenol, quercetin glycosides, safrole)

# The Industrial Hygiene Method and Workplace Health Hazards

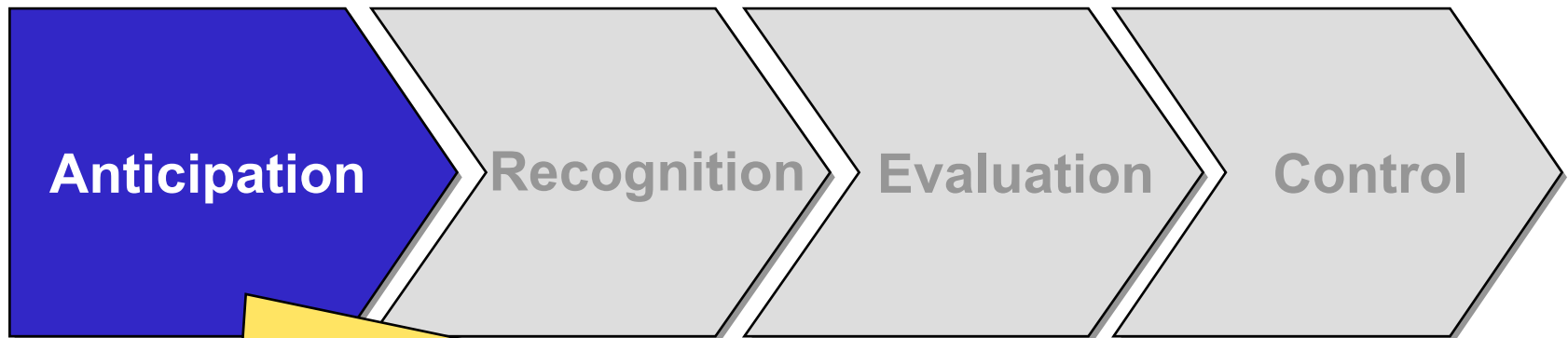
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As mentioned earlier, there are four fundamental elements of the industrial hygiene method.



# Anticipation

Hazard anticipation is one of the proactive components.



- Building facilities, systems, and services (IEQ and Microbial, Traditional)
- Chemical purchases/MSDSs (Traditional-chemical)
- Management of change processes (IEQ, Microbial, and Traditional)

## Anticipation: Building Facilities, Systems, and Services

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A “general” knowledge of the following is essential especially for addressing IEQ and microbial issues:

- ◆ Building age, construction, and maintenance
- ◆ HVAC and air handling systems
- ◆ Utilities
- ◆ Plumbing and drainage
- ◆ Housekeeping services
- ◆ Types of internal and/or contracted maintenance
- ◆ Others?

## Anticipation: Building Facilities, Systems, and Services

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Some of the IEQ and microbial issues that can lead to potential employee health “concerns”

- ◆ include:
  - ◆ Supply of outdoor air to buildings
  - ◆ Design, operation, and maintenance of HVAC, exhaust, and recirculation systems
  - ◆ Environmental parameters such as temperature, humidity, CO, CO<sub>2</sub>, and particulates
  - ◆ Internal processes or activities
  - ◆ For mold, **“it’s all about moisture”** (internal vs. external)

# Anticipation: Building Facilities, Systems, and Services

What might we be concerned with here?

