Systems of Safety and Hazard Communication

First Edition

Written and Produced by

The Rutgers Occupational Training and Education Consortium (OTEC)
and New Labor

For the University of Medicine & Dentistry of New Jersey (UMDNJ),
School of Public Health, Office of Public Health Practice

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Courses offered by OPHP lead to nationally recognized certifications in the asbestos, lead, hazardous waste, occupational health, construction, and other industries. OPHP is centrally located in New Jersey for the convenience of New York City and New Jersey based students.

Programs and Services
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OTEC/LOSHI

Occupational Training and Education Consortium (OTEC)
OTEC partners with unions, employers and other organizations to develop innovative training programs that work toward strengthening the existing systems of safety in the workplace. Relying on participatory educational models, OTEC is committed to building a lasting "culture of safety" in workplaces in New Jersey and around the country.

Latino Occupational Safety and Health Initiative (LOSHI)
LOSHI was established by OTEC and New Labor. Through partnerships with employers, staffing firms, unions and community and faith based organizations LOSHI has developed a series of comprehensive site-specific safety and health training programs, trained over 100 worker-trainers and delivered thousands of hours of training to Latino workers throughout New Jersey.

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New Labor

New Labor is an alternative model of worker organization that combines new and existing strategies to improve working conditions and provide a voice for immigrant workers in central New Jersey. Adapting to changes in the economy, New Labor strategically utilizes worker advocacy, customized training, and grassroots enterprises to leverage members' interests at work and in their communities. Since its founding in January of 2000, New Labor has grown to over 1,400 dues paying members and provides important solutions to the challenges faced by low-wage workers in today's economy.

Visit New Labor's website at www.newlabor.net

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The Small Group Activity Method

Basic Structure
The Small Group Activity Method is based on activities. An activity can take from 45 minutes to an hour. Each Activity has a common basic structure:

- **Small Group Tasks**
- **Report-Back**
- **Summary**

1. Small Group Tasks: Activities include tasks (problems), or sets of tasks, for the groups to work on. Each task asks that groups use their experience and the factsheets to solve problems and make judgments on key issues.

2. Report-Back: For each task, groups select scribes that take notes on the small group discussions and report back to the class as a whole. During the report-back the scribe informs the entire class as to how his or her group solved the particular problem. The trainer records each scribes report-back on large pads of paper in front of the class so that everyone can refer to them.

3. Summary: Before the discussion drifts too far, the trainer needs to bring it all together during the summary. Here, the trainer highlights the key points of the Activity and brings up any problems or points that may have been overlooked during the report-back.

Three Basic Learning Exchanges

The Small Group Activity Method is based on the idea that every training is a place where learning is shared. With SGAM, learning is not a one-way street that runs from trainer to worker. Rather SGAM is a structured procedure that allows us to share information. It is based on three learning exchanges:

- **Worker-to-Worker**
- **Worker-to-Trainer**
- **Trainer-to-Worker**

Worker-to-Worker: Most of us learn best from each other. SGAM is structured so that the worker-to-worker exchange is a key element of the training. The worker-to-worker exchange allows participants to learn from each other by solving problems in their small groups.

Worker-to-Trainer: Lecture-style training assumes that the trainer knows all the answers. With SGAM it is understood that the trainers also have a lot to learn and this is the purpose of the worker-to-trainer exchange. It occurs during the report-back and it is designed to give the trainer an opportunity to learn from the participants.

Trainer-to-Worker: This is the trainer's opportunity to clear up confusion and make points they think are key. By waiting until the summary section, trainers know better what people need to know.

Activity 1: Hazard Mapping

Purpose

To begin the process of analyzing areas in our facility where the risks of accidents and injuries are greatest.

This Activity has one task.

Task

In your groups choose a scribe and review the factsheets on pages 4-9. The factsheets will help you learn about hazard mapping and how it can be used to help you identify the areas in your facility where the risks of accidents and injuries are greatest.

Then based on your own experience and the factsheets use the sheet of paper and markers and follow steps 1-5 on the next page to help you create your hazard map. Write large and use the entire sheet of paper for your map. Use the factsheets to help you label and describe the specific hazard areas.

Step 1:
Make a drawing on the sheet of paper that shows the basic layout of your facility. (See Factsheet 6, page 9 for an example of what a hazard map looks like.)

Step 2:
Identify the hazards in each area of the facility using a color-coded circle on the map. (See Factsheets 3-4 on pages 6-7.)

Step 3:
Rate each hazard on a scale of 1 to 4 (See Factsheets 3-4 on pages 6-7)

Step 4:
Label each hazard with a name or brief description. (See Factsheets 5-6, on pages 8-9.)

Step 5:
Based on your map make a list of the hazards that concern you the most and be ready to tell us why these hazards are a concern for your group.

1. Use Hazard Mapping to Identify Problems

A Hazard Map is a visual representation of the workplace that identifies where there are hazards that could cause injuries. For example, a hazard map might look at the following:

- Physical hazards
- Frequency of exposures
- Levels of exposures
- A specific chemical
- Specific workers or job classifications most likely to be exposed

Hazard Maps and Worker Experiences
Hazard mapping draws on what workers know from on-the-job experience. The hazard mapping approach works best when conducted by a small group of workers from the same department or work area.

2. Why Hazard Map?

Hazard mapping can help you identify occupational safety and health hazards. If your workplace has other ways or approaches for identifying hazards, they can be included in your hazard map.

The point of hazard mapping is to gather the knowledge about hazards from your co-workers so you can work together to eliminate and/or reduce the risks of accidents and injuries.

Hazard mapping respects the vast array of skill, experience and knowledge that workers have about their jobs. Hazard mapping requires working together to identify, prioritize and solve problems.

3. Labeling

Hazard Code Key		
	Blue	**Electrical** Hazards
	Green	**Chemical** Hazards
	Orange	**Physical** Hazards (heat, noise, air quality, slippery floors, poor lighting, poorly designed work stations, etc.)
	Brown	**Flammable/Explosive** Hazards
	Black	Other Hazards (specify)

Level of Hazard	
1	**Low Hazard**
2	**Medium Hazard**
3	**High Hazard**
4	**Very High Hazard**

4. Examples of Hazard Mapping Labels

Hazard Codes and Levels of Hazards		
	Blue	**Electrical**—Medium Hazard
	Green	**Chemical**—High Hazard
	Orange	**Physical**—Medium Hazard
	Brown	**Flammable/Explosive**—Very High Hazard
	Black	Other—Low Hazard

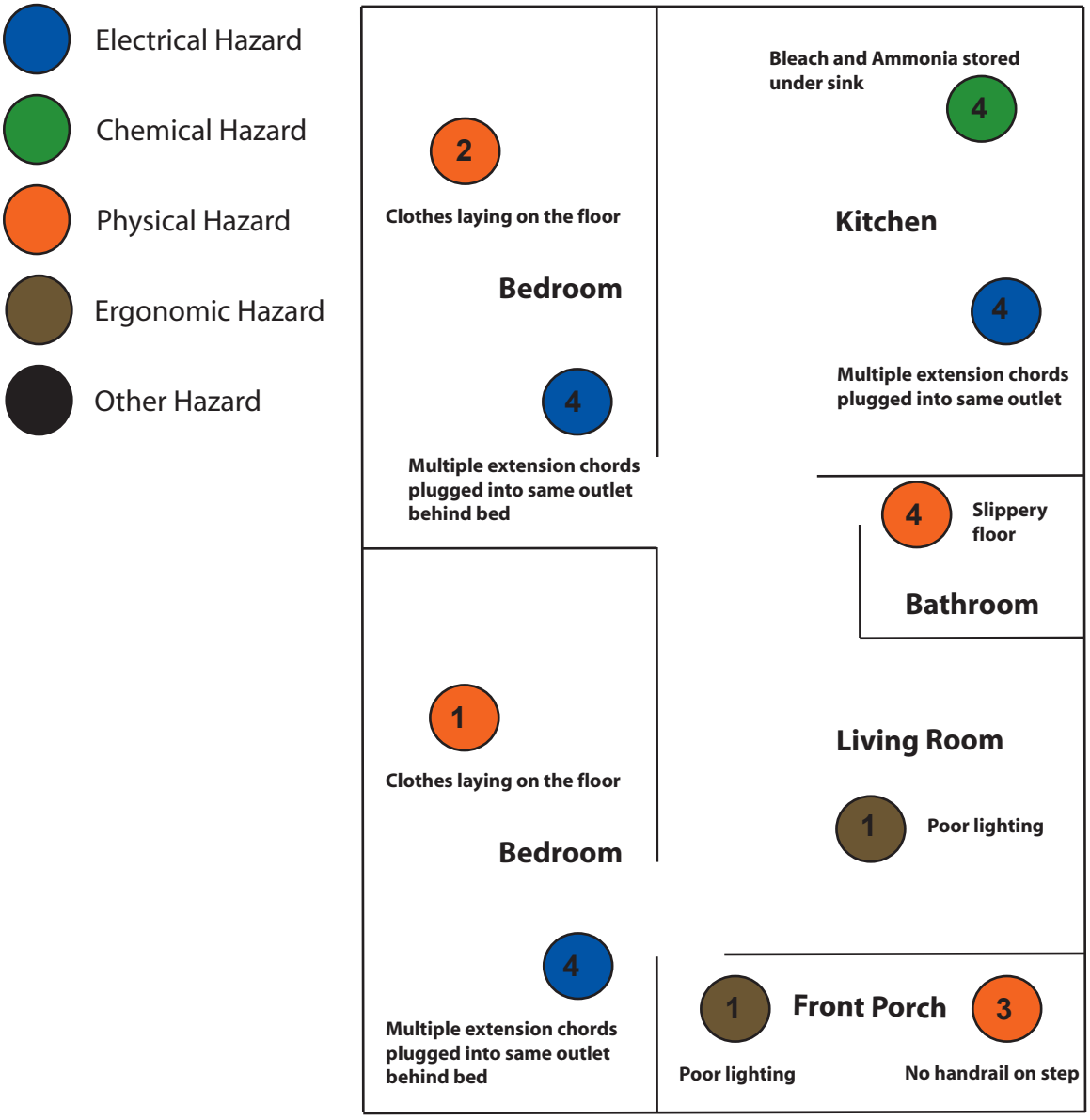
5. Identifying Areas of Concern

Before you begin developing your map, think about where the hazards may exist in your facility.

Potential Facility Hazards	
✓	**Docks:** Injuries happen here when forklifts run off the dock, products fall on employees or equipment strikes a person.
✓	**Forklifts:** About 100 employees are killed and 95,000 injured every year while operating forklifts in all industries. Forklift turnovers account for a significant percentage of these fatalities.
✓	**Conveyors:** Workers can be injured when they are caught in pinch points or in the in-going nip points, are hit by falling products or develop musculoskeletal disorders associated with awkward postures or repetitive motions.
✓	**Materials Storage:** Improperly stored materials may fall and injure workers
✓	**Chemicals:** Chemical burns and/or exposures are possible if spills of hazardous materials occur.
✓	**Forklift Charging Stations:** Fires and explosion risks are possible unless proper guidelines are followed.
✓	**Poor Ergonomics:** improper lifting, repetitive motion or poor design of operations can lead to musculoskeletal disorders in workers.
✓	**Other Hazards:** Inadequate fire safety provisions, improper use of lockout procedures and failure to wear personal protective equipment also create hazards in the workplace.

Source: Occupational Safety and Health Administration (OSHA), *Worker Safety Series, Warehousing*, http://www.osha.gov/Publications/warehousing.html

6. Example of a Home Hazard Map



Summary:

1. A Hazard Map is a visual representation of the workplace where there are hazards that could cause injuries.

2. Hazard mapping can help you identify occupational safety and health hazards.

3. The point of hazard mapping is to gather the knowledge about hazards from your co-workers so you can work together to eliminate and/or reduce the risks of accidents and injuries.

Evaluation

Activity 1: Hazard Mapping

1. How important is this activity for employees at your facility?
Please circle one number.

Activity Is Not Important				Activity Is Very Important
1	**2**	**3**	**4**	**5**

2. Please **put an "X" by the one factsheet** you feel is the most important.

	1. Using Hazard Mapping to Identify Problems		**4.** Examples of Hazard Mapping Labels
	2. Why Hazard Map?		**5.** Identifying Areas of Concern
	3. Labeling		**6.** Example of a Home Hazard Map

3. Which summary point do you feel is most important?
Please circle one number.

Most Important Summary Point				
1.	2.	3.		

