

Third Edition



# Workplace Health and Safety Manual

Chemical Hazards

Machine Hazards

# Chapters

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Chemical Hazards – Page 7

Machine Hazards – Page 31

# OSHA

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It is not possible to include discussion of everything necessary to ensure a health and safe working environment in a manual of this nature. Thus, this information must be understood as a tool for addressing workplace hazards, rather than an exhaustive statement of an employer's legal obligations, which are defined by statute, regulations, and standards. Likewise, to the extent that this information references practices or procedures that may enhance health or safety, but which are not required by a statute, regulation, or standard, it cannot, and does not, create additional legal obligations.

Finally over time, OSHA rules and interpretations may be modified in light of new technology, information, or circumstances; to keep apprised of such developments, or to review information on a wide range of occupational safety and health topics, visit OSHA's website at [www.osha.gov](http://www.osha.gov).

# **Western North Carolina Workers' Center**

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Western North Carolina Workers' Center's mission is to develop leadership among workers through organizing and education to resolve issues of labor rights and promote fair working conditions in Western North Carolina.

## **Illustrations**

Mark Hurwitt Graphics

# The Small Group Activity Method

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## Illustration Reflection

What is happening in the illustration on the cover of the manual? Who is leading the workshop and why? What are the learners doing?

### **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**

**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.

**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 scribe's report back on large pads of paper in front of the class so that everyone can refer to them.

**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 space 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 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.

# Chemical Hazards

## Purpose

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To analyze areas in the workplace where the risks of chemical exposures are greatest.

To understand the different ways for workers to become familiar with the hazardous chemicals in their workplace.

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



# Task One

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**Step 1:**

Review the factsheets on pages 10 to 13.

**Step 2:**

Make a drawing on the sheet of flip chart paper that shows the basic layout of your workplace. See page 13 for an example of what a drawing looks like. Use the entire sheet of paper for your map.

**Step 3:**

Identify the chemical hazards in each area of the facility using the hazard code key on page 11 and a colored sticker.

**Step 4:**

Label each chemical hazard with a name or brief description.

**Step 5:**

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



# 1. Use Hazard Mapping to Identify Chemical Exposures

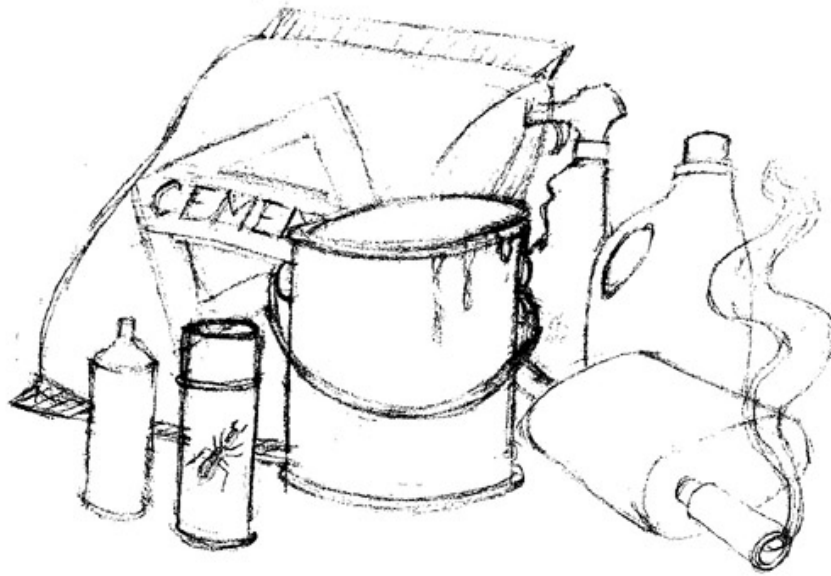
A hazard map is a visual representation of the workplace that identifies where there are chemical hazards that could cause injuries or illness to workers.

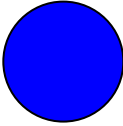
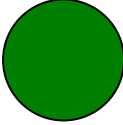
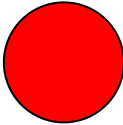
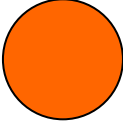
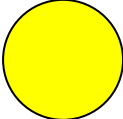
Hazard mapping draws on what workers know from on-the-job experience and respects the vast array of skills, experience, and knowledge that workers have about their jobs.

The hazard mapping approach works best when conducted by a small group of workers from the same department or work area and requires working the small group to work together to identify, prioritize, and solve problems



## 2. Chemical Hazards Code Key



Color	Type of Chemical Hazard	Examples
<p data-bbox="305 289 378 321"><b>Blue</b></p> 	<p data-bbox="456 289 1130 363"><b>Solid chemical hazards</b> – chemicals in solid form</p>	<p data-bbox="1172 289 1430 405">Dry paint (dry paint can contain lead)</p>
<p data-bbox="293 560 389 592"><b>Green</b></p> 	<p data-bbox="456 560 1143 720"><b>Dusts chemical hazards</b> – Dust are small particles of solids. Workers can be exposed to materials that are already in dust form, or through work processes that create these dust.</p>	<p data-bbox="1172 560 1463 634">Cement bags, fiberglass, asbestos</p>
<p data-bbox="310 938 373 970"><b>Red</b></p> 	<p data-bbox="456 938 1076 1054"><b>Liquid chemical hazards</b> – These are chemicals that are found in liquid form at room temperature.</p>	<p data-bbox="1172 938 1442 1012">Pesticides, paints, cleaning products</p>
<p data-bbox="282 1190 402 1222"><b>Orange</b></p> 	<p data-bbox="456 1190 1101 1350"><b>Vapors as chemical hazards</b> – Vapors are gases that have evaporated. Certain vapors can cause eye and skin irritation. Some can even cause brain damage over time.</p>	<p data-bbox="1172 1190 1442 1264">Pesticides, paints, cleaning products</p>
<p data-bbox="289 1547 396 1579"><b>Yellow</b></p> 	<p data-bbox="456 1547 1133 1705"><b>Gases as chemical hazards</b> – Some chemicals exist as gases at room temperature. Other solid or liquid chemicals converted to gases when they are heated.</p>	<p data-bbox="1172 1547 1451 1705">Aerosols, carbon monoxide, vehicle fumes, hydrogen sulfide.</p>