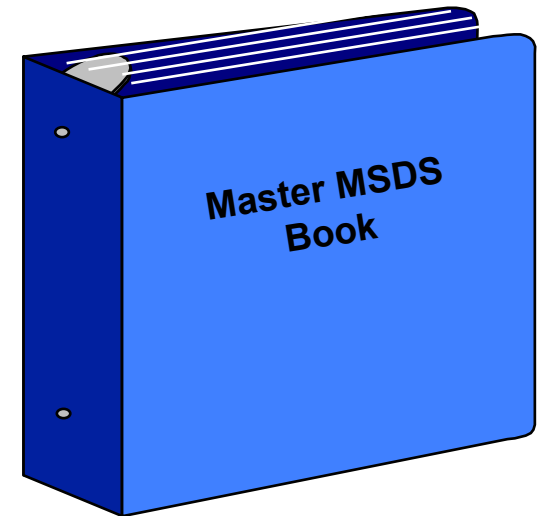


## Anticipation: Chemical Purchases (Materials & MSDS)

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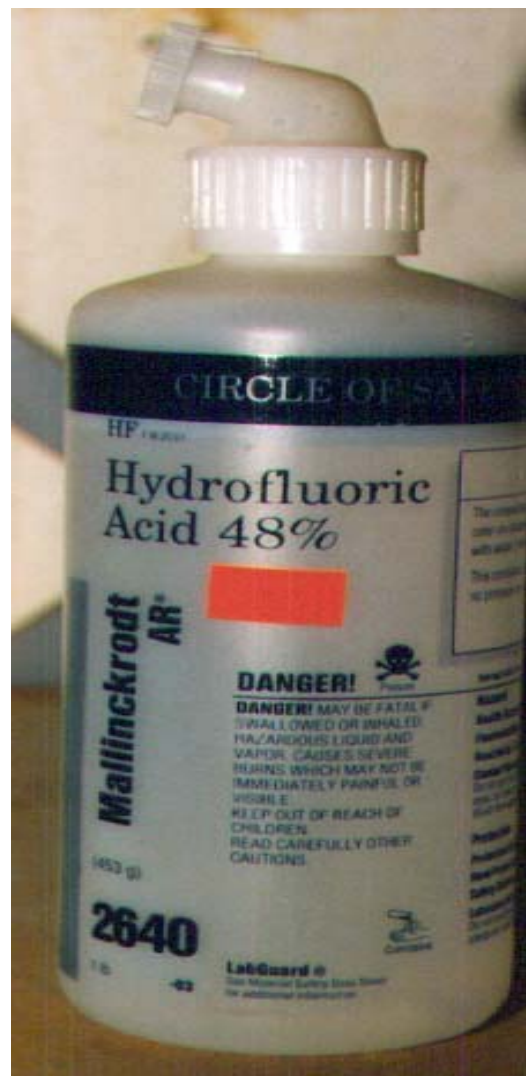
Materials need to be evaluated prior to being introduced into the facility or plant.

- ◆ Does the material contain ingredients known to be hazardous? At what concentrations?
- ◆ Is the substance regulated?
- ◆ Does the material contain any carcinogens?
- ◆ How will the material be used?
- ◆ How often and long will it be used?
- ◆ Will employees be exposed to the material?
- ◆ What types of controls will be needed?



# Anticipation: Chemical Purchases (MSDS)

What might concern us with this material?



# Anticipation: Management of Change

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To identify potential new hazards, changes to plant operations and activities should be reviewed on an ongoing basis including:

- ◆ Installation of new or modification of old equipment
- ◆ Start up of new processes
- ◆ Change of existing processes
- ◆ Implementation of new controls
- ◆ Construction or lease of a new facility