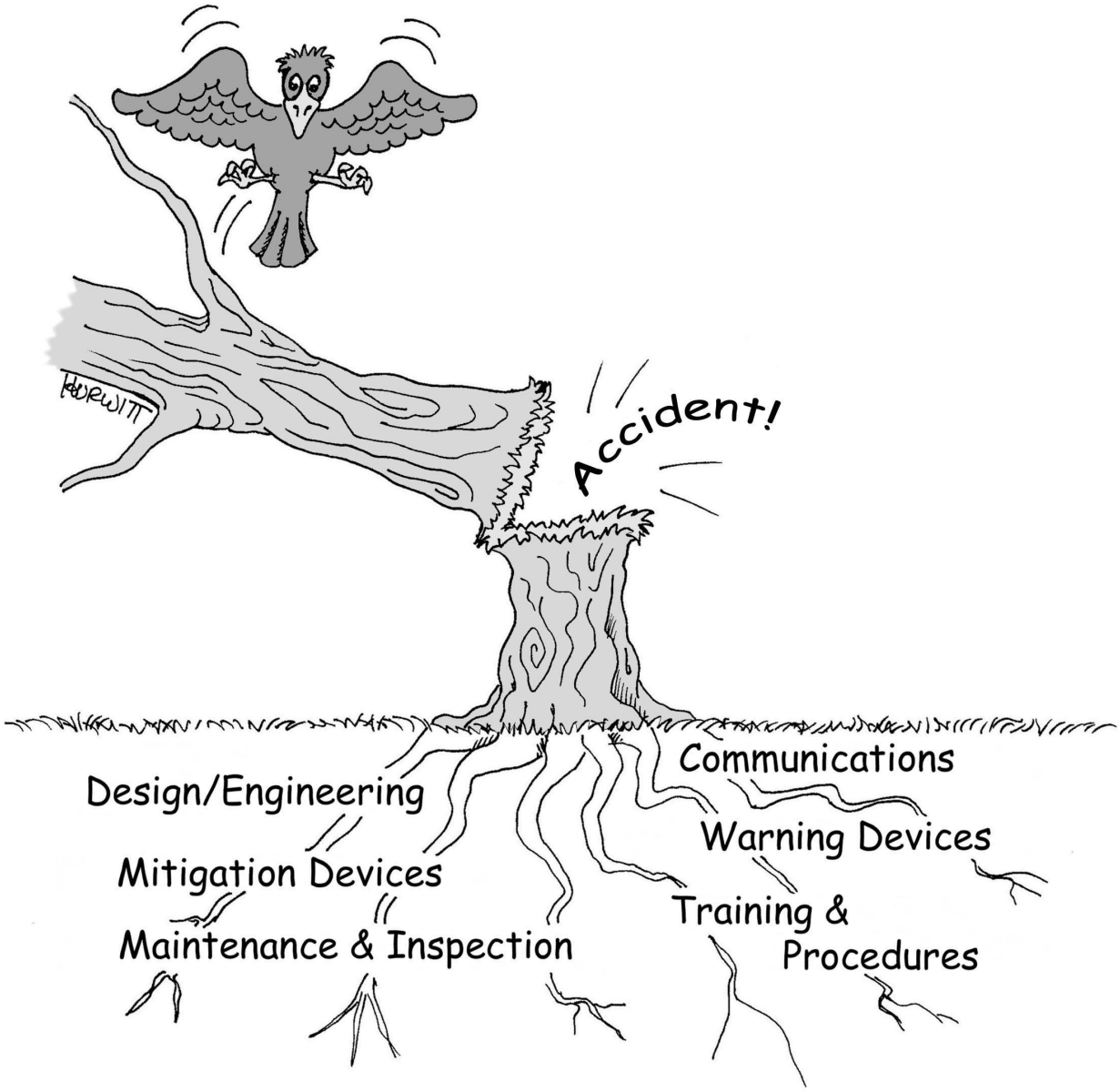
4. What would you suggest be done to improve this Activity?

Activity 2: Systems of Safety

Purpose

To introduce the concept of systems of safety and accident prevention.

This Activity has one task.



Systems of Safety is based on an Activity that was originally written by the Labor Institute (a non-profit organization based in New York City) and worker-trainers from the Oil, Chemical and Atomic Workers Union (OCAW).

Task 1

Shortly after midnight on March 24, 1989, the tanker Exxon Valdez ran aground on Bligh Reef in Alaska, spilling 11 million gallons of crude oil. Over 1,500 miles of shoreline were polluted by the spill. Responsibility for the incident was initially placed on the tanker captain, who had been drinking earlier that evening. Captain Hazelwood was disciplined, sued and fired. Further investigation of the accident revealed the following facts:

a. The radar station in the city of Valdez, which was responsible for monitoring the locations of tanker traffic in the treacherous waters of Prince William Sound, had replaced its radar with much less powerful equipment. The location of tankers could not be monitored in the area of Bligh Reef.

b. Congressional approval of the Alaskan oil pipeline and tanker transport network included an agreement by the oil corporations to build and use double-hulled tankers. This would significantly reduce the amount of oil released in an accident. In order to save money, the oil industry generally abandoned the agreement. The Exxon Valdez did not have a double hull.

c. Crew fatigue was typical on the tankers. In 1977, the average oil tanker operating out of Valdez had a crew of 40 people. By 1989, crew size had been cut in half. Crews routinely worked 12- to 14-hour shifts plus extensive amounts of overtime. The Exxon Valdez had arrived in port at 11 p.m. the night before. The crew was rushing to get loaded for departure the next evening.

d. State-of-the-art equipment for monitoring icebergs in shipping lanes was promised by the oil industry, but it was never installed. The Exxon Valdez was traveling outside the normal sea lane in order to avoid icebergs that were thought to be in the area.

e. Although the Coast Guard at Valdez was assigned to conduct safety inspections of the tankers, it did not perform these inspections. Its staff had been cut by one-third.

f. Tanker crews relied on the Coast Guard to plot their location continually. Although the Coast Guard operating manual required this, the area Coast Guard Commander decided it was no longer needed and discontinued tracking the ships all the way out to Bligh Reef. Tanker crews were never informed of the change.

g. Spill response teams and equipment were not maintained. This seriously impaired attempts to contain and recover the spilled oil.

Sources: Fran Locher Freiman and Neil Schlager, *Failed Technology*, Detroit Gale Research Inc., 1994; Art Davidson, *In the Wake of the Exxon Valdez*, San Francisco: Sierra Club Books, 1990.

Task 1 *(continued)*

Review the factsheets on pages 18-26. Then in your groups list the safety systems and sub systems that are flawed in each paragraph above. (Factsheet 1 defines Systems of Safety. Factsheets 2 thru 7 explain each of the systems. Factsheet 8 includes a chart showing all the systems and examples of sub-systems.) **You can list more than one system or flaw for each paragraph.**

Flawed System(s) and Sub-System(s)
a. System(s): **Subsystem(s):**
b. System(s): **Subsystem(s):**
c. System(s): **Subsystem(s):**
d. System(s): **Subsystem(s):**
e. System(s): **Subsystem(s):**
f. System(s): **Subsystem(s):**
g. System(s): **Subsystem(s):**

1. What Are Systems of Safety?

A efficient systems of safety program outlines in detail how a facility operates safely. It is a proactive program that is designed to prevent injuries from occurring.

Some major systems of safety include :

- Design and Engineering
- Maintenance and Inspection
- Mitigation Devices (i.e., relief valves)
- Warning Devices (i.e., alarms)
- Training and Procedures
- Personal Protective Factors

There are many sub-systems which make up these major systems of safety. For example, refresher training is a sub-system of a facility's training system.

You may have additional systems of safety at your site. They may be organized differently and have different names, but all of our facilities have systems of safety in place.

Source: Adapted in part from Harold Roland and Bian Moriarty, System Safety Engineering and Management, New York: John Wiley and Son, 1983.

2. The Design System

The highest level of hazard prevention is gained by using the Design and Engineering System.

The **organizational side** of Design and Engineering involves how work is organized and the roles people play. It includes:

- Staffing levels
- How resources are used
- How work is assigned and coordinated

The **technical side** of Design and Engineering involves the machinery and processes of work. It includes:

- Process and equipment design and engineering (including redesign)
- Selection of machinery, chemicals and other materials
- Ergonomic design of equipment and control panels
- Reducing the inventory of hazardous materials

Source: Nicholas Ashford, The Encouragement of Technological Change for Preventing Chemical Accidents, Environmental Protection Agency, 1993.

3. The Maintenance and Inspection System

Properly designed equipment can turn into unsafe junk if it isn't appropriately maintained, inspected and repaired. An effective mechanical integrity system should be evaluated by its performance in eliminating the use of breakdown maintenance.

Important elements of the maintenance and inspection system include:

- Keeping spare parts readily available
- Equipment inspections for wear and damage
- Proper training for maintenance employees
- Needed repairs not put off for production requirements
- Use of proper materials, equipment, tools and spare parts including use of a quality control program

4. The Mitigation System

The mitigation system of safety involves the use of equipment that automatically acts to control or reduce the adverse consequences of hazardous incidents. Mitigation devices do not require any action on the part of employees in order for the equipment to function.

The mitigation system provides opportunities for secondary prevention. Mitigation equipment does not eliminate hazards, it only controls the severity of incidents.

Typical examples of mitigation devices include:

- Relief valves
- Automatic shutdown devices
- Mechanical ventilation
- Automatic trip devices
- Machine guards

5. The Warning System

The warning system of safety includes the use of devices that warn employees that a dangerous or potentially dangerous situation is occurring. These warning components require employee intervention to control or mitigate the hazardous situation. Employees must be able to understand the meaning of the warning. They must also be able to respond in a timely manner and understand what actions are necessary.

Examples of warning devices include:

- Fire, spill and evacuation alarms
- Back-up alarms on vehicles

6. The Procedures and Training System

The operation and maintenance of processes that are dangerous require a system of written procedures and training. The greater the hazard of the process, the greater the need for procedures and training.

Parts of an effective procedures and training system include:

- Procedures and training which consistently incorporate the philosophy that safety is more important than production
- Employee involvement in developing and overseeing training and procedures activities
- Methods developed by the technical and manufacturing workforce to certify that training is understood, promotes safety, and is not punitive
- An emergency response plan and training that are in place and are routinely practiced
- Procedures and training which identify all potential hazards, the possible consequences of these hazardous conditions and the actions needed to respond to each hazard or potential hazard

7. Personal Protective Factors

Personal protective factors are the last line of defense among the various systems of safety. They define the traditional roles that employees play in health and safety and generally include obeying the rules (individual behavior) and wearing Personal Protective Equipment (PPE). Unfortunately in far too many situations PPE and behavior are used to compensate for hazards that are built into the work process.

Being Proactive

A better approach is to view the role of employees as proactive and engaged in the process of making the workplace a safe and healthy environment. This perspective requires employees to look critically at the workplace, work together to identify the hazards and then contribute ideas, experience and know-how to correct the system flaws.

Hazards can be eliminated or significantly reduced when employees are actively engaged in the process of identifying systems flaws and correcting them using higher-level solutions such as Design and Engineering.

8. Safety Systems and Sub-Systems

Safety Systems	**Design/ Engineering**	**Maintenance & Inspection**	**Mitigation Devices**	**Warning Devices**	**Training & Procedures**	**Personal Protective Factors**
Type of Prevention	**Primary** *(Goal is to eliminate or prevent hazards)*	**Secondary** *(Enhances prevention and minimizes hazards)*	**Secondary** *(Enhances prevention and minimizes hazards)*	**Secondary** *(Enhances prevention and minimizes hazards)*	**Secondary** *(Enhances prevention and minimizes hazards)*	**Last Line of Defense** *(Protects–to some degree–after other systems fail to control)*
Safety Sub-System	**Technical** Codes Standards Recordkeeping OSHA 300 Log Guidelines that address Design and Engineering Chemical Substitution Design and Engineering of equipment, materials and processes **Organization** Communications Staffing Workload Resource Allocation Shift Schedules	Inspections Preventive Maintenance Parts Quality Control	Shutdown Devices Back-up Generator System and Emergency Outlets Fire Suppression Devices	Monitors Facility Alarms Process Alarms	Operating Manuals Safety Information Emergency Response Refresher Training Communications	Personal Decision Making and Actions Personal Protective Equipment (PPE)

Source: Center for Chemical Process Safety, Guidelines for Technical Management of Chemical Process Safety, New York: American Institute of Chemical Engineers, 1989, pp. 99-103.

9. What Are Root Causes?

The root causes of incidents are the prime factors that underlie the causal factors of an accident. Root causes are sometimes referred to as "basic" causes. There are almost always several root causes involved in an incident, accident or near-miss. For example, the root causes of an electrocution might include improperly designed or maintained equipment, poor lockout procedures or inadequate training. Root causes are always found in safety systems. Effective prevention of similar incidents requires improving the systems.

Examples of Root Causes

- Poor design of process units, machinery and equipment
- Poor layout of work areas
- Difficult access to equipment
- Unsafe sitting and spacing of process units, machinery and equipment
- Lack of preventive maintenance or inspection
- Inadequate procedures or training for both normal and emergency situations
- Excessive overtime
- Inadequate staffing levels

Sources: Mine Safety and Health Administration, Accident Prevent, 1990, pp. 35-38; and Center for Chemical Process Safety, Guidelines for Investigating Chemical Process Incidents, New York: American Institute of Chemical Engineers, 1992, pp. 129-131.

Summary:

1. Creating and maintaining proactive systems of safety are the key to preventing injuries.

2. Major systems of safety include:

    - Design and Engineering
    - Maintenance and Inspection
    - Mitigation Devices (i.e., relief valves)
    - Warning Devices (i.e., alarms)
    - Training and Procedures
    - Personal Protective Factors

3. **The Design and Engineering system can provide primary prevention by eliminating the possibility of a serious accident. The other systems of safety provide secondary prevention by reducing the probability, or severity, of an accident.**

4. Your workplace may have different structures and names for its systems of safety, but all workplaces have systems of safety.

