



# Introduction to Industrial Hygiene for the Safety Professional

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## Welcome

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- Today we will introduce and discuss the elements of effective Industrial Hygiene Monitoring Programs for the Safety Professional
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## Learning Objective #1

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At the conclusion of this presentation, attendees will be able to:

**State** the importance and use of an effective industrial hygiene monitoring program



## Learning Objective #2

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At the conclusion of this presentation, attendees will be able to:

**List** the steps involved in the industrial hygiene monitoring process



## Learning Objective #3

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At the conclusion of this presentation, attendees will be able to:

**List** the different roles of different individuals and organizations involved in the industrial hygiene monitoring process

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## Industrial Hygiene?

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Many people think “Industrial Hygiene” is being sure to brush your teeth prior to coming to work each day...

As important as Personal Hygiene is in the workplace, **Industrial Hygiene is something completely different...**

## Definition - Industrial Hygiene

The American Industrial Hygiene Association (AIHA) defines Industrial Hygiene as:

The **science and art** devoted to the **anticipation, recognition, evaluation, and control** of environmental factors or stresses arising in or from the workplace which may cause sickness, impaired health and well-being, or significant discomfort and inefficiency among workers or among citizens in the community

## Definition - Industrial Hygienist

The AIHA defines an Industrial Hygienist as occupational safety and health professionals concerned with the control of environmental stresses or occupational health hazards that arise as a result of or during the course of work



## Importance of an Effective Industrial Hygiene Monitoring Program

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An Industrial Hygiene Monitoring Program allows safety professionals to scientifically quantify worker exposures at the job site, and then base each hazard control upon this actual exposure data.



## Importance of an Effective Industrial Hygiene Monitoring Program

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Companies involved in construction, general industry, maritime industry, and the service industry all expose employees to hazards.

An effective Industrial Hygiene Monitoring Program will serve to identify, quantify, and prioritize workplace hazards

## Importance of an Effective Industrial Hygiene Monitoring Program

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Industrial Hygiene includes the development of corrective measures to control health hazards by either reducing or eliminating the exposure

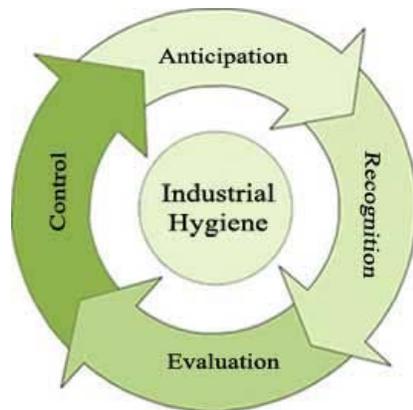


## Importance of an Effective Industrial Hygiene Monitoring Program

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Once we can quantify the exposures, we can base all of our engineering controls, administrative controls, and Personal Protective Equipment (PPE) on the actual exposure levels, in order to control and eliminate the hazards and prevent injuries and illnesses

## Importance of an Effective Industrial Hygiene Monitoring Program



The four (4) elements of Industrial Hygiene are:

1. Anticipating;
2. Recognizing;
3. Evaluating, and;
4. Controlling...

...Occupational Hazards

## Importance of an Effective Industrial Hygiene Monitoring Program

The main goal of an organization's Occupational Safety and Health Program is to prevent occupational injury and illness by:

1. Anticipating;
2. Recognizing;
3. Evaluating, and;
4. Controlling...

...Occupational Hazards.... Look Familiar?

## Anticipating Hazards

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Anticipating health hazards before they occur allows a more efficient use of resources by minimizing costly retrofits and renovations needed to protect the health of workers

## Hazard Recognition and Evaluation

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An unrecognized hazard can not be controlled, evaluated, or eliminated

Upon recognition of a hazard, the Industrial Hygienist identifies a set of measures necessary for proper evaluation of the hazard





## Controlling Hazards

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The Industrial Hygienist, working with other members of the work team, can implement and monitor controls that will reduce exposure to acceptable limits

The Industrial Hygiene Monitoring Program is an integral part of this process



## An Effective Industrial Hygiene Monitoring Program...

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- Will serve to identify, evaluate, and quantify hazard exposures
- Allows the organization to prioritize the workplace hazards in order to assign resources towards the control or elimination of the hazards
- Thus, preventing injuries and illnesses from recurring