### 3. Identifying Areas of Concern

Before you begin developing your map, think about where chemical hazards may exist in your workplace.

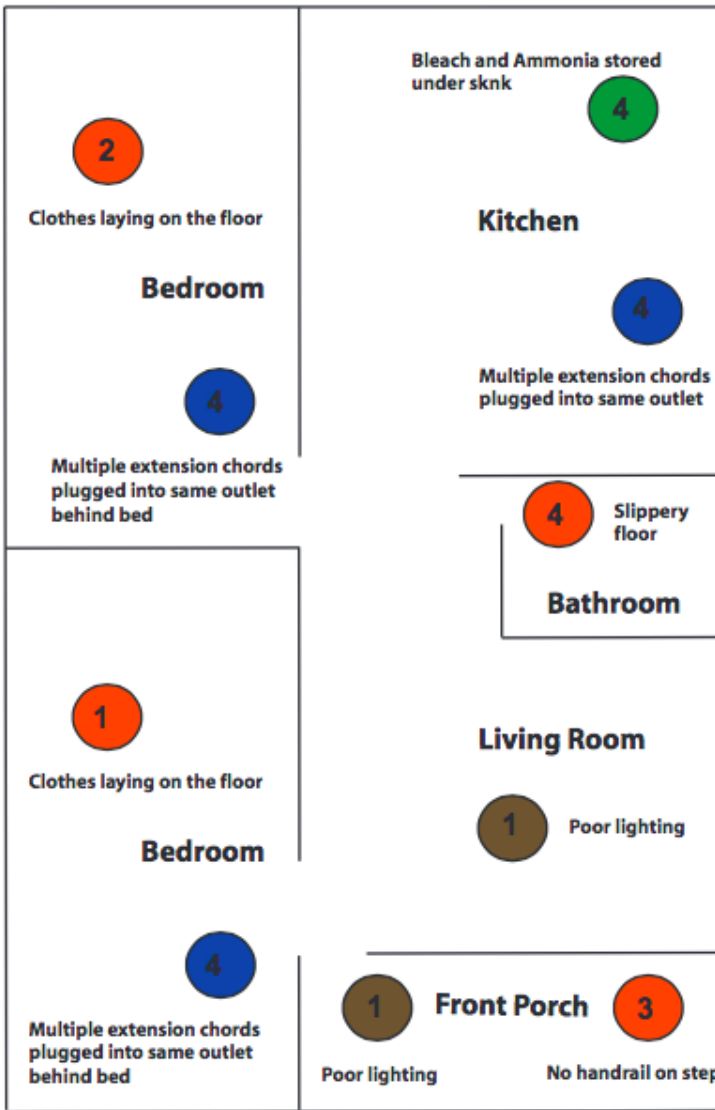
<b>Potential Locations of Chemical Hazards</b>	
	When measuring or sampling
	Transferring hazardous materials
	Packaging and unpacking of hazardous materials
	Operations involving hazardous materials such as welding, machining, plating, spray coating, using cleaning solvents, etc
	Maintenance activities involving hazardous materials
	Spills

Source: Health and Safety in the Workplace: Instructional Guide: Interfaith Worker Justice, 2010.



# 4. Example of a Home Hazard Map

- Electrical Hazard
- Chemical Hazard
- Physical Hazard
- Ergonomic Hazard
- Other Hazard



## Task Two


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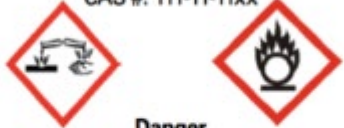
**In your groups, read the case study below and review the factsheets on pages 17 to 21. Then working together, use the factsheets and your own experience to answer the questions on the next page.**

Maria works in the kitchen of a restaurant as a dishwasher. To clean cooking pans, she soaks them in a powerful cleaning solution. She uses liquid resistant gloves to protect her hands and arms.

One day, as Maria was lifting three large pans out of the cleaning solution at once, the pans slipped out of her hands and back into the solution, which splashed all over the side of her face and into her left eye. She was blind in one eye for two weeks. Maria was lucky...she got her eyesight back. The labels on the next page were attached to the chemicals that she was using.