5. **Active management and employee involvement is essential for these systems to be effective.**

6. The root causes of incidents are the prime factors that underlie the causal actors of an accident. Root causes are sometimes referred to as "basic" causes. There are almost always several root causes involved in an incident, accident or near-miss.

Evaluation

Activity 2: Systems of Safety

1. How important is this activity for employees at your facility?
Please circle one number.

Activity Is Not Important				Activity Is Very Important
1	2	3	4	5

2. Please **put an "X" by the one factsheet** you feel is the most important.

	1. Systems of Safety		**6. The Training and Procedures System**
	2. The Design/Engineering System		**7. Personal Protective Factors**
	3. The Maintenance & Inspection System		**8. Systems of Safety and Sub-Systems**
	4. The Mitigation System		**9. What Are Root Causes?**
	5. The Warning System		

3. Which summary point do you feel is most important?
Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.				

4. What would you suggest be done to improve this Activity?

Activity 3: Chemical Hazards and MSDSs

Purpose

To increase our knowledge of the how we may be exposed to hazardous chemicals on the job and what we can do to reduce the risks.

This activity has two tasks.

Task 1

In your groups, read the factsheets on pages 34-41. Then based on the factsheets and your own experience write a response to the statement below. For each paragraph, list the factsheets that helped you write your response.

Statement:

"Working at this facility is nothing like working on a construction site or at a place where they produce lots of toxic chemicals. So I doubt that OSHA would be worried about the chemicals that we work with.

For many years I worked at a place that produced hazardous chemicals and I always knew when we were making the highly toxic stuff because you could smell it.

But even when I worked with highly toxic chemicals I wasn't that concerned. The truth is as long as you don't drink the stuff or pour it directly into your eyes, it can't get into your system.

I should know, I was exposed a few times but nothing ever happened to me. As long as you can avoid getting a heavy dose in your system, small amounts of the stuff won't hurt you.

I think the whole chemical hazards thing is overblown and I'm not going to worry about the cleaning chemicals I use on my job."

How would you respond? (Please make a list.)

1.

2.

3.

4.

5.

1. The Hazard Communication Standard

The Occupational Safety and Health Administration (OSHA) requires all employers to comply with the Hazard Communication Standard (HAZCOM). It requires employers to inform employees about the chemical hazards they are potentially exposed to on the job.

Under HAZCOM employers must develop a hazard communication program that includes training employees on how to safely use the chemicals they work with.

A basic HAZCOM program must include the following:

- A list of the hazardous chemicals used at the workplace
- Chemical labeling procedures
- Material Safety Data Sheets
- Employee training
- A written plan explaining how the employer will comply with the hazard communication standard

What Is OSHA?

The Occupational Safety and Health Administration (OSHA), is an agency of the U.S. Department of Labor. Congress created OSHA under the Occupational Safety and Health Act of 1970. Prior to 1970, no uniform, comprehensive provisions existed to protect workers against unsafe or hazardous work situations.

OSHA's sole responsibility is to develop mandatory job safety and health standards and enforce them through workplace inspections, employer assistance, and by imposing citations and financial penalties.

OSHA covers all private sector employers and employees in manufacturing, construction, long shoring, shipping, agriculture, law, medicine, charity, disaster relief, organized labor, private education, and religious groups who employ workers.

2. Chemical Hazard Awareness

There are four basic ways that chemicals can enter your body:

- **Direct contact**—on the skin or eyes
- **Absorption**—through the skin
- **Accidental Ingestion**—through the mouth
- **Inhalation**—through the lungs

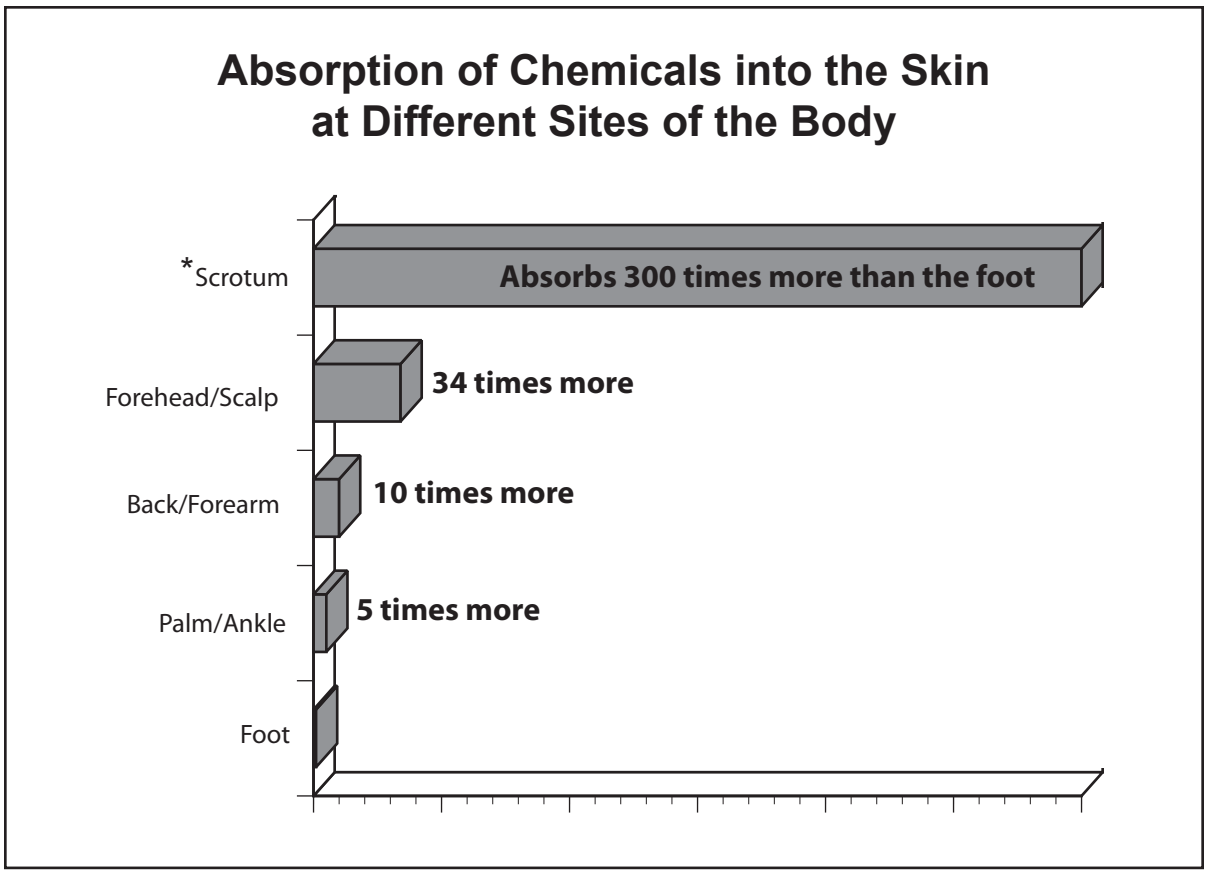
Direct Contact = Surface
The cleaners and disinfectants we work with can burn or irritate the skin and eyes on contact, causing damage on the surface. Dermatitis (inflammation of the skin) and conjunctivitis (inflammation of the eye membrane) are two examples.

Absorption = Penetration
Some chemicals can pass right through the skin undetected and enter the bloodstream. They are carried throughout the body, causing harm. Broken skin or puncture wounds greatly increase the rate at which chemicals are absorbed.

Source: Occupational Safety and Health Administration, *Personal Protective Equipment*, Washington DC, 1998.

Absorption of Chemicals by Your Body

Chemicals can enter your system by being absorbed through the skin. In fact, as the chart below shows, when it comes to absorption through the skin, different parts of your body absorb chemicals at very different rates. (If you are working with chemicals you should wash your hands **BEFORE** and after using the bathroom!)



*For men (studies of female workers yet to be done).
Source: E. Hodgson and P.E. Levi, *A Textbook of Modern Toxicology*, Second Edition. Stamford: Appleton & Lange, 1997, pg. 36-40.

3. Don't Trust Your Nose

You can't rely on your sense of smell to protect you from exposure to toxic chemicals. Let's face it, your nose has some important limitations. Here are the basic ones:

- Some dangerous chemicals, such as carbon monoxide, are odorless. No nose can smell them.

- For some chemicals, you can only detect the smell when the toxin is around you in such large quantities that your health is being harmed by it. For example, by the time you can smell ethylene oxide (used in gas sterilizers), you're already in trouble.

- Our noses can become accustomed to chemicals. That means that after a while we can't smell even very powerful odors. For instance, our noses can learn to turn off strong odors like ammonia and bleach.

4. Dose and the Body's Response

After ingestion, inhalation or skin contact, toxic chemicals as well as their by-products react in the body. For most toxic substances to cause harm there needs to be a sufficient "dose" given.

"Dose" refers to how much a substance reacts with the body. Dose is measured by the concentration of the substance and the time period of the exposure.

The higher the concentration, the larger the dose.

The longer the exposure, the larger the dose.

There are basically two ways the body reacts to a dose of a toxic substance:

- **Linear/Non-Threshold** For any dose, no matter how small, the body may have a reaction. This type of response may be found with cancer-causing chemicals and cancer-causing physical agents, such as radiation. **Any** dose carries a risk.

- **Threshold** There needs to be a certain level of dose before there is a bodily response. This type of response is found with most toxic chemicals (not for cancer-causing agents and chemicals)**.** For example, low-level exposure to acetone (found in nail polish remover) throughout the plant is not very harmful, but at higher concentrations it will cause irritation to the eyes, mucous membranes, and upper respiratory tract. Nausea, dizziness and headaches may result.

Sources: *Centers for Disease Control, 1998.* OSHA, May 1995; *Fit the Glove* by Gerard Arotti. Michael Roder, *A Guide For Evaluating the Performance of Chemical Protective Clothing (CPC)*, US Dept. of Health and Human Services; June 1990.

5. The Long and Short of It

There are two different types of effects that result from toxic exposure. They are acute and chronic.

Acute Effects
"Acute" means that health effects are felt at the time of exposure or shortly after, or result from a short-term, highly concentrated exposure. Examples of acute effects:

- Hydrogen chloride (HCl), when inhaled, causes fluid to collect in the lungs (pulmonary edema) and bleeding in the respiratory tract. When it comes into contact with the skin, it causes severe burns unless promptly washed off.

- Caustic soda, also known as sodium hydroxide (NaOH), corrodes the skin. It burns, and actually dissolves the skin while in contact with it.

- Carbon monoxide (CO) bonds to the protein in blood that is responsible for carrying oxygen to the cells. If enough of the blood bonds with CO instead of oxygen, the cells "starve" and you may die.

Although acute toxicity is often seen within minutes or hours after a sudden, high exposure there are some instances where a one-time high-level exposure causes delayed effects. For example, symptoms of high exposures to certain pesticides may not appear for several days.

Chronic Effects
"Chronic" is a word that means the ill effects will not be seen for some time after exposure. It is associated with low concentration exposures over a longer period of time.

- Cancer is a chronic effect, as is asbestosis.

- Lung diseases, like bronchitis and emphysema, are examples of noncancerous, chronic diseases.

- Solvents can cause chronic damage to the liver, kidneys and brain.

Many chemicals can cause either chronic or acute effects. The difference is in the amount of the dose. High doses generally cause acute effects. Low doses over time cause chronic effects.

- Exposure to PCBs in large doses can cause a skin disease called chloracne.

- Exposure to benzene over a long period of time can cause leukemia, a chronic effect.

- Exposure to arsenic over a long period of time can cause lung cancer, a chronic effect.

Task 2

In your groups review the factsheets (including the MSDS for sodium hypochlorite solution) on pages 44-59. Then based on your own experience and the factsheets answer the questions below.

1. If you worked with sodium hypochlorite solution would you be concerned about a fire or explosion hazard?

   ☐ Yes
   ☐ No

2. What personal protective equipment (PPE) does the MSDS call for in handling sodium hypochlorite solution?

3. What first aid is recommended for sodium hypochlorite solution?

4. What is recommended for the proper storage of sodium hypochlorite solution?

5. Is sodium hypochlorite solution incompatible with other chemicals?

6. What are the health hazards that could result from exposure to sodium hypochlorite solution?

   Acute (Short-Term) Hazards Chronic (Long-Term) Hazards

7. Did you find working with the MSDS difficult or confusing? Why or why not?

8. Are MSDSs a useful health and safety resource tool at work? Why or why not?

6. What's in an MSDS?

Material Safety Data Sheets (MSDSs) give detailed information on chemical and physical dangers, safety procedures and emergency response techniques. Employers are required to have MSDSs for every hazardous chemical in the workplace. The MSDSs must be readily accessible to all employees on every shift and in the employee's work area.

MSDSs include the following information:

1. Product identity
2. Hazardous ingredients
3. Physical and chemical characteristics
4. Fire and Explosion Data
5. Reactivity
6. Health hazards
7. Precautions for safe handling and use
8. Control measures

A description of each section is included below and on the next few pages.