## Sources of Hazard Information

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Hazard Information is available in many different forms:

- General Knowledge of Chemicals and Processes
  
- General Knowledge of the Materials Used



## Sources of Hazard Information

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- Observations of Work Practices
  
- Safety Data Sheets (SDS)
  
- Review of Plans for New Facilities and Renovations
  
- Conversations with Workers
  
- Objective Data

## Sources of Hazard Information

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- Types of Processes
- Number of Employees
- Types of Exposures
- Historical Injury/Incident Data



## Sources of Hazard Information

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- Review of Historical Data/Information
  - Test Reports/Chemical Analyses
  - Earlier Monitoring Data
  - Information from Professional Associations, Colleges, Universities, and Government documenting Previous Studies, Results, and Findings
  - Research Data

## Sources of Hazard Information

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- ❑ Discussions with Medical Personnel
- ❑ Production / Process Review
- ❑ Environmental Analysis Data
- ❑ Process Flow Diagrams
- ❑ Job Safety Analyses (JSA)



## Sources of Hazard Information

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- ❑ Review of Literature
- ❑ Inventory of Chemicals
- ❑ Equipment
- ❑ Field Survey



## Preliminary Survey

- We can take all of this preliminary information and create an initial Preliminary Industrial Hygiene Survey Report



## Industrial Hygiene Monitoring Plan

- Using information discovered during the preliminary survey, the Industrial Hygiene Monitoring Plan can be formulated
- The Industrial Hygiene Monitoring is performed to evaluate the degree of employee exposure to hazards in the workplace



## Industrial Hygiene Monitoring Plan

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- Industrial Hygiene Monitoring is a continuous program of observation, measurement, and judgment.
- Industrial Hygiene Monitoring is a combination of observation, interview, and measurement that permits a judgment to be made regarding the potential hazards present in the workplace and the effectiveness of each hazard control



## Industrial Hygiene Monitoring Plan

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- The Industrial Hygiene Monitoring Plan establishes what we will measure, how we will measure it, how we will analyze the data, and how we will report the findings of our analyses
- Our Industrial Hygiene Monitoring Plan is made up of the objectives that will allow us to systematically reach our monitoring goal

## What Should We Measure?

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Common Workplace Hazards include:

- Industrial Noise Exposure
- Exposure to Heat
- Exposures to Cold
- Biological Exposures



## What Should We Measure?

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Common Workplace Hazards include:

- Exposure to Chemicals in the Air that are Inhaled
- Exposure to Chemicals that Contact the Skin
- Exposure to Chemicals that are Ingested
- Potential “Injection” Exposures

## What Should We Measure?

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Common Workplace Hazards include:

- Exposure to Vibration
- Exposure to Low or High Illumination Levels
- Exposure to Radiation (Ionizing and Non-Ionizing)

## Chemical Hazards

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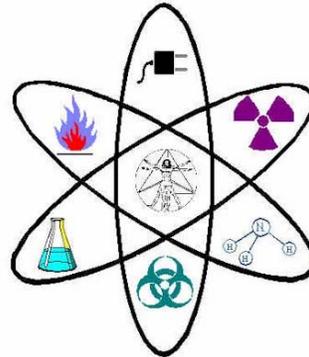
Chemicals pose a wide range of potential health hazards:

- Irritation
- Disease
- Sensitization
- Carcinogenicity

## Chemical Hazards

Chemicals pose a wide variety of Physical Hazards:

- Flammability
- Corrosivity
- Reactivity
- Toxicity



## Chemical Hazards

Chemical Hazards can be found in many forms:

- Dusts
- Liquids
- Fumes
- Mists
- Gases
- Vapors
- Smoke



## Physical Hazards



- Ionizing Radiation
- Non-Ionizing Radiation
- Noise
- Vibration
- Heat
- Cold

## Radiation

Ionizing and Non-Ionizing Radiation should be monitored by an Industrial Hygienist with specialized training, methods, and instrumentation.