Source: Adapted from [http://www.ccohs.ca/teach\\_tools/chem\\_hazards/case\\_studies.html](http://www.ccohs.ca/teach_tools/chem_hazards/case_studies.html)

	<h2 style="margin: 0;">Ammonia (Anhydrous)</h2> <h3 style="margin: 0;">DANGER</h3> <p style="margin: 0;">Fatal if inhaled. Causes severe skin burns and eye damage. Contains gas under pressure; may explode if heated. Very toxic to aquatic life.</p> <p style="margin: 0;"><b>Contact with eyes:</b> Flush eyes immediately with plenty of water for 15 minutes and seek medical advice immediately.</p> <p style="margin: 0;"><b>Skin Contact (or Hair):</b> Remove/Take off immediately all contaminated clothing. Rinse Skin with water/shower.</p> <p style="margin: 0;"><b>Inhalation:</b> Remove to fresh air. If breathing is stopped, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice.</p> <p style="margin: 0;">Store in a locked cabinet. Protect from sunlight. Store in a well-ventilated place.</p>	
	See Material Safety Data Sheet for further details regarding safe use of this product.	
ABC Chemical Supply	123 Nearby Blvd. Anytown, US 12345	(987) 654-3210

<p style="margin: 0;"><b>OXI252</b> (disodiumflammy) CAS #: 111-11-11xx</p>	
	
<p style="margin: 0;"><b>Danger</b> May cause fire or explosion; strong oxidizer Causes severe skin burns and eye damage</p>	
<p style="margin: 0;">Keep away from heat. Keep away from clothing and other combustible materials. Take any precaution to avoid mixing with combustibles. Wear protective neoprene gloves, safety goggles and face shield with chin guard. Wear fire/flame resistant clothing. Do not breathe dust or mists. Wash arms, hands and face thoroughly after handling. Store locked up. Dispose of contents and container in accordance with local, state and federal regulations.</p>	
<p style="margin: 0;"><b>First aid:</b> IF ON SKIN (or hair) or clothing: Rinse immediately contaminated clothing and skin with plenty of water before removing clothes. Wash contaminated clothing before reuse. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF INHALED: Remove person to fresh air and keep comfortable for breathing. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. Immediately call poison center. Specific Treatment: Treat with doctor-prescribed burn cream.</p>	
<p style="margin: 0;"><b>Fire:</b> In case of fire: Use water spray. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.</p>	
Great Chemical Company, 55 Main Street, Anywhere, CT 064XX	Telephone (888) 777-8888



1. What is the signal word for each of the chemicals? What do the words mean?
2. What are the precautionary steps in regard to the chemicals?
3. What are first aid measures that a worker should take if exposed to the chemicals?
4. What are the names of the pictograms associated with each chemical?

# 1. Safety Data Sheets (SDS)

Safety Data Sheets (SDSs), which must accompany hazardous chemicals, are the more complete resource for details regarding hazardous chemicals. Every employer whose workplace using hazardous chemicals is required to keep SDS related to each chemical used in the workplace.

The SDS gives information about the hazards associated with the chemicals and ways for workers to protect themselves from harm while using them.

Workers have a right to request and read the SDS of the chemical that they handle.

Employers are not required to have SDS in languages other than English.

Source: Health and Safety in the Workplace: Instructional Guide: Interfaith Worker Justice, 2010.

## 2. Labels

Containers of hazardous chemicals must have a label printed on it or attached to it. The label provides information to workers on the specific hazardous chemical. The label must contain the following information:

**Product Identifier** –  
The chemical name or code number of the chemical.

**Signal Word** – Used to indicate the relative level of severity of the hazard and alert the worker to a potential hazard. “Danger” and “Warning” are the only two words used as signal words. “Danger” is used for more severe hazards. “Warning” is used for less severe hazards.

**Pictogram(s)** –  
Graphic symbols used to communicate specific information about the hazards of a chemical.

**Name, Address and Telephone Number** –  
Information about the chemical manufacturer of the chemical.

**SAMPLE LABEL**

CODE Product Name _____	} <b>Product Identifier</b>	<b>Hazard Pictograms</b>
Company Name Street Address _____ City _____ State _____ Postal Code _____ Country _____ Emergency Phone Number _____	} <b>Supplier Identification</b>	
Keep container tightly closed. Store in a cool, well-ventilated place that is locked. Keep away from heat/sparks/open flame. No smoking. Only use non-sparking tools. Use explosion-proof electrical equipment. Take precautionary measures against static discharge. Ground and bond container and receiving equipment. Do not breathe vapors. Wear protective gloves. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling. Dispose of in accordance with local, regional, national, international regulations as specified.	} <b>Precautionary Statements</b>	<b>Signal Word</b> <b>Danger</b>
<b>In Case of Fire:</b> use dry chemical (BC) or Carbon Dioxide (CO <sub>2</sub> ) fire extinguisher to extinguish.		<b>Hazard Statements</b> Highly flammable liquid and vapor. May cause liver and kidney damage.
<b>First Aid</b> If exposed call Poison Center. If on skin (or hair): Take off immediately any contaminated clothing. Rinse skin with water.		<b>Supplemental Information</b> Directions for Use _____ _____ _____ Fill weight: _____ Lot Number: _____ Gross weight: _____ Fill Date: _____ Expiration Date: _____

OSHA 3492-01R 2016

**Hazard Statement(s)** –  
Describe the nature of the hazards of a chemical and the degree of the hazards. For example, “Causes damage to kidneys through prolonged exposure when absorbed through the skin.”

**Precautionary Statement(s)** – Describe recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure to the hazardous chemical or improper storage or handling. There are four types of precautionary statements: prevention (to minimize exposure); response (in case of accidental spillage or exposure emergency response, and first-aid); storage; and disposal.

### 3. Pictograms

Pictograms are graphic symbols used to communicate specific information about the hazards of a chemical.