Section I: Product Identity
This information gives you the product's name as it appears on the label and on the company's chemical inventory list. Product identity is usually the chemical's brand name, e.g. "Solvent 460" or "Trichlor." The manufacturer is listed along with a contact person you can call to get more information on the product.

Section II: Hazardous Ingredients
This section is the key part of the MSDS. It gives you the basic ingredients in the product and tells you the legal and recommended limits for workplace exposures. Remember to get the exact spelling of the chemicals because many chemicals have similar names but different health effects.

The following explains some technical language you might find on data sheets related to exposure limits:

PEL (Permissible Exposure Limit): This is the **maximum** exposure established by OSHA. It can be a time-weighted average (TWA) exposure limit, a "ceiling" exposure limit, or a "peak" exposure limit. These are all legal standards.

TLV (Threshold Limit Value): This is a **recommended** average concentration over an 8-hour day. This term is used to express the airborne concentration of a material to which nearly all persons supposedly can be exposed without adverse effects, day after day. TLVs can be expressed in three different ways. (TLVs are suggested, **not legal**, standards established by the American Conference of Governmental Hygienists [ACGH], which is not a government agency.)

- **TLV-TWA (Time-Weighted Average):** This is the concentration for a normal 8-hour workday or 40-hour workweek. If the MSDS only lists TLV, it usually means a time-weighted average.

To Determine Whether a Product Contains a Highly Toxic Chemical

Check the " Hazardous Ingredients" section of the material safety data sheet (MSDS). If an ingredient is identified as a carcinogen, do not use the product. Products without carcinogens are available for all uses.

All MSDSs must list any ingredient subject to the reporting requirements under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), also called the Toxics Release Inventory, or TRI. Screen out products containing these ingredients, which have been identified as chemicals of concern to US EPA.

If you have questions about the health or environmental impacts of specific product ingredients, do a search on the Internet or contact the supplier.

(continued)

6. What's in an MSDS? *(continued)*

- **TLV-STEL (Short-Term Exposure Limit):** This is the maximum concentration for a 15-minute period (maximum of four such periods per day, with at least 60 minutes between exposure periods, provided that the daily TLV-TWA is not exceeded). This is like the OSHA "ceiling" limit.

- **TLV-C (Ceiling Exposure Limit):** This is the concentration that should not be exceeded even for a split second. This is like the OSHA "peak" limit.

Section II: Hazardous Ingredients (continued)
LD50 or LC50 (Lethal Dose and Lethal Concentration): These terms refer to the dose or concentration of a chemical, which, in experiments, kills 50 percent of the test animals.

Skin or "S": This means the substance may be absorbed through the skin by liquid contact or through the mucous membranes and eyes by direct contact or airborne contact.

Below are some explanations for the numbers used in this section. (Note that for most substances, mg/m^3 can be converted into ppm, which means parts per million. It is used for measuring the concentration of a gas or vapor in a million parts of air.)

- mg/m^3: This is milligrams of substance per cubic meter of air. The term is most commonly used for measuring concentrations of dusts, metal fumes, or other particles in the air.

- mg/kg: This is milligrams of substance per kilogram of body weight. It is used generally to measure toxic chemicals given to experimental animals to ingest.

Section III: Physical/Chemical Characteristics
This section provides critical information about the properties of chemicals such as vapor pressure, vapor density, boiling point and evaporation rate. These measurements can help you learn a lot about hazards of a particular chemical.

Chemical Properties	
Boiling Point	The boiling point of a substance is the temperature at which the liquid boils or becomes a gas. The lower the boiling point, the quicker it evaporates and the easier it is to inhale. Chemicals with boiling points below 100^{O}C (or 212^{O}F) require special caution.
Vapor Pressure	A high vapor pressure indicates that a liquid will evaporate easily. Chemicals which evaporate quickly are called volatile. This means that air concentrations can build up quickly, even though the substance is in liquid form. Liquids with high vapor pressures may be especially hazardous if you are working with them in a confined space or an enclosed area.
Vapor Density	If the vapor density is less than one, it will tend to rise in air. If the vapor density is greater than one, it will fall in air and concentrate in the bottom of tanks or confined spaces.
Appearance and Odor	This information may help identify a substance that spills or leaks in your work area. However, many chemicals are hazardous at levels lower than they can be smelled. Also, many chemicals, such as hydrogen sulfide and ammonia, cause “olfactory fatigue”, which means that workers rapidly lose their ability to smell the substance.
Specific Gravity	If the specific gravity is greater than one, the substance will sink in water; if less than one, it will float on top of water.
Evaporation Rate	This is the rate at which a substance evaporates compared to either ether, which evaporates quickly, or butyl acetate, which evaporates slowly. If the substance has an evaporation rate greater than one, it evaporates faster than the comparison substance. For comparison to butyl acetate, fast evaporation is 3.0 and above, slow is 0.8 and below, medium is anything in between.

(continued)

6. What's in an MSDS? (continued)

Section IV: Fire and Explosion Data
This section provides basic information on the fire hazards of a chemical (flashpoint) and the special precautions necessary to extinguish a fire (extinguishing media).

Flash Point	This is the lowest temperature at which a liquid gives off enough vapor to form a mixture with air that can be ignited by a spark. Liquids with flash points below 100^{o}F are considered flammable, and liquids with flash points between 100 and 200^{o}F are considered to be combustible. Flammable and combustible liquids require special handling and storage precautions.
Extinguishing Media	It should specify what kind of fire extinguisher to use. There are four classifications of fires: Class A for paper and wood, Class B for more flammable materials such as liquids or greases, Class C for electrical fires, and Class D for fires involving metals or metal alloys.

Section V: Reactivity Data
This section tells us whether or not the chemical is likely to break down or react with other substances to cause fires, explosions, or the release of different, even more hazardous, substances.

Section VI: Health Hazard Data
This section describes the health effects of the chemical, including signs and symptoms of exposure and medical conditions made worse by exposure. Acute (short-term) and chronic (long-term) effects of exposure must always be included. Routes of entry (inhalation, skin contact, swallowing) and emergency and first aid procedures must also be included. This section must also contain information on target organs (liver, kidneys or central nervous system), signs or symptoms of exposure, medical conditions generally aggravated by exposure, and emergency First Aid procedures.

Unfortunately, a lot of MSDSs in circulation do not contain complete and accurate health hazard information. They often leave out chronic health information, such as whether a chemical causes cancer or birth defects and most have not been studied for these effects. In fact, Environmental Defense Fund research indicates that currently even the most basic toxicity testing results cannot be found in the public record for nearly 75% of the top-volume chemicals in commercial use.

Section VII: Precautions for Safe Handling and Use
This section should give you information to plan for emergencies (e.g., type of emergency respirators to have on hand, exit routes, and ways to deal with small spills). It also provides procedures for proper waste disposal and precautions for storage and handling. This section is often incomplete for emergency planning purposes.

Section VIII: Control Measures
This section provides information on appropriate respirators, protective clothing, ventilation, and safe work practices. The information usually represents the bare minimum in protection and tends to emphasize protective gear and respirators over engineering controls that could eliminate the problem at the source of exposure.

CHECKING THE ACCURACY OF MSDSs

What can be done if you suspect that the MSDS that you received is not accurate or complete?

- Ask your employer: If an MSDS is not accurate, your employer is responsible for obtaining an accurate, complete MSDS. Ask your employer to request a more accurate MSDS from the supplier or manufacturer.
- Contact the manufacturer: You or your union can contact the manufacturer and ask for a more accurate MSDS. Some MSDSs are also available on-line.
- Contact the NJ Dept. of Health: The Right to Know Program can provide Hazardous Substance Fact Sheets that have more complete information on specific ingredients listed on MSDSs. (www.state.nj.us/health/eoh/rtkweb/ or phone: 609-984-2202).

Sources: American Federation of State, County and Municipal Employees (AFSCME), *How to Read a Material Safety Data Sheet*, www.afscme.org/health/faq-msds.htm *Cleaning for Health, Products and Practices for a Safer Environment*, INFORM, August 2002, www.informinc.org/cleanforhealth.php

7. The Problems with MSDSs

MSDSs give guidance on using, storing, and handling substances safely on the job and in emergencies such as fires and spills. But MSDSs have some problems. Here's how Anne Jackson, the corporate safety director for Pepperidge Farm Inc., put it:

> *"The MSDSs I have to work with at Pepperidge Farm usually fall into one of two categories: those written by attorneys for attorneys and those written by chemical engineers for chemical engineers... The origin of the problem is a lack of focus by OSHA and chemical suppliers on the true purpose of the requirement – protecting employees!"*

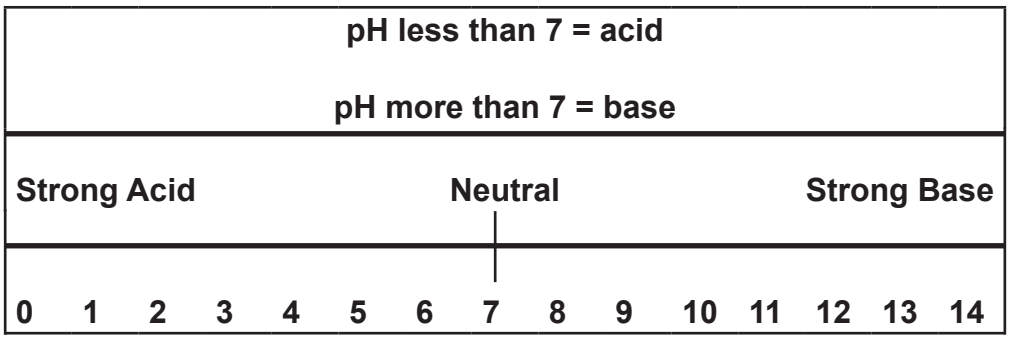
Hospital Study Focuses on MSDS Problems

The Seattle Area Hospital Council conducted a study of 476 MSDSs to see how accurate they were. Here's what they found:

- 53.4% of the MSDSs did not have all the blanks filled in
- 30% were inconsistent (meaning, they included information which contradicted itself)
- 97.1% did not have all of the required elements
- OSHA Permissible Exposure Limits did not appear on 90%
- 89% did not say whether the chemical was a carcinogen

8. pH: A Basic Chemical Term

The pH of a chemical tells you if the chemical is an acid, a base (also called alkali or caustic), or neutral. The pH scale goes from 0 to 14, with 7 being neutral (water is neutral with a pH of 7).



The lower the pH (below 7), the stronger the acid. The higher the pH (above 7), the stronger the base. Many organic hydrocarbons (e.g., gasoline, benzene, kerosene, etc.) have almost neutral pHs (close to 7).

Here are some things to remember about pH:

- Chemicals with a pH much lower or much higher than 7 will cause irritation and burns to the part of the body coming into contact with the material.

- Basic chemicals (those with a pH above 7) are much more dangerous to the eyes than are acids. Acids "sit" on the surface of the eyes, if splashed, and can therefore be washed off (if done quickly), often without resulting in permanent damage.

- Base substances rapidly penetrate the eye tissue, often causing quick and lasting damage.

- Store like with like. Chemicals with lower or higher pH should only be stored with chemicals of like pH and never with their opposite or a neutral chemical.

(continued)

8. pH: A Basic Chemical Term *(continued)*

The Fearsome Incompatibles

Keep these...	away from these...	or you may get these
Acids	Bases	**Heat** **Violent Reaction**
Acids or Bases	Reactive Metals (Aluminum, Beryllium, Calcium, Lithium, Potassium, Magnesium, Sodium, Zinc Powder), Metal Hydrides	**Fire** **Explosion** **Hydrogen Gas**
Water or Alcohols	Concentrated Acids or Bases Calcium, Lithium, Potassium, Metal Hydrides, Other Water Reactive Wastes	**Heat** **Fire** **Explosions** **Flammable and Toxic Gases**
Reactive Organic Compounds or Solvents (Alcohols, Aldehydes, Nitrated Hydrocarbons)	Concentrated Acids or Bases, Reactive Metals and Metal Hydrides	**Fire** **Explosion**
Cyanide or Sulfide Solutions	Acids	**(Toxic) Hydrogen Cyanide Sulfide Gas**
Strong Oxidizers (Chlorates, Chlorine, Chrome Acid, Hypochlorites, Nitrates, Perchlorates, Permanganates, Peroxides)	Organic Acids, Concentrated Mineral Acids, Reactive Metals, Metal Hydrides, Reactive Organic Compounds or Solvents, Flammable or Combustible Waste	**Fire** **Explosion**

9. An Alternative Source of Information

Through New Jersey's Right to Know program you can obtain factsheets (at no charge) for 1,717 commonly used hazardous substances and chemicals (630 are available in Spanish). The factsheets are easier to read than most MSDSs. (www.state.nj.us/health/eoh/rtkweb/).

The phone number for the Right to Know program is 609-984-2202. The e-mail address is rtk@doh.state.nj.us.