# Noise



## Noise Surveys

### Determine:

- Sources of Noise
- Amount of Noise
- Exposure Population
- Duration of Exposure
- Proper PPE
- Attenuation

# Temperature

- Very Hot Temperatures are very dangerous to human beings and are also very common in the workplace
- Very Cold Temperatures are very dangerous to human beings and are also very common in the workplace



# Temperature

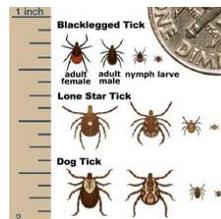
## Guidelines for Evaluation:

- Occupational Exposure Limits are designed to protect industrial workers from temperature-related illnesses
- Thermal Comfort Limits are used to ensure productivity and quality of work

# Biological Hazards

Sources of Biological Hazards (biohazards) include:

- Bacteria
- Viruses
- Insects
- Plants
- Birds
- Animals
- Humans



## Ergonomic Hazards



Ergonomics is the science of fitting the job to the worker. Ergonomic hazards include:

- Repetitive Motion Injuries
- Musculoskeletal Disorders

## Toxicity Versus Hazardous

- Toxicity is the ability of a substance to produce an unwanted effect when that material has reached a sufficient concentration at a certain site in the body.
- A Hazard is the practical likelihood that exposure to the toxic material will cause harm.

## Routes of Entry

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Routes of Entry include:

- Inhalation
- Absorption
- Ingestion
- Injection



## Personnel Monitoring

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- Personnel Monitoring is the measurement of a particular employee's exposure to a workplace hazard, and in theory, reflects actual exposure to the employee
- Personnel Monitoring is usually performed using personnel monitoring devices, portable, and battery powered air sampling pumps, that allow the employee to work as usual

## Area Monitoring

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- Area Monitoring measures the ambient concentration of a hazard or contaminant in a given area during a given period of time
- Area Sampling is often performed utilizing portable sampling devices that may or may not be battery-powered.



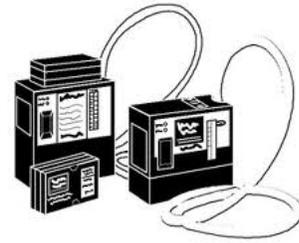
## Personnel and Area Monitoring

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- Personnel and Area Monitoring are often combined to determine employee's Time Weighted Average (TWA) Exposure
- A Time Weighted Average (TWA) is required to determine if the exposure exceeds the Permissible Exposure Limit (PEL)

## Personnel and Area Monitoring

- Many times Personnel and Area Monitoring Samples are collected and then subsequently submitted to a laboratory for analysis
- The laboratory analyses each sample by accepted analytical methods and then reports the results of the analysis



## Direct Reading Instruments

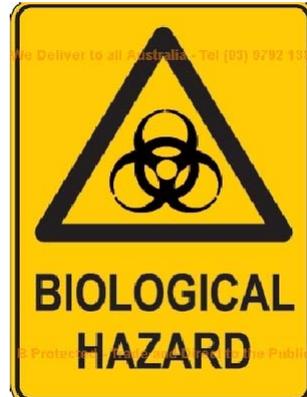
- Certain types of analyses are performed using a Direct Reading Instrument that performs the analysis onsite and provides the data directly
- Examples include Noise Dosimeters, which are capable of performing all analyses onsite and provide results immediately



## Biological Monitoring and Medical Screening

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- Biological Monitoring is a tool that can be used to assess worker's total exposure to chemicals.
  
- Exhaled air, blood, and urine can be analyzed in order to determine the worker's exposure



## Biological Monitoring and Medical Screening

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Three main types of Biological Monitoring include:

- Measurement of the contaminant itself (directly)
  
- Measurement of a metabolite of the chemical
  
- Measurement of enzymes or functions that reflect harm caused by a hazardous exposure

## Medical Surveillance

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- ❑ Medical Surveillance is performed in order to determine employee ' s exposure to chemicals in order to track exposure and to provide for early detection of disease.
- ❑ Over 20 OSHA Standards now have requirements for Medical Surveillance



## Sampling Strategy

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- ❑ The preliminary research and initial field survey help you to identify potential hazards to which workers may be exposed
- ❑ The Industrial Hygiene Sampling Plan devises the strategy that will be utilized in order to determine the intensity of the hazards, the source of the contaminants, and the adequacy of current hazard controls

## How to Sample

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- The Industrial Hygiene Samples should represent each worker's exposure
  