#### Flame Over Circle



Oxidizers

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#### Exploding Bomb



Explosives  
Self-Reactives  
Organic Peroxides

### Exclamation Mark



Irritant (skin and eyes)  
Skin Sensitizer  
Acute Toxicity (harmful)  
Narcotic Effects  
Respiratory Tract  
Irritant  
Hazardous to Ozone Layer

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### Health Hazard



Carcinogen  
Mutagenicity  
Reproductive Toxicity  
Respiratory Sensitizer  
Target Organ Toxicity  
Aspiration Toxicity

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### Flame



Flammables  
Pyrophorics  
Self-Heating  
Emits Flammable Gas  
Self-Reactives  
Organic Peroxides

## Gas Cylinder



Gases Under Pressure

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## Corrosion



Skin Corrosion  
Burns  
Eye Damage  
Corrosive to Metals

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## Skull and Crossbones



Acute Toxicity (fatal or toxic)

Source: OSHA Brief - Hazard Communication Standard: Labels

## **Task Three**

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### **Step 1:**

Review the factsheets on pages 23 to 26.

### **Step 2:**

Using the large sheet of paper with and draw an outline of a body (front and back) like the one on page 43. Use the entire sheet of paper for your body map.

### **Step 3:**

Identify on the body where potential types of chemical exposures that you could suffer as a result of your work with hazardous chemicals using the color-coded key on page 24 and a colored sticker.

### **Step 4:**

Label each hazard exposure with a name or brief description.

### **Step 5:**

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

# 1. Using Body Mapping to Chemical Exposures

A body map is a drawing that shows what parts of your body are vulnerable to chemical exposures.

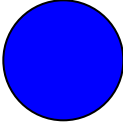
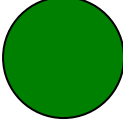
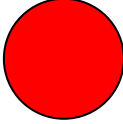
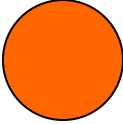
A body map draws on what workers know from on-the-job experience and respects the vast array of skill, experience and knowledge that workers have about their jobs.

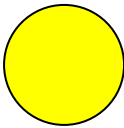
The body mapping approach works best when conducted by a small group of workers from the same department of work area and requires working the small group to work together to identify, prioritize and solve problems.





## 2. Chemical Hazards Code Key

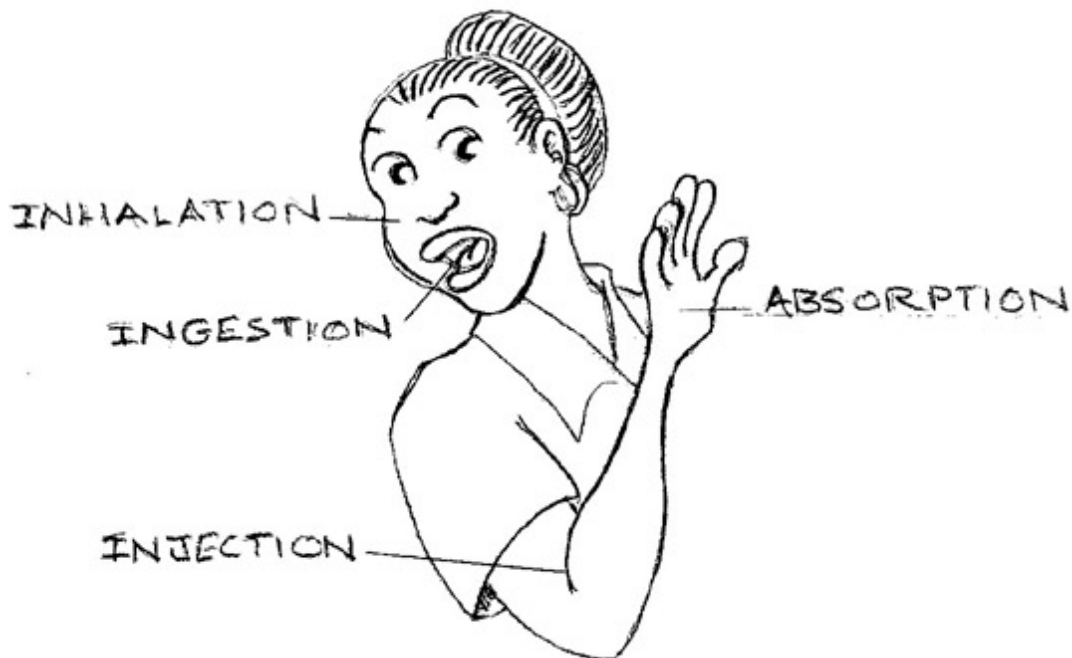
Color	Type of Chemical Hazard	Examples
<p><b>Blue</b></p> 	<p><b>Solid chemical hazards</b> – chemicals in solid form</p>	<p>Dry paint (dry paint can contain lead)</p>
<p><b>Green</b></p> 	<p><b>Dusts chemical hazards</b> – Dust are small particles of solids. Workers can be exposed to materials that are already in dust form, or through work processes that create these dust.</p>	<p>Cement bags, fiberglass, asbestos</p>
<p><b>Red</b></p> 	<p><b>Liquid chemical hazards</b> – These are chemicals that are found in liquid form at room temperature.</p>	<p>Pesticides, paints, cleaning products</p>
<p><b>Orange</b></p> 	<p><b>Vapors as chemical hazards</b> – Vapors are gases that have evaporated. Certain vapors can cause eye and skin irritation. Some can even cause brain damage over time.</p>	<p>Pesticides, paints, cleaning products</p>

Color	Type of Chemical Hazard	Examples
<b>Yellow</b> 	<b>Gases as chemical hazards</b> – Some chemicals exist as gases at room temperature. Other solid or liquid chemicals converted to gases when they are heated.	Aerosols, carbon monoxide, vehicle fumes, hydrogen sulfide.