10. Your Rights Under the Law

OSHA requires your company to:

- Have an MSDS for every hazardous chemical used in the workplace (including all maintenance and cleaning chemicals)
- Provide you with a copy of the MSDS no later than 15 days after the request, at no charge
- Ensure that MSDSs are readily accessible to all employees during each shift
- Provide training to you and your co-workers prior to handling hazardous chemicals so that you understand the health effects of these chemicals and how to work with them safely

You Can File an OSHA Complaint
If you are concerned about a health and safety problem on your job and your employer refuses to solve the problem you can file an OSHA complaint. If you file an OSHA complaint you will have to complete an OSHA-7 Complaint Form and it must be faxed, mailed or emailed to the local OSHA Regional Office. You can obtain a complaint form by contacting the OSHA area office or going online (www.osha.gov/as/opa/worker/complain.html#happens).

Your complaint may result in an OSHA investigation. If an OSHA investigation doesn't solve the problem you can still request an OSHA on-site inspection. If OSHA decides not to inspect, they must notify you in writing and give reasons. You may question this decision with the OSHA area director and regional administrator.

The OSHA General Duty Clause

Section 5(a)(1) of the Occupational Safety and Health Act requires that an employer:

> *"shall furnish to each of his employees employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."*

This is know as the OSHA "general duty clause."

MSDS Material Safety Data Sheet

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM HYPOCHLORITE SOLUTION

MSDS Number: S4106 --- *Effective Date: 05/05/00*

1. Product Identification

Synonyms: Bleach; hypochlorous acid, sodium salt; soda bleach; sodium oxychloride
CAS No.: 7681-52-9
Molecular Weight: 74.44
Chemical Formula: NaOCl
Product Codes: 9416, P005

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hypochlorite (as NaOCl)	7681-52-9	5%	Yes
Water	7732-18-5	95%	No

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
May cause irritation to the respiratory tract, (nose and throat); symptoms may include coughing and sore throat.
Ingestion:
May cause nausea, vomiting.
Skin Contact:
May irritate skin.
Eye Contact:
Contact may cause severe irritation and damage, especially at higher concentration.
Chronic Exposure:
A constant irritant to the eyes and throat. Low potential for sensitization after exaggerated exposure to damaged skin.
Aggravation of Pre-existing Conditions:
Persons with impaired respiratory function, or heart disorders (or disease) may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Consider oral administration of sodium thiosulfate solutions if sodium hypochlorite is ingested. Do not administer neutralizing substances since the resultant exothermic reaction could further damage tissue. Endotracheal intubation could be needed if glottic edema compromises the airway. For individuals with significant inhalation exposure, monitor arterial blood gases and chest x-ray.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Substance releases oxygen when heated, which may increase the severity of an existing fire. Containers may rupture from pressure build-up.
Explosion:
This solution is not considered to be an explosion hazard. Anhydrous sodium hypochlorite is very explosive.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Use water spray to cool fire-exposed containers, to dilute liquid, and control vapor.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Sodium Hypochlorite:
AIHA (WEEL) - STEL - 2 mg/m3

-OSHA Permissible Exposure Limit (PEL):
0.5 ppm (TWA), 1 ppm (STEL) as Chlorine

-ACGIH Threshold Limit Value (TLV):
1 ppm (TWA), 3 ppm (STEL) as Chlorine
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Colorless to yellowish liquid.
Odor:
Chlorine-like odor.
Solubility:
100% in water.
Density:
1.07 - 1.14
pH:
9 - 10 (neutral solution-no excess sodium hydroxide)
% Volatiles by volume @ 21C (70F):
ca. 95
Boiling Point:
40C (104F) Decomposes slightly
Melting Point:
-6C (21F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
17.5 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Slowly decomposes on contact with air. Rate increases with the concentration and temperature. Exposure to sunlight accelerates decomposition. Sodium hypochlorite becomes less toxic with age.
Hazardous Decomposition Products:
Emits toxic fumes of chlorine when heated to decomposition. Sodium oxide at high temperatures.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Ammonia (chloramine gas may evolve),amines, ammonium salts, aziridine, methanol, phenyl acetonitrile, cellulose, ethyleneimine, oxidizable metals, acids, soaps, and bisulfates.
Conditions to Avoid:
Light, heat, incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a tumorigen and mutagen. Irritation data: eye, rabbit, 10 mg - Moderate

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Hypochlorite (as NaOCl) (7681-52-9)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Dilute with water and flush to sewer if local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Sodium Hypochlorite (as NaOCl) (7681-52-9)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Hypochlorite (as NaOCl) (7681-52-9)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Hypochlorite (as NaOCl) (7681-52-9)	No	No	No	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Hypochlorite (as NaOCl) (7681-52-9)	100	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: No information found.
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **0** Reactivity: **1**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Avoid breathing mist.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2, 3, 8, 11, 14, 15, 16.
Disclaimer:
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Summary

1. The Occupational Safety and Health Administration (OSHA) requires all employers to comply with the Hazard Communication Standard (HAZCOM). It requires employers to inform employees about the chemical hazards they are potentially exposed to on the job

2. There are four basic ways that chemicals can enter your body:

    - Direct contact—on the skin or eyes
    - Absorption—through the skin
    - Ingestion—through the mouth with food
    - Inhalation—through the lungs

3. You can't rely on your sense of smell to protect you from exposure to toxic chemicals.

4. After ingestion, inhalation or skin contact, toxic chemicals as well as their by-products affect the body. For most toxic substances to cause harm there needs to be a sufficient "dose" given. The higher the concentration, the larger the dose. The longer the exposure, the larger the dose.

5. There are two different types of effects that result from toxic exposure. They are acute and chronic. "Acute" means that health effects are felt at the time of exposure or shortly after, or result from a short-term, highly concentrated exposure. "Chronic" is a word that means the ill effects will not be seen for some time after exposure.

6. Material Safety Data Sheets (MSDSs) give detailed information on chemical and physical dangers, safety procedures and emergency response techniques. Employers are required to have MSDSs for every hazardous chemical in the workplace. The MSDSs must be readily accessible to all employees on every shift and in the employee's work area.

7. MSDSs have some problems. They are sometimes hard to read and are not written for their intended purpose—to protect workers.

8. The pH of a chemical tells you if the chemical is an acid, a base (also called alkali or caustic), or neutral. Chemicals with lower or higher pH should only be stored with chemicals of like pH and never with their opposite or a neutral chemical.

9. Through New Jersey's Right to Know program you can obtain factsheets (for no charge) on over 1,700 commonly used hazardous substances and chemicals. The factsheets are easier to read than most MSDSs.

10. OSHA requires employers to provide training to you and your co-workers prior to handling hazardous chemicals. OSHA also requires employers to have MSDSs readily accessible to all employees during each shift. If you are concerned about a health and safety problem on your job and your employer refuses to solve the problem you can file an OSHA complaint.

Evaluation Activity 3: Chemical Hazards and MSDSs

1. How important is this activity for you and your co-workers?
Please circle one number.

Activity Is Not Important				Activity Is Very Important
1	2	3	4	5

2. Please **put an "X" by the one factsheet** you feel is the most important**.**

	1. The Hazard Communication Standard		**6.** What's in an MSDS?
	2. Chemical Hazard Awareness		**7.** The Problems with MSDSs
	3. Don't Trust Your Nose		**8.** pH: A Basic Chemical Term
	4. Dose and the Body's Response		**9.** An Alternative Source of Information
	5. The Long and Short of It		**10.** Your Rights Under the Law

3. Which summary point do you feel is most important?
Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.

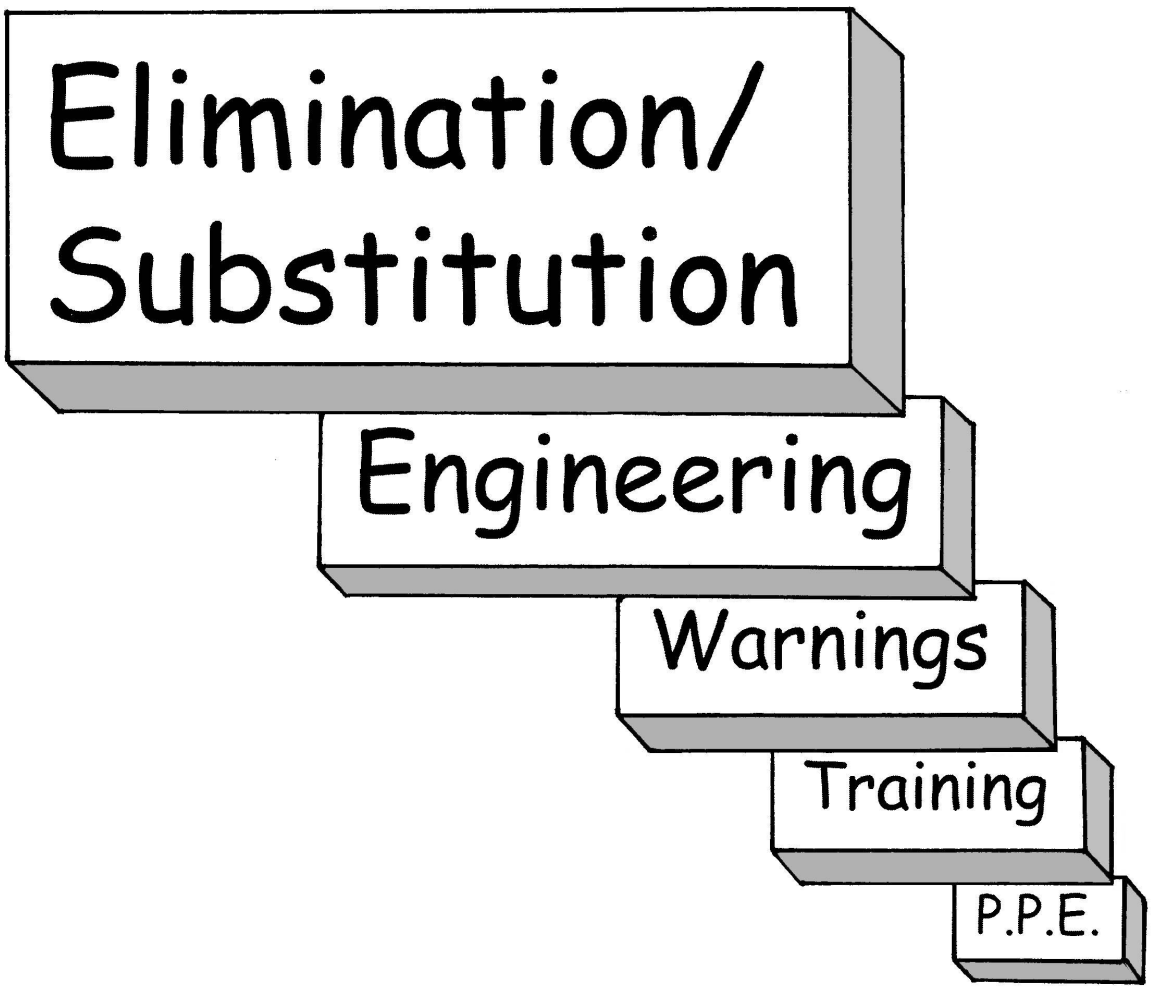
4. What would you suggest be done to improve this Activity?

Activity 4: Personal Protective Equipment and Chemical Protective Clothing

Purpose

To evaluate the importance, use and limits of personal protective equipment (PPE) and chemical protective clothing in preventing injuries and exposures.

This Activity has two tasks.



Task 1

In your groups, review the factsheets on pages 68-85. Then working together based on the factsheets and your own experience complete the PPE Hazard Worksheet below. After you have completed the worksheet answer the questions on the next page.

PPE Hazard Worksheet	**What type(s) of PPE could be used to protect you from these hazards? (You can list more than one)**	**Are these hazards a problem or concern for you on your job?**	
Hazards	**Types of PPE**	**YES**	**NO**
Flying particles such as dusts or powders; Chemical gases or vapors, or a combination of these	Type(s) of PPE: Factsheet(s):		
Molten metal, liquid chemicals, acids or caustic liquids that could splash	Type(s) of PPE: Factsheet(s):		
Falling objects from above; the possibility of accidential head contact with electrical hazards; exposed pipes or beams that you could bump with your head	Type(s) of PPE: Factsheet(s):		
Handling, moving, mixing or applying hazardous chemicals to surfaces and equipment	Type(s) of PPE: Factsheet(s):		
Noise that is so loud that you have difficulty hearing normal speech in the work area and/or you have to shout to make yourself heard more than an arm's length away	Type(s) of PPE: Factsheet(s):		
Heavy equipment; heavy falling or rolling objects; sharp objects such as nails or spikes on walking surfaces, exposure to hot substances, slippery surfaces, corrosive or poisonous materials, or exposure to electrical hazards	Type(s) of PPE: Factsheet(s):		

1. **For each hazard your group checked "YES" on the worksheet, please explain the problem and/or the source of your concern.**

2. **In your opinion could any of the hazards be eliminated through higher level controls such as engineering or chemical substitution (See Factsheet 1 for more information)**

   a. **If so, what could be done to reduce or eliminate the hazard(s).**

3. **Do members of your group wear protective clothing, gloves, and/or glasses?**

   a. **If so, do the gloves, clothing or glasses provide the right amount of protection? (See Factsheets 2 through 6 and the Appendix on pages 70-77)**

   b. **Are you using gloves that are made for the chemicals you work with?**

   c. **Does your eye protection fit properly?**

   d. **Can you see clearly when you are wearing your eye protection?**

4. **How old are the gloves and/or protective clothing that you are using tonight? How will you know when it's time to replace them? (See Factsheet 6 for more information.)**

5. **For what type of hazards would you use a particulate respirator and can you use it for protection against chemical gases or vapors?**

1. PPE and the Hierarchy of Controls

The Occupational Safety and Health Administration (OSHA) requires employers to eliminate, substitute or use engineering controls to reduce hazardous conditions on the job. Employers must apply these *higher level controls* before resorting to the use of *lower level controls* such as warnings, training and procedures and the use of personal protective equipment (PPE). It is important to recognize that **PPE is the least effective way to control a hazard.**

Hierarchy of Controls
1. Elimination/Substitution
2. Engineering
3. Hazard Warnings (administrative and standard operating procedures–SOPs)
4. Training Procedures
5. Personal Protective Equipment

Applying the *Hierarchy of Controls* is the most effective way to deal with workplace hazards. The lower levels of control—warnings, training/procedures, and PPE—are acceptable only when the higher levels of control—elimination, substitution or engineering—are not feasible or do not adequately reduce risk.