- The National Institute for Occupational Safety and Health (NIOSH) has developed the NIOSH Analytical Methods that will provide you with the correct method to collect and analyze each sample

## Methods of Air Sampling

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- Charcoal Tubes
- Cassettes
- Sorbent Tubes
- Passive Sampling
- Direct Reading Instruments
- Personnel Sampling
- Area Sampling
- Grab Samples
- Time Weighted Average (TWA) Samples



## Where to Sample

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- Personnel Sampling – The collection media is attached to the employee
- Area Sampling – The Work Area is Sampled
- Determine which method of sampling and what sampling technology will work best in each situation

## Whom to Sample

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- Use the results of the preliminary investigation and observations to determine which personnel are the most likely to be exposed to each hazard
- Regulatory issues
- Study processes and air movement patterns
- Study differences in work patterns, habits, tasks

## When to Sample

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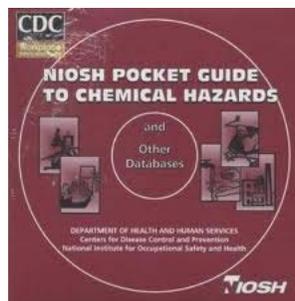
- Sampling can be performed at different times with varying results
  - Study temperature patterns
  - Study ventilation patterns
  - Study Work Flow
  - Study Work Load
- To determine the most opportune times to perform Industrial Hygiene Monitoring

## How Long Do We Sample?

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Each NIOSH Analytical Method prescribes the type of sampling media to utilize and the recommended duration of the sampling event

- Flow Rates
- Sampling Times
- Expected Concentration Ranges
- Duration of the Sampling Event



## Time Weighted Average

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- TWA
- Measuring the exposure over an eight (8) hour period, typically the entire work shift
- The TWA is the average concentration for a conventional 8 Hour 40 Hour a week work week, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.
- TWA data is compared to the Permissible Exposure Limit (PEL)

## Short Term Exposure Limit (STEL)

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STEL is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from:

- Irritation
- Chronic or irreversible tissue damage
- Narcosis of sufficient degree to increase the likelihood of accidental injury or impair self-rescue

## Short Term Exposure Limit (STEL)

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- ❑ An STEL is a 15-Minute TWA exposure that should not be exceeded at any time during the workday
- ❑ Exposures above the TLV-TWA up to the STEL should be no longer than 15 minutes and should not occur more than 4 times per day

## Ceiling (TLV-C)

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- ❑ The Ceiling Concentration is the concentration that should not be exceeded during any part of the working exposure.
- ❑ An airborne concentration of a toxic chemical in the workplace that should never be exceeded



## Documenting Sampling Activities

Accurate Records are a Necessity  
when performing Industrial  
Hygiene Monitoring

- Time Sampled
- Flow Rates
- Sample Locations
- Sample Identifications
- Parameters
- Engineering Controls Present
- Sketches of the Sampling Areas
- Chain of Custody Forms

Chemical being tested	Sample Location	Sampling Time	Concentration (mg)	Concentration (ppm)
Formaldehyde (37% Solution)	Inside hood (inlet of fan)	10 min	0.0069	11
Formaldehyde (37% Solution)	Hood Effluent (outlet of fan)	10 min	0.0002	0.08
Formaldehyde (37% Solution)	Room Air	10 min	0.0002	0.08

Table 1 - Formaldehyde Filter Test

Chemical being tested	Sample Location	Sampling Time	Concentration (mg)	Concentration (ppm)
Formaldehyde (37% Solution)	Inside hood (inlet of fan)	10 min	0.0056	9.1
Formaldehyde (37% Solution)	Hood Effluent (outlet of fan)	10 min	< 0.0002	< 0.09
Formaldehyde (37% Solution)	Room Air	10 min	< 0.0002	< 0.09

Table 2 - Activated Carbon Filter Test

## How Many Samples Should We Collect?



- Each situation will require a different number of samples to be collected
- Base your judgment upon the factors unique to each situation
- Try to represent each Job Description



## How Many Times Should We Sample?

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- OSHA or MSHA Regulated Chemicals will require that monitoring is performed on a routine basis
  
- After all Changes
  
- Monitoring should be repeated if the results, the analyses, or the sampling media are compromised or questionable



## How Many Times Should We Sample?

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- Monitoring should be repeated if previous results indicate that corrective actions are required – to evaluate if the corrective actions were effective
  