# Anticipation: The “TEAM”

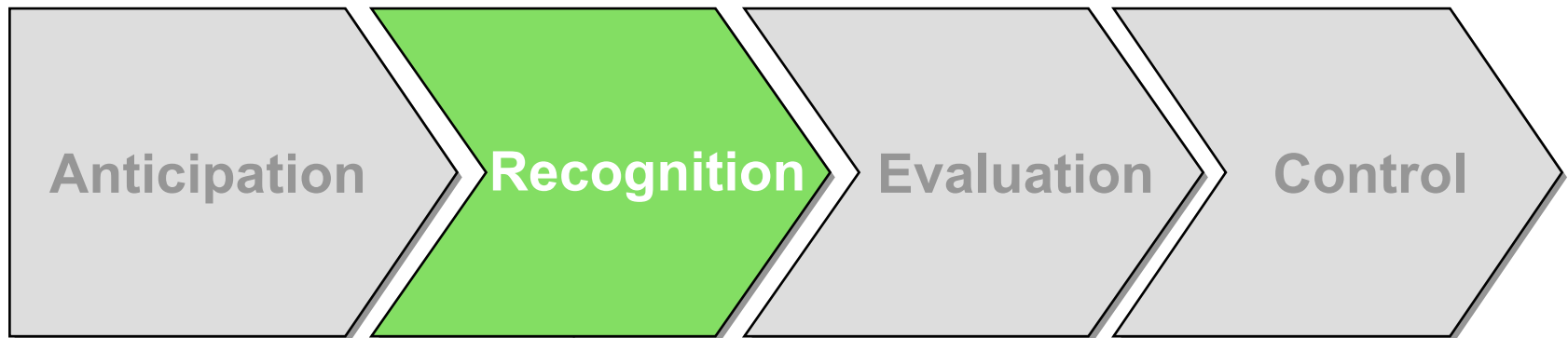
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So who are the TEAM members who need to participate in this process:

- ◆ OHS, Facilities, Maintenance, Production, Engineering and many others.... depending on the situation.
- ◆ Key is to get help from those “in the know”...the OHS personnel cannot be expected to know it all.
- ◆ “Outsiders” will ask a lot of questions because they may not know your facilities, operations, and services. You will need to get the info they need.

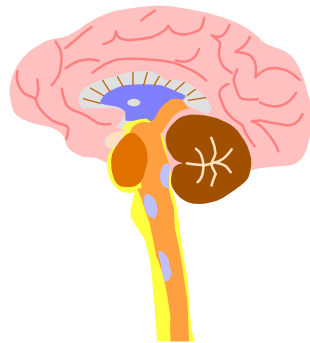
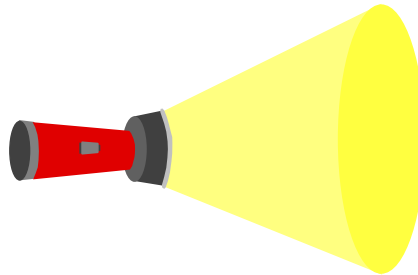
# Recognition

Recognition relates to the identification of hazards and stressors in the workplace.



- Plant/facility walk-throughs, inspections, and surveys
- Reviews of accident reports, audit reports, chemical inventories, review of MSDS etc.
- Employee input

# Recognition: The “Tools of the Trade”



# Recognition: What have we here?

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However,  
some times  
you have to  
look a little  
bit deeper  
to  
recognize a  
problem.



# Recognition: The “TEAM”

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So who are the TEAM members who need to participate in this process :

- ◆ Again, some or all.... depending on the situation.
- ◆ An IH professional or OHS rep with IH training is valuable during this step since they will look at things from a different perspective.
- ◆ “Outsiders” will again ask a lot of questions. The average IH is like a “2 year old”....they ask a lot of questions!!
- ◆ You need to assist them with getting answers.

# Evaluation

Once a hazard has been anticipated and/or recognized, the degree and extent of exposure and risk to employees must be determined.