### 3. Routes of Exposure to Chemical Hazards

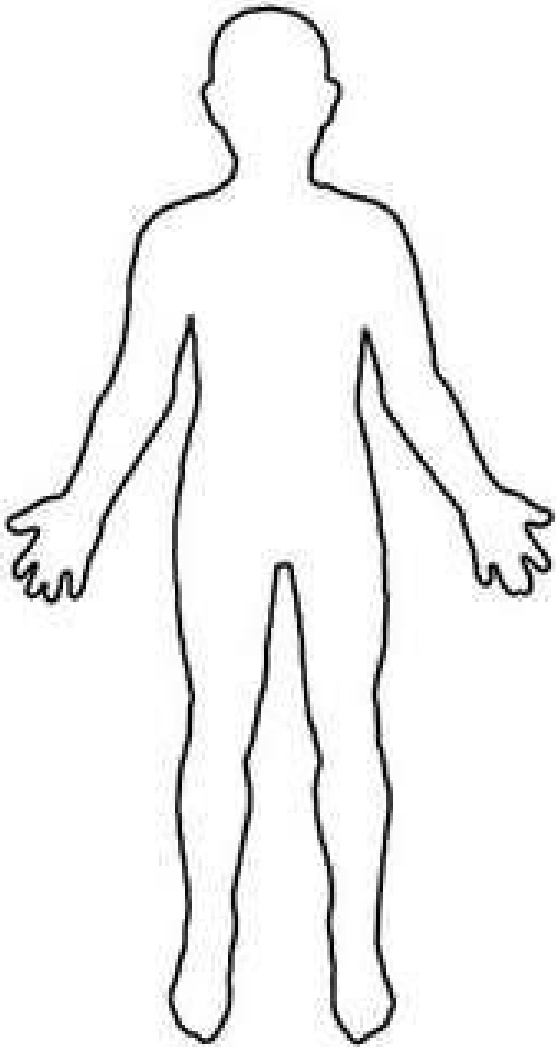
Potential Routes of Exposure to Chemical Hazards	
<b>Inhalation</b>	Breathing in contaminated air (dust, fumes, mist, smoke)
<b>Absorption</b>	Skin contact where chemicals can pass through the skin into the blood stream
<b>Ingestion</b>	Chemicals swallowed accidentally if food, cigarettes or hands are contaminated
<b>Injection</b>	A sharp object such as a needle punctures the skin and injects chemicals into the blood stream

Source: Health and Safety in the Workplace: Instructional Guide. Interfaith Worker Justice, 2010.

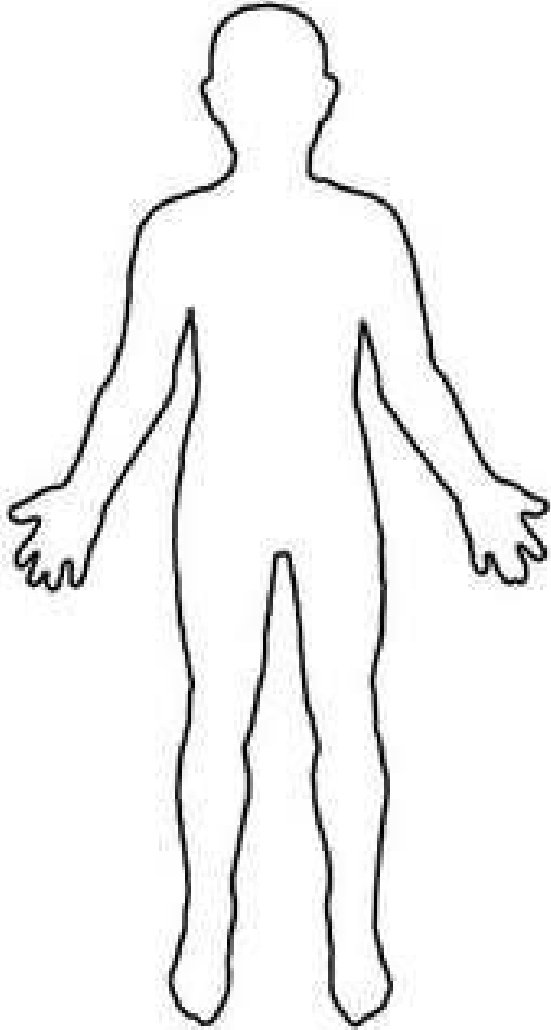


## 4. Example of a Body Map

**Front**



**Back**




## Task Four


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In your groups, observe the pieces of Personal Protective Equipment that is in the box for your group. Working together in groups, use the factsheet on page 29, your body map from the previous activity, the labels on the next page, and your own experience to answer the following questions. Then, choose a worker from the group and dress the worker with the Personal Protective Equipment from the box.