Selecting the Right PPE
OSHA strongly recommends that employers conduct a comprehensive *hazard assessment* prior to determining the PPE needed. For each work site, a certificate must be completed that lists the findings of the inspections and the specific protective equipment needed.

In order to select the appropriate PPE employers should:

- Conduct an exposure assessment to determine the type and amount of hazardous exposure
- Take into account the factors affecting PPE selection
- Understand the assigned protection factors
- Know the kinds of PPE and their characteristics

Factors Affecting PPE Selection
1. Physical configuration of the job site *(Will PPE be used in tightly constrained areas with machinery thact could snag hoses?)*
2. Medical condition of the person wearing the PPE
3. Correct fit and comfort of PPE
4. Resistance to physical stress *(Will PPE be used in an area where abrasions, cuts, punctures or tears may occur?)*

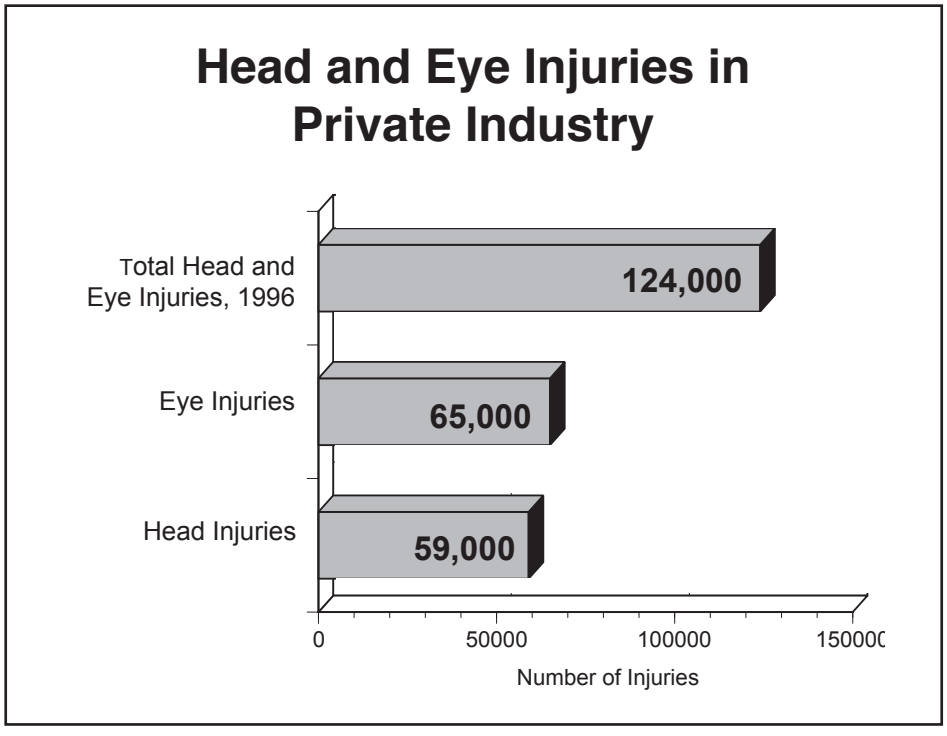
Sources: OSHA Regulations (Standards 29 CFR), *PPE,* 1910.132 and *Non-Mandatory Compliance Guidelines for Hazard Assessment and PPE Selection,* 1910 Subpart I App B. *Center for Disease Control, 1998.*

2. Eye Protection

Eye protection (including safety glasses, goggles, or full face shields) must be provided where there is a potential for injury to the eyes or face from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or a combination of these. Protective eye equipment should:

- Provide adequate protection against the particular hazards
- Be comfortable to wear under the existing work conditions
- Fit snugly without interfering with a person's movement or vision
- Be durable
- Be capable of being disinfected
- Be kept clean and in good repair

For eye protection, it is important that the protective equipment properly fit the person without interfering with their ability to move or see.



Source: Occupational Safety and Health Administration, *Personal Protective Equipment*, Washington DC, 1998.

3. Hand Protection

There are many types of gloves available to protect against a wide variety of hazards. It is extremely important that you use gloves that are designed for the hazards and tasks of the job you are doing. Gloves made for protection against one hazard may not protect against another hazard even though they may appear to be protecting your hands.

In general, gloves fall into four groups:

- **Leather, canvas or metal mesh** provide protection from cuts, burns, or heat;
- **Fabric and coated fabric** gloves provide protection from dirt and abrasions
- **Chemical and liquid-resistant gloves** provide protection from burns, irritation and dermatitis;
- **Insulating rubber gloves** provide protection from cuts, lacerations and abrasions

Factors That Determine Glove Selection	
✓	Type of chemicals handled
✓	Nature of contact (total immersion, splash, etc.)
✓	Duration of contact
✓	Area requiring protection (hand only, forearm, arm)
✓	Grip requirements (dry, wet, oily)
✓	Thermal protection
✓	Size and comfort
✓	Abrasion/resistance requirements

Source: OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

4. Use the Proper Gloves for Chemicals

If you work with chemicals you must use protective gloves. Unfortunately, MSDSs fall short of making specific recommendations for glove protection.

There is no glove currently available that is resistant to all chemicals, and no glove offers protection for an infinite period of time. That leaves important questions that must be answered including:

- How long should we use the gloves?
- After exposure can we decontaminate the gloves?
- After glove reuse will decontamination cause degradation?

ASTM Standards
In order to help you answer these questions the American Society for Testing and Materials (ASTM) has developed several standards regarding the performance of glove protection (F1407,F739,F903). The ASTM standards address glove degradation, permeation, penetration and breakthrough (*see Factsheet 7 for more information on degradation, permeation, penetration and breakthrough*).

If the gloves you are using have been tested by the manufacturer using the ASTM standards, it will say so on the packaging and you will be able to determine if the gloves are appropriate for the work you are doing. If they have not been tested you should not use them.

The chart below lists some common materials used in making gloves and their protection values (*see the Appendix on pages 131 for a list of various gloves and their protection ratings for specific chemicals. Use it to help you select the most appropriate gloves for your protection*).

MATERIAL	PROTECTION VALUE
Butyl Rubber	Resistant to bases and many organics
Neoprene	Resistant to mineral acids, organic acids, caustics, alcohol, and petroleum solvents
Nitrile	Resistnt to mineral acids, caustics, and petroleum solvents.
Natural Rubber	Resistant to ketones, alcohols, caustics, and organic acids
Polyurtehane	Resistant to alcohols, bases, aliphatic hydrocarbons
Polyvinyl Chloride (PVC)	Resistant to mineral acids, caustics, organic acids, and alcohols
Polyvinyl Chloride (PVA)	Resistant to chlorinated solvents, petroleum solvents and aromatics (not resistant to water)

Sources: *Centers for Disease Control, 1998.* OSHA, May 1995; *Fit the Glove* by Gerard Arotti. Michael Roder, *A Guide For Evaluating the Performance of Chemical Protective Clothing (CPC),* US Dept. of Health and Human Services; June 1990.

5. Body Protection

There are many varieties of body protection available for specific hazards. The following are examples of workplace hazards that could cause bodily injury:

- Cuts
- Radiation
- Temperature extremes
- Hot splashes from molten metals and other hot liquids
- Impacts from tools, machinery and materials
- Hazardous chemicals

Protective clothing comes in a variety of materials (each effective against particular hazards) including:

- Paper-like fiber used for disposable suits provide protection against dust and splashes.

- Treated wool and cotton adapts well to changing temperatures, is comfortable, and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.

- Duck is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.

- Leather is often used to protect against dry heat and flames. Rubber, rubberized fabrics, neoprene and plastics protect against certain chemicals and physical hazards.

- When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

Types of Chemical Protective Clothing (CPC)

If a hazard indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use; it must fit and function properly. The following are the basic types of CPC available. In emergency situations where the chemical is unknown and airborne, OSHA requires all employers to provide Hazmat team responders with fully encapsulated suits to protect both skin and lungs.

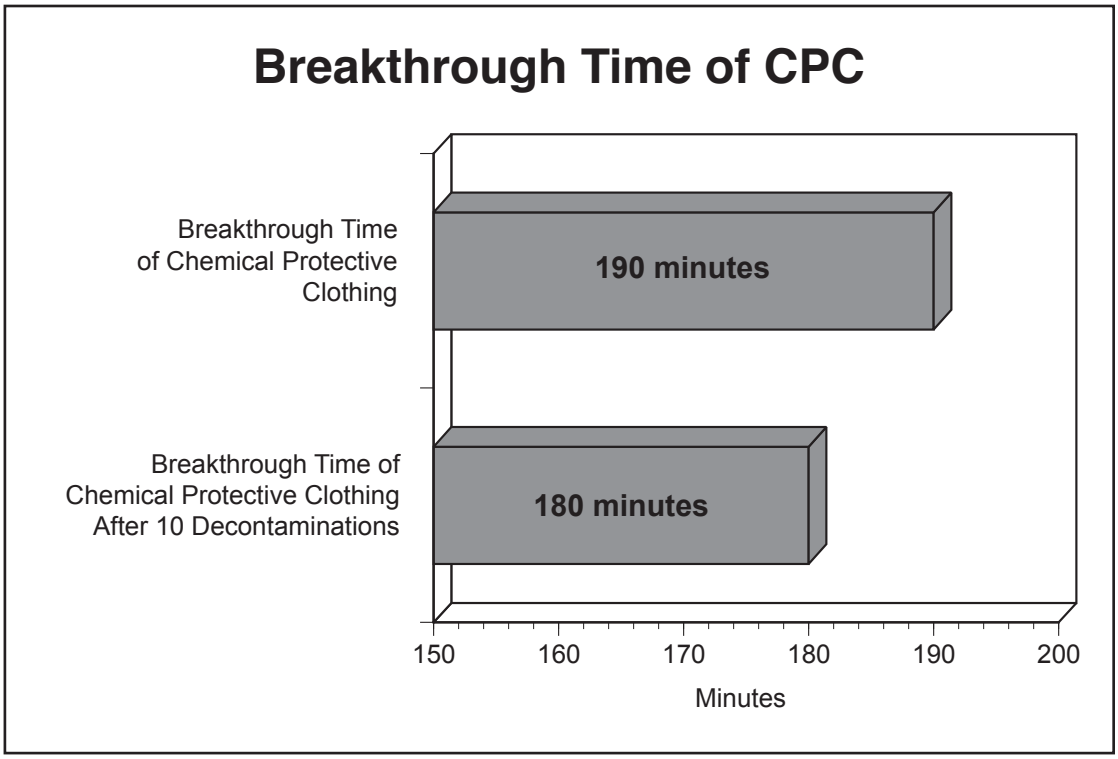
CPC for Emergencies
Fully Encapsulated Suits These suits protect from splashes and vapors. The encapsulated suit is used with a supplied air mask and self-contained breathing apparatus (SBCA) so that a sealed environment is created to keep out all forms of contaminants.
Splash Suits (Non-Encapsulating Suits) The suit consists of a jacket and hood in combination with a pair of pants or bib overalls. The suit provides protection from chemical splashes. It is worn with protective boots and gloves. Duct tape is used to seal any overlap between boot and cuff, glove and sleeve, and hood and respirator.
Other CPC
Aprons, Leggings and Sleeve Protectors These garments do not provide full and complete body protection. However, they do provide additional splash protection when used with non-encapsulating suits.
Face-Shields and Goggles When full-face respirators are used, the face and eyes are protected. In situations where these respirators are not used, face-shields or goggles need to be used to protect the face from chemicals.
Helmets, Hoods and Hair Coverings This type of equipment is used in some situations to provide head protection against chemicals. Safety helmets are also used to protect against head hazards.

Source: OSHA Standard 29 CFR 1910.138, "Hand Protection. OSHA Personal Protective Equipment Program, *General Guidelines for Choosing Personal Protective Equipment*, App. A and B. OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

6. The Limits of CPC

CPC can leak. The leakage has a lot to do with *breakthrough time*—the the point when a chemical *permeates* or passes through the protective clothing.