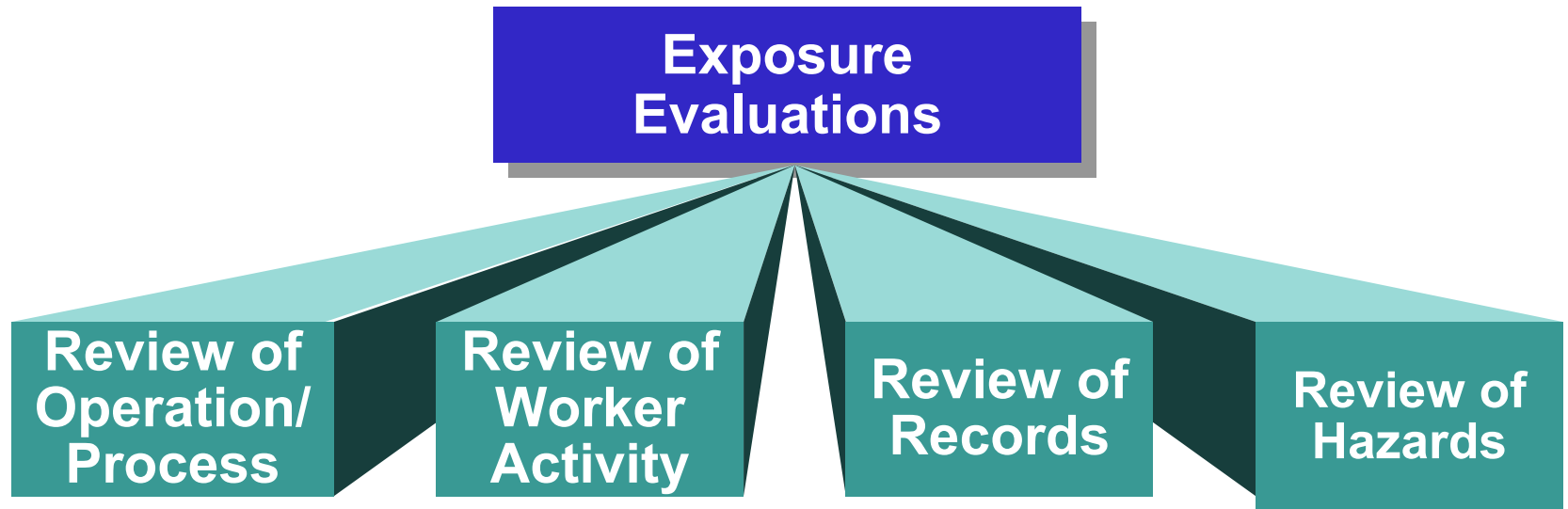


- Qualitative **exposure evaluations**
- Quantitative **exposure monitoring**

# Exposure Evaluations: Typical Elements

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All industrial hygiene exposure evaluations typically consist of at least four steps:



# Evaluation: The “TEAM”

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So who are the TEAM members who need to participate in this process :

- ◆ Depending on the specific situation, non-IHs may be able to conduct basic evaluation with some general instruction (e.g., passive badges, direct-reading instruments). **Interpretation of results can be an issue, though.**
- ◆ **IH professionals are specifically trained to evaluate health** hazards in the workplace; need to match the hazard to the IH though (e.g., not all IHs are skilled in IEQ, microbial, chemicals, and vice versa)
- ◆ You will need to answer as well as ask them a lot of questions.

# Exposure Evaluations: Review of Operation/Process

The site OHS professional should have a general understanding of the operation and the materials used.

- ◆ Understand facility processes and their potentially hazardous by-products (e.g., intermediates, off-gases)
- ◆ Identify the chemicals/raw materials used
- ◆ Obtain background information about the “situation at hand”
- ◆ Consider maintenance activities and other non-routine tasks.
- ◆ Consider potential emergencies



# Exposure Evaluations: Review of Worker Activity

Employee and area activities should be evaluated to determine the potential for exposure.

Evaluate the:

- ◆ Potential for release
- ◆ Potential exposure levels  
(including duration and frequency of exposure)
- ◆ Number of people potentially exposed
- ◆ Current controls in place and their function



# Exposure Evaluations: Review of Records

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If available, it is important to include a review of records and documents in the evaluation.