<b>Type of Hazard</b>	<b>The part of the body potentially affected by the hazard</b>	<b>The type of Personal Protective Equipment (PPE) that could be used for the hazard</b>



	<h2>Ammonia (Anhydrous)</h2>
	<h3>DANGER</h3> <p>Fatal if inhaled. Causes severe skin burns and eye damage. Contains gas under pressure; may explode if heated. Very toxic to aquatic life.</p> <p><b>Contact with eyes:</b> Flush eyes immediately with plenty of water for 15 minutes and seek medical advice immediately.</p> <p><b>Skin Contact (or Hair):</b> Remove/Take off immediately all contaminated clothing. Rinse Skin with water/shower.</p> <p><b>Inhalation:</b> Remove to fresh air. If breathing is stopped, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice.</p> <p>Store in a locked cabinet. Protect from sunlight. Store in a well-ventilated place.</p> <p>See Material Safety Data Sheet for further details regarding safe use of this product.</p>
<p>ABC Chemical Supply      123 Nearby Blvd. Anytown, US 12345      (987) 654-3210</p>	

<p><b>OXI252</b> (disodiumflammy) CAS #: 111-11-11xx</p>	
	
<p><b>Danger</b> May cause fire or explosion; strong oxidizer Causes severe skin burns and eye damage</p>	
<p>Keep away from heat. Keep away from clothing and other combustible materials. Take any precaution to avoid mixing with combustibles. Wear protective neoprene gloves, safety goggles and face shield with chin guard. Wear fire/flame resistant clothing. Do not breathe dust or mists. Wash arms, hands and face thoroughly after handling. Store locked up. Dispose of contents and container in accordance with local, state and federal regulations.</p>	
<p><b>First aid:</b>  <b>IF ON SKIN (or hair) or clothing:</b> Rinse immediately contaminated clothing and skin with plenty of water before removing clothes. Wash contaminated clothing before reuse.  <b>IF IN EYES:</b> Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  <b>IF INHALED:</b> Remove person to fresh air and keep comfortable for breathing.  <b>IF SWALLOWED:</b> Rinse mouth. Do NOT induce vomiting. Immediately call poison center.  <b>Specific Treatment:</b> Treat with doctor-prescribed burn cream.</p>	
<p><b>Fire:</b> In case of fire: Use water spray. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.</p>	
<p>Great Chemical Company, 55 Main Street, Anywhere, CT 064XX      Telephone (888) 777-8888</p>	



# **1. Personal Protective Equipment and Chemical Hazards**

The type of Personal Protective Equipment (PPE) a worker requires in order to work with a particular chemical is outlined in the Safety Data Sheets (SDS).

PPE is the least efficient way to protect workers because it does not get rid of the hazardous situation. If equipment fails, workers are still exposed to the risk.



# Summary

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The point of hazard mapping is to gather the knowledge about chemical hazards from groups of workers so that workers can together eliminate and/or reduce the risks of accidents and injuries.

Chemical hazards can be found in the following forms: solid chemical hazards, dust particles as chemical hazards, liquid chemical hazards, vapors and gases as chemical hazards.

The Safety Data Sheet (SDS) gives information about the hazards associated with the chemicals and ways for workers to protect themselves from harm while using them.

A label must be printed on containers of hazardous chemicals that provides information to workers on the specific hazardous chemical.

Pictograms are graphic symbols used to communicate specific information about the hazards of a chemical.

A body map is a picture that shows what parts of your body can be exposed to chemical hazards and what those chemical hazards are.

Personal Protective Equipment (PPE) is the least efficient way to protect workers because it does not get rid of the hazardous situation. If equipment fails, workers are still exposed to the risk.

# Machine Hazards

## Purpose

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To analyze areas in the workplace where the risks injuries due to machine hazards are greatest.

To understand the different ways to control machine hazards in the workplace.

To understand the importance of lockout/tagout procedures in preventing amputations and injuries.



# Task One

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**Step 1:**

Review the factsheets on pages 33 to 37.

**Step 2:**

Make a drawing on the sheet of flip chart paper that shows the basic layout of your workplace. See page 37 for an example of what a drawing looks like). Use the entire sheet of paper for your map.

**Step 3:**

Identify the machine hazards in each area of the facility using the hazard code key on pages 35-36 and a colored sticker.

**Step 4:**

Label each hazard with a name or brief description.

**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 Machine Hazards

A hazard map is a visual representation of the workplace that identifies where there are machine hazards that could cause injuries or amputations to workers.

Hazard mapping draws on what workers know from on-the-job experience and respects the vast array of skill, experience and knowledge that workers have about their jobs.

The hazard mapping approach works best when conducted by a small group of workers from the same department of work area and requires working the small group to work together to identify, prioritize and solve problems.

## 2. Machine Hazards

Employee exposure to unguarded or inadequately guarded machines is prevalent in many workplaces. Consequently, workers who operate and maintain machinery suffer approximately 18,000 amputations, lacerations, crushing injuries, abrasions, and over 800 deaths per year. Amputation is one of the most severe and crippling types of injuries in the occupational workplace, and often results in permanent disability.

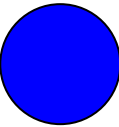
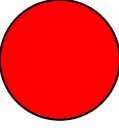
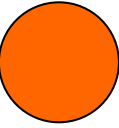
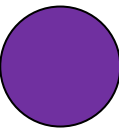
All machines consist of three fundamental areas:

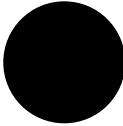

1. the point of operation – where work is performed on the material, such as cutting, shaping, boring, or forming of a product.
2. the power transmission device – all components of the mechanical system which transmit energy to the part of the machine performing the work including flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.
3. the operating controls – A mechanical or electrical power control on each machine to make it possible for the worker to cut off the power from each machine without leaving his or her position at the point of operation.