A Department of Health and Human Services study found that the breakthrough time of CPC can decrease from 190 minutes to 180 minutes after 10 decontaminations (disinfecting or sterilizing the clothing).



Evaluating CPC

There are three things to keep in mind when evaluating the limits of protective clothing:

1. **Permeation**
   When the chemical passes through the protective material, this is called permeation. For example, even though a plastic glove looks solid, it still has many pores and open spaces. The proper glove will provide a barrier, but over time and with extended use, chemicals eventually pass through.

2. **Degradation**
   When the chemical corrodes, dissolves or damages the protective clothing, this is called degradation. If the chemical changes the protective properties of the clothing, then it will no longer be protective. Sometimes degradation is visible—the material may be puckered, brittle and/or eroded. Sunlight and high temperatures can cause degradation.

3. **Penetration**
   When a chemical passes through a garment/glove by way of holes or imperfections, this is called penetration. Penetration can occur at zippers or stitched seams and through pin holes or tears in a garment or glove.

Source: Michael Roder, *A Guide For Evaluating the Performance of Chemical Protective Clothing (CPC)*, US Dept. of Health and Human Services; June 1990.

7. Hearing Protection

Overexposure to noise can lead to permanent hearing loss. If you are experiencing any of the symptoms listed below then you may be overexposed to noise.

- Difficulty hearing normal speech in the work area
- Shouting to make oneself heard more than an arm's length away
- Ringing in the ears after leaving the work area
- After work, dulled or muffled hearing that disappears after 14 hours (It's hard to hear normal conversation, TV, radio, etc.)
- Headaches, dizziness or other health conditions related to stress (for example: high blood pressure, fatigue, etc.)
- Co-workers who are hard of hearing

NOISE SOURCE	DECIBEL LEVELS
Decibel Levels 30-80	
Whisper	30dB
Normal Conversation	60dB
Vacuum Cleaner	75db
Ringing Telephone	80dB
Decibel Levels 85-120 (Diminished mental ability at 80dB)	
City Traffic	85dB
Hair Dryer, Power Lawn Mower	90dB
Chain Saw	110dB
iPod (on high)	112dB
Football Game in Stadium	117dB
Decibel Levels 120 and Over (The point at which pain begins)	
Ambulance Siren	120dB
Noisy Squeak Toys	135dB
Firecracker, Jet Engine Take Off	140dB
Gunshot	165dB
Rocket Launch	180dB

Decibels and Exposure Limits

Decibels (dB) measure the loudness of noise. **When decibels go up by 3, loudness doubles.** For example, 93 dB is twice as loud as 90 dB.

In general, the louder the noise, the shorter the amount of time you can be exposed before hearing protection is required. For example, you can be exposed to a noise level of 90 dB for 8 hours per day before hearing protection is required. But if the noise level reaches 115 dB hearing protection is required if the exposure exceeds 15 minutes.

Types of Hearing Protection

The basic types of hearing protection include:

- **Single-use earplugs** made of waxed cotton, foam, silicone

rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.

- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. Disposables should be used only once and then discarded. Reusable plugs should be cleaned after each use.
- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair or facial movements such as chewing may reduce the protective value of earmuffs.

Permissible Noise Exposures

Duration Per Day in Hours	Sound Level in dB
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
.5 (30 minutes)	110
.25 (15 minutes)	115

Ear Plugs Not Always Effective

A National Institute for Occupational Safety and Health (NIOSH) study shows that as actually worn in the facility, earplugs **are less than half as effective** in protecting workers' hearing as their manufacturers claim. In 15 different facilities, 420 workers had their hearing tested while wearing one of four types of earplugs. The results were compared with the earplug manufacturers' claims. None of the plugs provided the claimed percentage of effectiveness.

Ear Muffs May Provide Even Less Protection

Ear muff manufacturers also dangerously overstate the effectiveness of their product. In fact, earmuffs may provide even less protection than earplugs. A study of shipyard workers showed there was greater hearing impairment among the workers who had used earmuffs than those who had used plugs. A study concluded that plastic plugs were more comfortable to wear than earmuffs, and therefore provided the best protection for long-term use.

Sources: NIOSH, *A Practical Guide to Preventing Hearing Loss,* 96-110, Appendix B, "Hearing Protection Devices," July, 1999 OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

8. Foot/Leg Protection

If you face possible foot or leg injuries from falling or rolling objects, crushing or penetrating materials, exposure to hot substances, corrosive or poisonous materials, or exposure to electrical hazards then you will need foot and leg protection.

When to Wear Foot or Leg Protection	
✓	When heavy objects such as barrels or tools might roll onto or fall on the feet
✓	Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes
✓	Exposure to molten metal that might splash on feet or legs
✓	Working on or around hot, wet or slippery surfaces
✓	Working when electrical hazards are present

Foot and leg protection choices include the following:

- **Leggings** protect the lower legs and feet from heat hazards such as molten metal or welding sparks.
- **Metatarsal guards** protect the instep area from impact and compression.
- **Toe guards** fit over the toes of regular shoes to protect the toes from impact and compression hazards.
- **Combination foot and shin guards** protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed.
- **Safety shoes** have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles of some safety shoes protect against puncture wounds. Safety shoes may also be designed to be electrically conductive to prevent the buildup of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect workers from workplace electrical hazards.

Source: OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

9. Head Protection

Serious head injuries can kill or impair you for life. Wearing a properly fitted safety helmet or hard hat is one of the easiest ways to protect your head from injury. Hard hats can protect you from impact and penetration hazards as well as from electrical shock and burns.

If you are working on a job where objects might fall from above or there is a possibility of accidental head contact with electrical hazards, or you could bump you head against fixed objects (e.g., exposed pipes or beams) then you should be wearing a hard hat. Whenever you are working below others who are using tools or working under a conveyor belt, you should be wearing a hard hat.

Types of Hard Hats

(The information should be listed on the hat)

Class A:

- General service (building construction, shipbuilding, lumbering)
- Good impact protection but limited voltage protection

Class B:

- Electrical/Utility work
- Protects against falling objects and high-voltage shock and burns

Class C:

- Designed for comfort, offers limited protection
- Protects against bumps from fixed objects, but does not protect against falling objects or electrical shock

Hard hats must have a hard outer shell and a shock-absorbing lining that includes a headband and straps that suspend the shell from 1 to 1 1/4 inches away from the head. This provides shock absorption during an impact and ventilation during normal wear. Protective headgear must meet ANSI Standard Z89.1-1986 (Protective Headgear for Industrial Workers) or provide an equivalent level of protection (see Factsheet 5 for more information on ANSI Standards).

Source: OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

10. Cleaning and Maintenance of PPE

Here are some guidelines for the cleaning and maintenance of PPE:

- All protective equipment should be maintained in good condition and replaced when no longer suitable for its purpose.
- PPE should not be used longer than the time indicated by the manufacturer.
- PPE should be cleaned, disinfected and thoroughly examined before it is used again.
- A record should be kept of the condition, cleaning, disinfection, and examination of personal protective equipment.
- When PPE is sent off site to be cleaned, care should be taken to make sure that the contractor fully understands the precautions necessary for handling contaminated clothing.

11. Respirators

Air-Purifying Respirators (APRs)
These are the most commonly used and misused respiratory protection devices. They involve the use of cartridges or canisters that contain either filters (to screen out dusts, fumes, or mists) or activated charcoal or other absorbent material (to screen out organic vapors, acids, gases, etc.) to reduce exposures of the wearer. APRs come in two types:

- **Negative-pressure** types (either half-face or full-face), where filtered air is not forced into the mask
- **Powered-air** types, where filtered air is forced into the mask

The powered-air respirator is more protective and more comfortable than the negative-pressure type because it forces air to flow out, thereby helping to prevent inward leakage of contaminants. APRs generally leak at the seal between the face and the mask. That's why you need to be fit-tested.

Supplied Air Respirators
This respirator involves wearing a mask, which is hooked up to a "fresh," uncontaminated, outside source of air by a hose. This fresh, unfiltered air (no cartridges or canisters are used) is forced into the face-piece. This type of equipment offers more protection than the air-purifying respirators but can be cumbersome to wear.

Self-contained breathing apparatus (SCBA)
This is similar to a supplied-air respirator but the fresh uncontaminated source of air comes from a "bottle" or "tank" worn on the back. **This is the only type of respirator protection permitted for use in atmospheres that are Immediately Dangerous to Life or Health (IDLH).**

(continued)

11. Respirators *(continued)*

Particulate Respirators
Particulate respirators are the simplest, least expensive, and least protective of the respirator types available *(For more information on different types of respirators see Task 2)*.

Particulate respirators only protect against particles such as dusts or powders. They do not protect against chemicals, gases, or vapors, and are intended only for low hazard levels.
Particulate respirators are "air-purifying respirators" because they clean particles out of the air as you breathe. Even if you can't see the particles, there may be too many in the air for this respirator to provide adequate protection.

Dust Masks Are Not Respirators!

Dust masks should not to be regarded as PPE, and if they are "required," it is due to a lack of understanding of the nature of their function. They can sometimes provide comfort against hot/cold air and nuisance (non-toxic) dusts, fumes, or mists, so you can say they "protect" against discomfort. But they are not respirators and they ARE NOT to be used for protection against airborne toxic particulate matter or for gases or vapors. They are never to be used as protection from illness or injury.

Important: If a mask doesn't say "NIOSH Approved" it is not a respirator!

NIOSH Approved Particulate Respirators
The National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), tests and certifies respirators for use by workers to protect against workplace hazards. Respirators certified by NIOSH will say "NIOSH Approved" and may have a certification number.

However, NIOSH only certifies respirators against specific hazards.

Just because a respirator is certified does not mean it will protect against all hazards. NIOSH-certified respirators are supplied with *Approval Labels* that identify the hazards that the respirator is approved to protect against. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against. NIOSH-approved disposable respirators are marked with the manufacturer's name, the part number (P/N), the protection provided by the filter (e.g. N-95), and "NIOSH."

Types of Particulate Respirators

An N-95 respirator is one of nine types of disposable particulate respirators. Particulate respirators are also known as "air-purifying respirators" because they protect by filtering particles out of the air you breathe. You can find particulate respirators at home centers such as Lowe's or Home Depot. Workers can also wear any one of the particulate respirators for protection against diseases spread through the air–but the respirators must be NIOSH approved and properly fit-tested and maintained. (**Note:** Don't use the same respirator for an extended period of time. Dispose of old respirators and get new ones on a regular basis.)

Disposable Particulate Respirators (Filtering Facepiece)

Type	Description
N95	Filters at least 95% of airborne particles. Not resistant to oil.
N99	Filters at least 99% of airborne particles. Not resistant to oil.
N100	Filters at least 99.7% of airborne particles. Not resistant to oil.
R95	Filters at least 95% of airborne particles. Somewhat resistant to oil.
R99*	Filters at least 99% of airborne particles. Somewhat resistant to oil.
R100*	Filters at least 99.7% of airborne particles. Somewhat resistant to oil.
P95	Filters at least 95% of airborne particles. Strongly resistant to oil.
P99*	Filters at least 99% of airborne particles. Strongly resistant to oil.
P100	Filters at least 99.7% of airborne particles. Strongly resistant to oil.

Source: NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84, Publication No. 96-101, January 1996, http://www.cdc.gov/niosh/npptl/topics/respirators/

Task 2

You have been offered a job that will require you to wear a respirator. The employer has assured you that he has the proper equipment for the job.

In your groups review the factsheets on pages 88-94, then working together make a list of questions you should ask about the respirator before taking the job.

Questions you would ask the employer before taking the job:

1.

2.

3.

4.

5.

12. Respirators: A Last-Ditch Control

Respirators are extremely limited as a control device. Their use must be carefully monitored. Here are some of the major problems:

Respirators…

- Are hot and uncomfortable
- Often fit poorly (allowing the toxic substance to get in)
- Put extra stress on the heart and lungs
- Limit conversation (and therefore safety)
- Do not offer any protection whatsoever against many chemicals
- Do not stop the toxic chemical from getting into the environment
- Do not prevent skin exposure
- Do not prevent eye exposure

13. What OSHA Says About Respirators

Here's what OSHA says in its respiratory protection standard (29 CFR 1910.134):

> **"...In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used."**

According to OSHA, any workplace where respirators are necessary to protect the health of workers or whenever respirators are required, the employer must establish and implement a written respiratory protection program.

Written Respiratory Protection Programs (For Non-Disposable Respirators) Must Include:
Procedures for selecting respirators
Medical evaluation for workers who are using respirators
Fit testing
Procedures for proper use of respirators in routine and emergency situations
Procedures and schedules for proper cleaning and maintenance of respirators
Procedures to ensure air quality and flow of breathing for atmosphere-supplying respirators
Training in the proper use of respirators, their limitations and their maintenance
Procedures for regularly evaluating the effectiveness of the program.