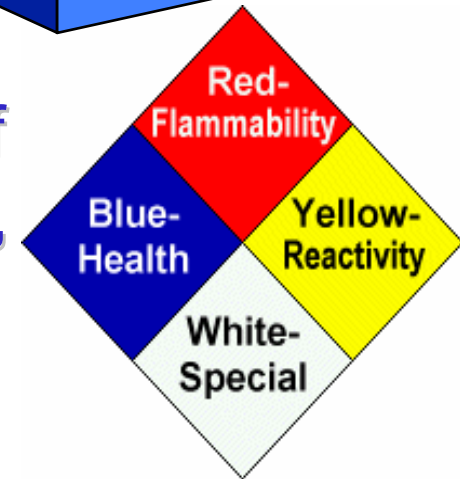
- ◆ Historical monitoring/sampling records
- ◆ Accident/injury records and logs
- ◆ First aid/illness records and logs
- ◆ Employee exposure complaints



# Exposure Evaluations: Review of Hazards

The OHS professional should ensure that potential health hazards are known.

- ◆ Review health effects data:
  - Material Safety Data Sheets
  - Literature sources
  - Suppliers/manufacturers
- ◆ Review and understand limitations of health effects ratings (e.g, the NFPA, HMIS, or other health rating)



# Exposure Monitoring/Assessment

If qualitative evaluations are not sufficient, quantitative exposure monitoring may be necessary.

- **Determine the stressor** that will be measured (e.g., a chemical, noise, biological hazard)
- Obtain the **sampling and analytical method**
- Design the **sampling strategy and plan**
- Conduct the **sampling and monitoring**
- Analyze and interpret the **results**
- Determine recommendations for **corrective actions** based on results
- **Document** the results

## Exposure Assessment: Determine the Stressor

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Since it is not possible to evaluate everything at once, priorities need to be established.

Considerations include:

- ◆ **The level of risk** (e.g., the “worst first”)
- ◆ Regulatory requirements
- ◆ Signs or symptoms of exposure
- ◆ Employee requests for respirators
- ◆ History of high exposures
- ◆ New materials/process

# Exposure Monitoring: Sampling Method

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There are many sources that provide specific sampling, monitoring, and analytical methods for airborne contaminants and environmental parameters

- ◆ NIOSH analytical methods
- ◆ OSHA sampling and analytical methods
- ◆ Commercial laboratories
- ◆ Manufacturer's sampling/monitoring methods
- ◆ For IEQ, direct-reading instruments
- ◆ For mold, if sampling is needed, source; non-viable, and viable

# Exposure Monitoring: Sampling Strategy

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A sampling strategy is the overall plan for conducting the exposure monitoring.

In addition to ***what*** will be sampled, the sampling strategy should outline:

- ◆ ***Who*** will be sampled?
- ◆ ***Where*** will the sampling be conducted? (area or breathing zone)?
- ◆ ***When*** will the sampling be conducted?
- ◆ ***How*** will the sample be collected (including what types of equipment)?

# Exposure Monitoring: Sampling Strategy-Who

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When selecting personnel to sample or monitor for airborne chemical contaminants, you should look at “worst first.”

## Maximum Risk Employee

The individual who is likely to have the highest exposure

# Exposure Monitoring: Sampling Strategy-Where

When monitoring, a primary consideration is whether to collect personal or area samples.

## Personal Sampling

Air sampling of an individual's exposure.

Not typically done for IEQ and mold

## Area Sampling

Air sampling of the **contaminant concentration** in the immediate work environment.

IEQ and mold evaluations may or may not include area air sampling

- Spot checks or long-term
- Unknown visual
- Post remediation

# Exposure Monitoring: Sampling Strategy-When

Sampling can be representative of a very short period of time or of a typical work day.