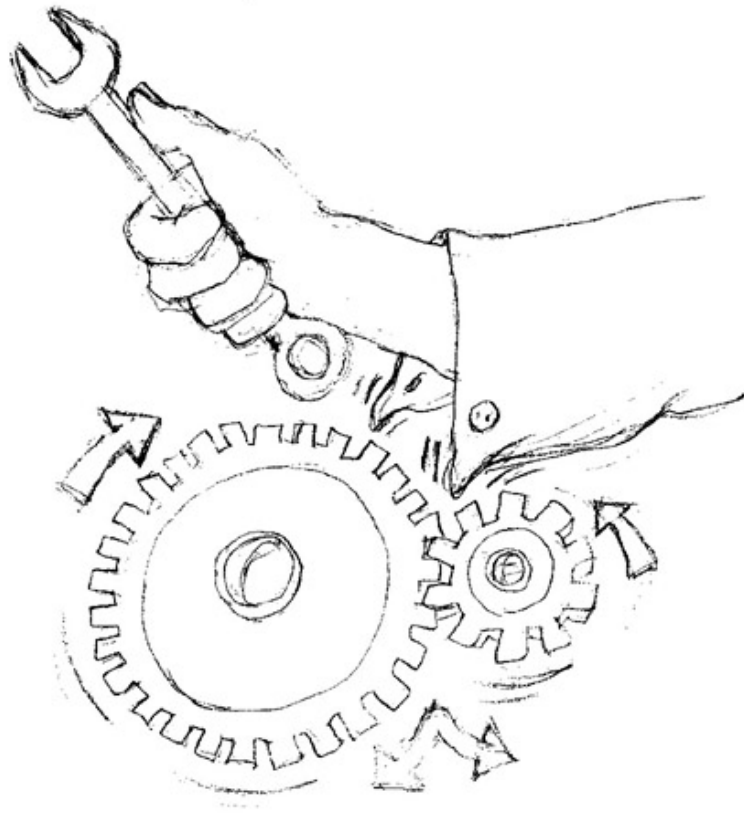
Despite all machines having the same basic components, their safeguarding needs widely differ due to varying physical characteristics and operator involvement.

Source: OSHA Machine Guarding e-tool  
<https://www.osha.gov/SLTC/etools/machineguarding/intro.html>

### 3. Machine Hazards Code Key

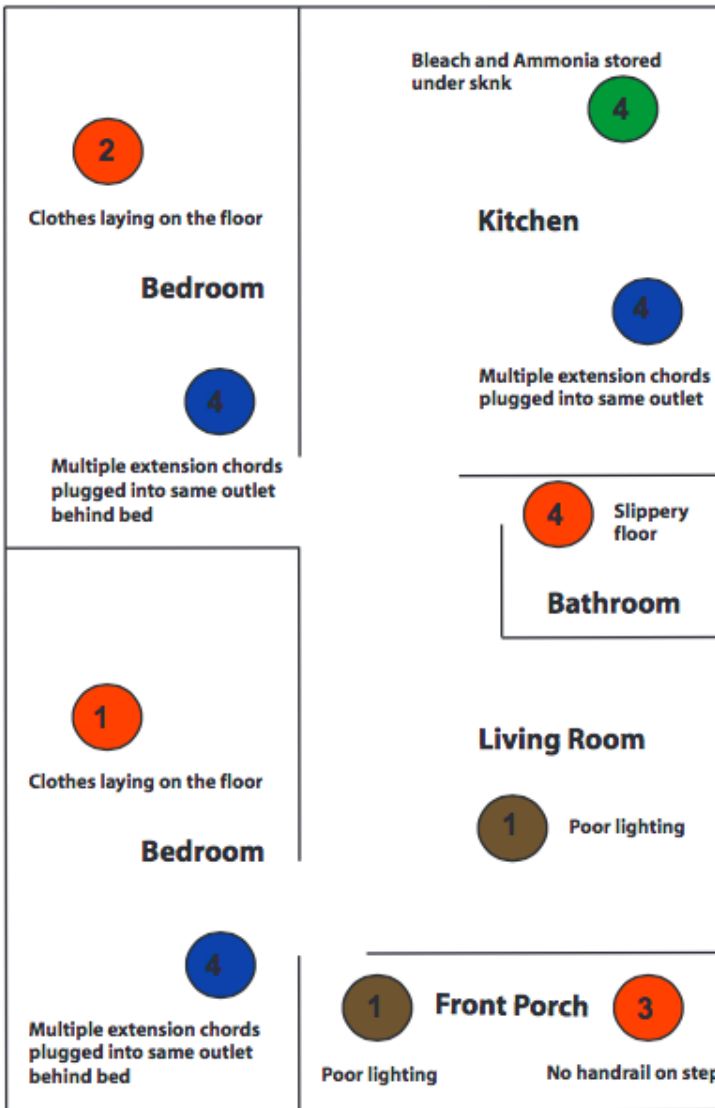
Color	Type of Machine Hazard
<p data-bbox="305 436 378 470"><b>Blue</b></p> 	<p data-bbox="459 394 1568 779"><b>Rotating</b> – can be dangerous; even smooth, slowly rotating shafts can grip hair and clothing, and through minor contact force the hand and arm into a dangerous position. Injuries due to contact with rotating parts can be severe. Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting are some examples of common rotating mechanisms which may be hazardous. The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys or set screws are exposed on rotating parts.</p>
<p data-bbox="305 875 378 909"><b>Red</b></p> 	<p data-bbox="459 875 1528 999"><b>Reciprocating</b> – may be hazardous because, during the back-and-forth or up-and-down motion, a worker may be struck by or caught between a moving and a stationary part.</p>
<p data-bbox="280 1165 402 1199"><b>Orange</b></p> 	<p data-bbox="459 1165 1549 1289"><b>Transversing</b> – (movement in a straight, continuous line) creates a hazard because a worker may be struck or caught in a pinch or shear point by the moving part.</p>
<p data-bbox="280 1526 402 1560"><b>Purple</b></p> 	<p data-bbox="459 1484 1568 1692"><b>Pinching</b> – results when power is applied to a slide for the purpose of blanking, drawing, or stamping metal or other materials. The danger of this type of action occurs at the point of operation where material is inserted, held, and withdrawn by hand. Typical machines used for punching operations are power presses and iron workers.</p>