14. Types of Respirators

Air-Purifying Respirators (APRs)
These are the most commonly used and misused respiratory protection devices. They involve the use of cartridges or canisters that contain either filters (to screen out dusts, fumes, or mists) or activated charcoal or other absorbent material (to screen out organic vapors, acids, gases, etc.) to reduce exposures of the wearer. APRs come in two types:

- **Negative-pressure** types (either half-face or full-face), where filtered air is not forced into the mask
- **Powered-air** types, where filtered air is forced into the mask

The powered-air respirator is more protective and more comfortable than the negative-pressure type because it forces air to flow out, thereby helping to prevent inward leakage of contaminants. APRs generally leak at the seal between the face and the mask. That's why you need to be fit-tested.

Supplied Air Respirators
This respirator involves wearing a mask, which is hooked up to a "fresh," uncontaminated, outside source of air by a hose. This fresh, unfiltered air (no cartridges or canisters are used) is forced into the face-piece. This type of equipment offers more protection than the air-purifying respirators but can be cumbersome to wear.

Self-contained breathing apparatus (SCBA)
This is similar to a supplied-air respirator but the fresh uncontaminated source of air comes from a "bottle" or "tank" worn on the back. **This is the only type of respirator protection permitted for use in atmospheres that are Immediately Dangerous to Life or Health (IDLH).**

Particulate Respirators
Particulate respirators are the simplest, least expensive, and least protective of the respirator types available *(For more information on different types of respirators see Task 2).*

Particulate respirators only protect against particles such as dusts or powders. They do not protect against chemicals, gases, or vapors, and are intended only for low hazard levels.
Particulate respirators are "air-purifying respirators" because they clean particles out of the air as you breathe. Even if you can't see the particles, there may be too many in the air for this respirator to provide adequate protection.

Dust Masks Are Not Respirators!

Dust masks should not to be regarded as PPE, and if they are "required," it is due to a lack of understanding of the nature of their function. They can sometimes provide comfort against hot/cold air and nuisance (non-toxic) dusts, fumes, or mists, so you can say they "protect" against discomfort. But they are not respirators and they ARE NOT to be used for protection against airborne toxic particulate matter or for gases or vapors. They are never to be used as protection from illness or injury.

Important: If a mask doesn't say "NIOSH Approved" it is not a respirator!

NIOSH Approved Particulate Respirators
The National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), tests and certifies respirators for use by workers to protect against workplace hazards. Respirators certified by NIOSH will say "NIOSH Approved" and may have a certification number.

(continued)

14. Types of Respirators *(continued)*

However, NIOSH only certifies respirators against specific hazards. **Just because a respirator is certified does not mean it will protect against all hazards.** NIOSH-certified respirators are supplied with *Approval Labels* that identify the hazards that the respirator is approved to protect against. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against. NIOSH-approved disposable respirators are marked with the manufacturer's name, the part number (P/N), the protection provided by the filter (e.g. N-95), and "NIOSH."

Types of Particulate Respirators

An N-95 respirator is one of nine types of disposable particulate respirators. Particulate respirators are also known as "air-purifying respirators" because they protect by filtering particles out of the air you breathe. You can find particulate respirators at home centers such as Lowe's or Home Depot. Workers can also wear any one of the particulate respirators for protection against diseases spread through the air–but the respirators must be NIOSH approved and properly fit-tested and maintained.

Disposable Particulate Respirators (Filtering Facepiece)	
Type	**Description**
N95	Filters at least 95% of airborne particles. Not resistant to oil.
N99	Filters at least 99% of airborne particles. Not resistant to oil.
N100	Filters at least 99.7% of airborne particles. Not resistant to oil.
R95	Filters at least 95% of airborne particles. Somewhat resistant to oil.
R99*	Filters at least 99% of airborne particles. Somewhat resistant to oil.
R100*	Filters at least 99.7% of airborne particles. Somewhat resistant to oil.
P95	Filters at least 95% of airborne particles. Strongly resistant to oil.
P99*	Filters at least 99% of airborne particles. Strongly resistant to oil.
P100	Filters at least 99.7% of airborne particles. Strongly resistant to oil.

Source: NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84, Publication No. 96-101, January 1996, http://www.cdc.gov/niosh/npptl/topics/respirators/

15. What Is Fit Testing?

Respirators are not made to fit every kind of face. As a result, OSHA mandates that employers make certain the respirators properly fit each of us.

Most respirators are made to fit the average male face. Scars, dentures, high cheekbones, etc. can make it next to impossible to get a proper fit with a respirator. In order for a respirator to be effective it has to create a seal with the wearer's face. Fit testing must be repeated annually and cannot be performed on workers with facial hair or other objects that can interfere with a proper face to respirator seal.

Fit testing involves giving a respirator to a worker and instructing him or her on how to wear the mask. The respirator must then be put on and adjusted so it is snug but comfortable. To achieve this, the contractor may have to provide you with a number of respirators made by a variety of manufacturers.

A qualitative fit test involves having an irritant like smoke, which will cause coughing, or a chemical with a strong smell, like banana oil, sprayed all around the respirator while you are wearing it. If the respirator doesn't fit, you'll cough or smell bananas.

OSHA Fit Testing Procedures
To ensure a proper fit, OSHA's qualitative fit testing requires that specfic exercises be conducted and specfic information be read during fit testing. For more information see OSHA Regulations (Standards - 29 CFR) 1910.134 App A., Fit Testing Procedures (Mandatory).

16. Respirator Maintenance and Care

Under the OSHA respiratory standard, the following respirator maintenance and care must be performed by the employer:

- Respirators issued for the exclusive use of an employee must be cleaned and disinfected to maintain sanitary conditions.

- Respirators that are shared, emergency-use respirators, or respirators used in fit testing must be cleaned and sanitized after each use.

- Respirators must be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals.

- All respirators must be inspected before each use and during cleaning.

- All respirators maintained for emergency use must be inspected monthly and checked for proper function after each use.

- All SCBAs must be inspected monthly.

- Written records of maintenance must be maintained for emergency-use respirators.

Summary

1. Using the *hierarchy of controls* employers must eliminate, substitute or use engineering controls to reduce hazardous conditions on the job. PPE is the least effective control in the hierarchy of controls.

2. OSHA strongly recommends that employers conduct a comprehensive *hazard assessment* prior to determining the PPE needed.

3. Eye protection must be provided where there is a potential for injury to the eyes or face from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or a combination of these.

4. When hand protection is required it is extremely important that you use gloves that are designed for the hazards and tasks you are doing.

5. If a hazard indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use; it must fit and function properly.

6. There are three things to keep in mind when evaluating the limits of protective clothing: **permeation, degradation, and penetration.**

7. Overexposure to noise can lead to permanent hearing loss. There are three basic types of hearing protection. S**ingle-use earplugs** are made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs. They should be discarded after each use. **Pre-formed or molded earplugs** that are individually fitted by a professional can be disposable or reusable. Reusable plugs should be cleaned after each use. The third type is **earmuffs** require a perfect seal around the ear.

8. If you face possible foot or leg injuries from falling or rolling objects, crushing or penetrating materials, exposure to hot substances, corrosive or poisonous materials, or exposure to electrical hazards

then you will need foot and leg protection.

9. If you are working on a job where objects might fall from above, or there is a possibility of accidental head contact with electrical hazards, or you could bump your head against fixed objects (e.g., exposed pipes or beams) then you should be wearing a hard hat.

10. All protective equipment should be maintained in good condition and replaced when no longer suitable for its purpose.

11. Respirators are extremely limited as a control device. Their use must be carefully monitored. There are four types of respirators including **air-purifying respirators (APRs), supplied air respirators, self-contained breathing apparatus (SCBA), and particulate respirators.**

12. According to OSHA, any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required, the employer must establish and implement a written respiratory protection program.

13. Respirators are not made to fit every kind of face. As a result, OSHA mandates that employers make certain the respirators properly fit each of us. Fit testing involves giving a respirator to a worker and instructing him or her on how to wear the mask. The respirator must then be put on and adjusted so it is snug but comfortable. To achieve this, the company may have to provide you with a number of respirators made by a variety of manufacturers.

14. Dust masks should not to be regarded as PPE. They are not respirators and they ARE NOT to be used for protection against airborne toxic particulate matter or for gases or vapors. They are never to be used as protection from illness or injury.

15. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against. NIOSH-approved disposable respirators are marked with the manufacturer's name, the part number (P/N), the protection provided by the filter (e.g. N-95), and "NIOSH."

Evaluation

Activity 4: Personal Protective Equipment

1. How important is this activity for you and your co-workers?
Please circle one number.

Activity Is Not Important				Activity Is Very Important
1	**2**	**3**	**4**	**5**

2. Please **put an "X" by the one factsheet** you feel is the most important**.**

	1. PPE and the Hierarchy of Controls		**9.** Head Protection
	2. Eye Protection		**10.** Cleaning and Maintenance of PPE
	3. Hand Protection		**11.** Respirators
	4. Use the Proper Gloves for Chemicals		**12.** Respirators: A Last-Ditch Control
	5. Body Protection		**13.**What OSHA Says About Respirators
	6. The Limits of CPC		**14.** Types of Respirators
	7. Hearing Protection		**15.** What Is Fit Testing?
	8. Foot/Leg Protection		**16.** Respirator Maintenance and Care

3. Which summary point do you feel is most important?
Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.
11.	12.	13.	14.	15.

4. What would you suggest be done to improve this Activity?

Activity 5: Evaluating the Training

Purpose

To evaluate this health and safety training and to spend some time talking about where we go from here.

This Activity has one task.

Task

First take a few minutes and write your answers to the questions below. We will discuss these questions as one large group.

One trainer will ask for the responses to the questions from each table and the other trainer will act as the scribe recording your answers on the flip chart in the front of the room.

1. **Describe the most important things you learned during this training.**

2. **Given your own experience and the things you have learned in this training, what are the health and safety problems at your workplace that need to be addressed right away?**

3. How would you rate the workbook's readability?

- ☐ **Too hard**
- ☐ **Just right**
- ☐ **Too easy**

4. What health and safety topics would you like to learn more about?

5. Of all the activities, which was your favorite? Why?

Appendix: Chemical Protective Gloves

The table below is from the U.S. Department of Energy's *Occupational Safety and Health Technical Reference Manual.* It rates various gloves as being protective against specific chemicals and can help you select the most appropriate gloves for the jobs you work on that involve working with or around dangerous chemicals. The ratings are abbreviated as follows: **VG**: Very Good; **G**: Good; **F**: Fair; **P**: Poor (not recommended). Chemicals marked with an asterisk (*****) are for limited service.

Chemical	Neoprene	Latex/Rubber	Butyl	Nitrile
Acetaldehyde*	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
Acetone*	G	VG	VG	P
Ammonium hydroxide	VG	VG	VG	VG
Amy acetate*	F	P	F	P
Aniline	G	F	F	P
Benzaldehyde*	F	F	G	G
Benzene*	P	P	P	F
Butyl acetate	G	F	F	P
Butyl alcohol	VG	VG	VG	VG
Carbon disulfide	F	F	F	F
Carbon tetrachloride*	F	P	P	G
Castor oil	F	P	F	VG
Chlorobenzene*	F	P	F	P
Chloroform*	G	P	P	F
Chloronaphthalene	F	P	F	F
Chromic acid (50%)	F	P	F	F
Citric acid (10%)	VG	VG	VG	VG
Cyclohexanol	G	F	G	VG
Dibutyl phthalate*	G	P	G	G
Diesel fuel	G	P	P	VG
Diisobutyl ketone	P	F	G	P
Dimethylformamide	F	F	G	G
Dioctyl phthalate	G	P	F	VG
Dioxane	VG	G	G	G

(continued)

Protective Gloves Chart (continued)

Epoxy resins, dry	VG	VG	VG	VG
Ethyl acetate*	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether*	VG	G	VG	G
Ethylene dichloride*	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
Furfural*	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerin	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrazine (65%)	F	G	G	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG
Lauric acid (36%)	VG	F	VG	VG
Lineolic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG
Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
Methyl chloride*	P	P	P	P

Methyl ethyl ketone*	G	G	VG	P
Methyl isobutyl ketone*	F	F	VG	P
Methyl metharcrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Naphthalene	G	F	F	G
Napthas, aliphatic	VG	F	F	VG
Napthas, aromatic	G	P	P	G
Nitric acid*	G	F	F	F
Nitric acid, red and white fuming	P	P	P	P
Nitromethane (95.5%)*	F	P	F	F
Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Styrene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65)	VG	VG	VG	VG
Tetrahydrofuran	P	F	F	F
Toluene*	F	P	P	F
Toluene diisocyanate (TDI)	F	G	G	F

(continued)

Protective Gloves Chart (continued)

Trichloroethylene*	F	F	P	G
Triethanolamine (85%)	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
Xylene*	P	P	P	F

Note: When selecting chemical-resistant gloves be sure to consult the manufacturer's recommendations, especially if the gloved hand(s) will be immersed in the chemical.

Protective gloves should be inspected before each use to ensure that they are not torn, punctured, or defective in any way. A visual inspection will help detect cuts or tears. Gloves that are discolored or stiff may be defective because of excessive use or degradation from chemical exposures (see the PPE Activity for more information on degradation).

Reuse of chemical-resistant gloves should be evaluated carefully. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved, the duration of the exposure, storage and temperature.