## Grab Samples

Air sampling representative of a very **short period** of time

“Chemicals”, IEQ, and mold

## Integrated Samples

Air sampling representative of the **typical workday**

“Chemical contaminants, primarily

# Exposure Monitoring: Sampling Strategy-How

## Direct Reading Instruments

Display concentration immediately (chemicals and IEQ)

### Combustible Gas/O<sub>2</sub> Indicators



### Colorimetric Tubes



### IEQ Meters



# Exposure Monitoring: Sampling Strategy-How

## Active Samplers (Chemical)

Require that a sampling “train” be established

### Air Sampling Pump and Tubing



### Collection Media



# Exposure Monitoring: Sampling Strategy-How

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## Active Samplers (Mold)

Also require that a sampling “train” be used

### Non-viable

Some Air Sampling  
Device and Greased  
Slides or Special  
Media

### Viable

Culture Plates of  
various types of  
nutrient agar

# Exposure Monitoring: Sampling Strategy-How

## Passive Samplers (Chemical)

Do not require pump to move contaminant through collection media

### Canisters (Area)



### Badges (Personnel and Area)



# Exposure Monitoring: Other Monitoring Activities

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While sampling, it is important to obtain information that will be important in interpreting results.

- ◆ Description of the process
- ◆ Description of work activities
- ◆ Description of PPE used
- ◆ Description of adjacent operations
- ◆ Environmental conditions
- ◆ Performance of local or other exhaust systems
- ◆ Employee work practices

# Exposure Monitoring: Other Monitoring Activities

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When sampling is completed, there are several activities that still must be done.

- ◆ Retrieval of equipment and of samples
- ◆ Recordkeeping (Chain-of-Custody)
- ◆ Packing of samples and paperwork for shipment
- ◆ Use accredited analytical laboratories

# Exposure Monitoring: Analysis of Results

Sampling and monitoring results can be reported using the following units of concentration:

Contaminant Form	Unit	Examples
<b>Gas/Vapor</b>	ppm	CO, CO <sub>2</sub> , acetone, solvents
<b>Aerosol</b>	mg/m <sup>3</sup>	Lead, cadmium (dust, fume)
<b>Aerosol</b>	mg/m <sup>3</sup>	Nuisance dusts (total/respirable)
<b>Aerosol</b>	ug/m <sup>3</sup>	Nuisance dusts (IEQ)

# Exposure Monitoring: Analysis of Results

Sampling results can be reported using the following units of concentration:

Contaminant Form	Unit	Examples
<b>Gas</b>	% vol	Oxygen
<b>Mold</b>	cfu/m <sup>3</sup>	Viable mold spores in air
<b>Mold</b>	fs/m <sup>3</sup>	Non viable mold spores in air
<b>Fibers</b>	f/cc	Asbestos, fiberglass

# Exposure Monitoring: Analysis of Results

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There are few regulatory and several recommended exposure limits for substances.

- ◆ ACGIH Threshold Limit Values (TLVs) - Annually reviewed
- ◆ OSHA Permissible Exposure Limits (PELs) – 1968
- ◆ NIOSH Recommended Exposure Limits (RELs)
- ◆ Internationally recognized limits (MAKs)
- ◆ Manufacturers established “internal” limits
- ◆ IEQ Parameters – ASHRAE and EPA
- ◆ Mold –**None per se** it is either confirmed or “Inside vs. Outside”

# Exposure Monitoring: Analysis of Results

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Personal monitoring and sampling results for airborne chemical hazards are compared against established exposure limits.

- ◆ Action Level (OSHA-term)
- ◆ Time-Weighted Average (TWA)
- ◆ Short-Term Exposure Limit (STEL)
- ◆ Ceiling (C)
- ◆ Immediately Dangerous to Life and Health (IDLH)  
– NIOSH Term

**Must use caution when addressing/comparing area sampling results!**

# Exposure Monitoring: Corrective Actions

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Sampling results **below** established exposure may require no action.

- ◆ Demonstrate the relative health and safety of the operation
- ◆ Demonstrate the effectiveness of hazard controls
- ◆ Reinforce effectiveness of safe and healthy employee work practices
- ◆ Demonstrate company/regulatory compliance

# Exposure Monitoring: Corrective Actions

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Sampling results **above** established exposure limits may indicate the need for corrective actions.