- Monitoring should be performed whenever materials, processes, or equipment are changed

## Who Should Sample?

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- An Occupational Health and Safety Team may consist of many members depending upon the organization:
  - Industrial Hygienist
  - Safety Professional
  - Occupational Health Nurse
  - Occupational Physician
  - Employees
  - Managers and Supervisors

## Who Should Sample?

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- In some organizations all of these functions may be performed by the same person!
- Although the concept of performing Industrial Hygiene Sampling may seem very simple, it can be very challenging and technical in reality



## Sampling Considerations

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- ❑ Sampling Equipment
- ❑ Sampling Methods
- ❑ Sampling Plan
- ❑ Sampling Media
- ❑ Chemistry
- ❑ Laboratory
- ❑ Data Analysis
- ❑ Reporting
- ❑ Suggested Corrective Actions



## Industrial Hygienist

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- ❑ Some organizations have a full-time Industrial Hygienist on staff
- ❑ Industrial Hygienist can also be Consultants, working for organizations on a contract basis
- ❑ Certain Industrial Hygiene Laboratories will rent monitoring equipment and also provide consulting services

## Locating Industrial Hygiene Consultants

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- ❑ American Industrial Hygiene Association (AIHA)
- ❑ Certified Industrial Hygienist (CIH) by the American Board of Industrial Hygiene (ABIH)
- ❑ Insurance Company Industrial Hygienists
- ❑ Trade Associations / Professional Organizations

## Working with Industrial Hygienists

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- ❑ Request a Proposal
  - Project Information
  - Scope of Services
  - Agree to Fees/Expenses
  - Agree to Scheduling
  - Check References
- ❑ Written Authorization
  - Manage your Consultants





## Analytical Chemists

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- Industrial Hygiene Analytical Laboratories generally seek accreditation through a third party such as AIHA, ISO, and many other third party registrars
- Analytical Chemists analyze the Industrial Hygiene Samples submitted to the laboratory by the Industrial Hygienist



## Engineers/Scientists

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- Engineering and Science is the basis for all Sampling Media, Sample Collection Equipment, Direct Reading Instruments, etc.
- Many companies design, fabricate, and sell this equipment to Industrial Hygienists, Laboratories, and Organizations



## Review

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Learning Objective #1 – Can We:

**Recognize** the importance and use of an effective industrial hygiene monitoring program?



## Review

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Learning Objective #2 – Can We:

**List** the steps involved in the industrial hygiene monitoring process ?

## Review

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Learning Objective #3 – Can We:

**List** the different roles of different individuals and organizations involved in the industrial hygiene monitoring process?

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## Review

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- Industrial Hygiene Monitoring allows safety professionals to quantitate the level of exposures in the workplace which allows us to base each Engineering Control, Administrative Control, and Personal Protective Equipment (PPE) on the actual hazard exposure



## Review

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- We may then utilize Industrial Hygiene Monitoring to gauge the effectiveness of each hazard control employed in the workplace



## Review

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### Steps Involved in the Industrial Hygiene Process

- Preliminary Investigation
- Initial Survey
- Sampling Plan
- Industrial Hygiene Monitoring
- Data Analysis
- Corrective Action
- Evaluation of Corrective Actions

## Review

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### Different Roles in the Industrial Hygiene Process:

- Safety Professional
- Industrial Hygienist
- Consultant
- Occupational Nurse
- Occupational Physician
- Analytical Laboratory
- Employee
- Management / Supervisor
- Equipment Designers / Manufacturers / Salesmen

## Conclusion

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- Industrial Hygiene Monitoring is a powerful tool that can be used to great effectiveness
- Utilize Industrial Hygiene Monitoring to Anticipate, Recognize, Evaluate, and Control workplace hazards
- Identify, control, and eliminate hazards to prevent injuries and illnesses

## Questions and Discussion

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- Questions?
- Discussion?
- Thank You



## Sources

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### Sources:

- Hagan, et al, National Safety Council, Accident Prevention Manual for Business & Industry – Administration & Programs, 12<sup>th</sup> Edition, 2001
- Plog, et al, National Safety Council, Fundamentals of Industrial Hygiene, 5<sup>th</sup> Edition, 2002