- ◆ Demonstrate the need for new or more effective engineering, administrative and/or PPE controls
- ◆ Demonstrate the potential health hazards of an operation
- ◆ Reinforce the need for better work practices

# Exposure Monitoring: Documentation

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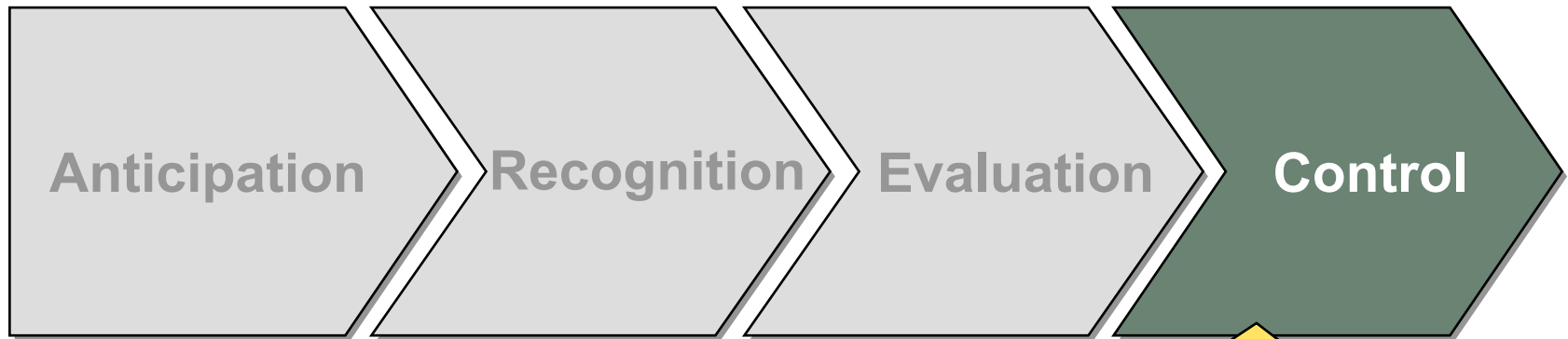
The results of all exposure monitoring or sampling need to be documented and communicated to affected persons.

Documentation should, at a minimum, include:

- ◆ Name of employee monitored
- ◆ Job/task monitored
- ◆ Date monitoring was conducted
- ◆ Material or agent monitored and methods used
- ◆ Results
- ◆ Comparison to standard(s)
- ◆ Conclusions/actions taken

# Control

There are three primary controls that should be considered for eliminating or reducing exposures to health hazards.



- Engineering Controls
- Administrative Controls
- PPE
- Combo

# Control

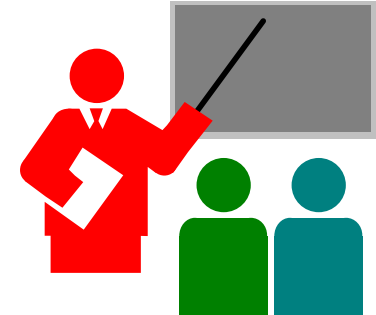
## Engineering Controls

- ◆ Removal/Remediation
- ◆ Substitution
- ◆ Ventilation
- ◆ Isolation/Enclosure



## Administrative Controls

- ◆ Job rotation?
- ◆ Change in work practices
- ◆ SOPs and Training



## Personal Protective Equipment

- ◆ Eye, face, hand, body, head, foot protection
- ◆ Respiratory protection



# Control: The “TEAM”

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So who are the “TEAM” members who can participate in this process :

- ◆ Practically, all members of the “TEAM” could be involved since it will have a bearing on facility and plant operations, production, etc.
- ◆ Control must be carefully addressed....what appears to be cost savings in the short term may become very expensive in long term.

# Conclusion and Summary

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In summary, we have discussed:

- Industrial Hygiene and the IH Method for Addressing Potential Workplace Exposures
  - ✓ IEQ
  - ✓ Microbial
  - ✓ Traditional (e.g., chemical)
- Roles and Functions of Team Members and the need for a Team Effort to Effectively and Efficiently Address Concerns

# Contact Information

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