Color	Type of Machine Hazard
<b>Black</b> 	<b>Shearing</b> – involves applying power to a slide or knife in order to trim or shear metal or other materials. A hazard occurs at the point of operation where material is actually inserted, held, and withdrawn. Examples of machines used for shearing operations are mechanically, hydraulically, or pneumatically powered shears.
<b>Brown</b> 	<b>Bending</b> – results when power is applied to a slide in order to draw or stamp metal or other materials. A hazard occurs at the point of operation where stock is inserted, held, and withdrawn. Equipment that uses bending action includes power presses, press brakes, and tubing benders.



# 4. Example of a Home Hazard Map

-  Electrical Hazard
-  Chemical Hazard
-  Physical Hazard
-  Ergonomic Hazard
-  Other Hazard





# **Task Two**

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**Working together in your groups, choose one type of hazard control from page 43. Then use the factsheets and your own experience to make a poster about the control to present to the rest of the group.**

**Then using the hazard maps that your developed in the previous activity, choose one or two hazards from the map that you believe are important. Then as a group prepare a short skit that demonstrates workers approaching their employer to discuss ways that the employer can control the workplace hazard. At least one of the hazard control methods and machine guard examples should be incorporated in the skit.**

**Step 1:**

Working together in your groups, choose one type of hazard control from page 40. Then use the factsheets on pages 39 - 42 and your own experience to make a poster about the control to present to the rest of the group.

**Step 2:**

Using the hazard maps that your developed in the previous activity, choose one or two hazards from the map that you believe are important.

**Step 3:**

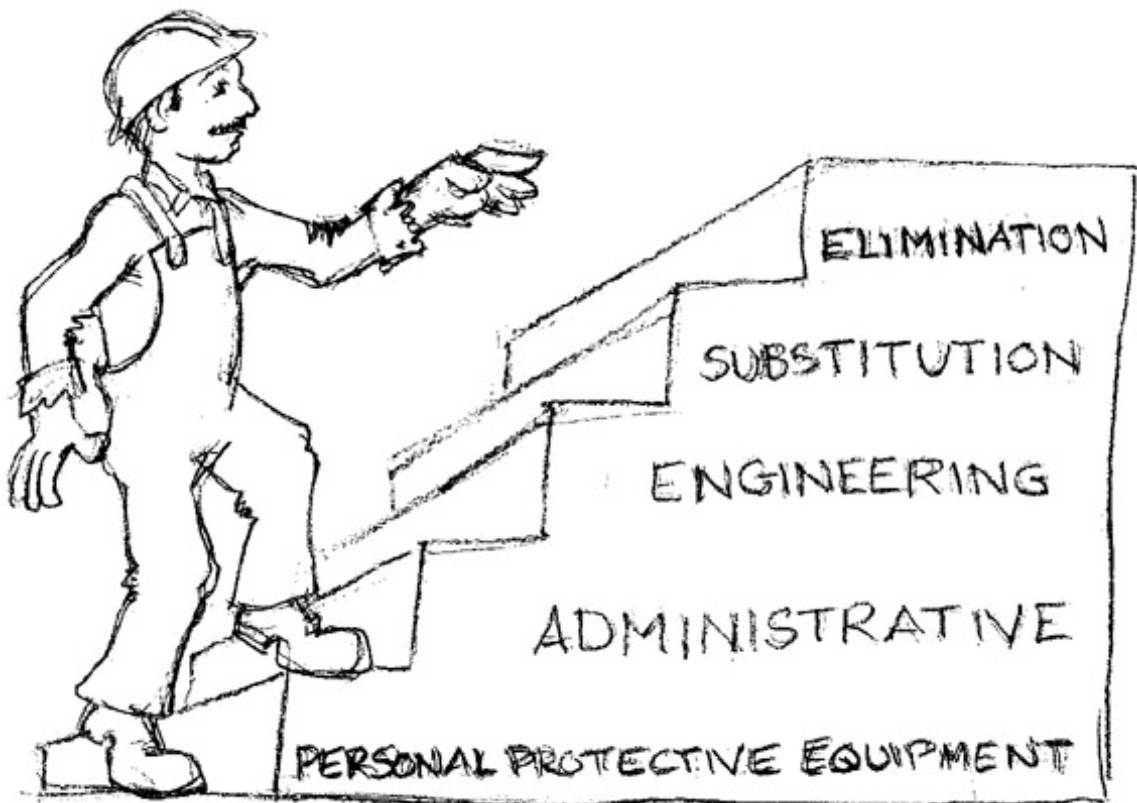
As a group prepare a short skit that demonstrates workers approaching their employer to discuss ways that the employer can control the workplace hazard. At least one of the hazard control methods from page 42 and machine guard examples from page 41 - 42 should be incorporated in the skit.

# 1. Hierarchy of Controls

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 **personal protective equipment (PPE) is the least effective way to control a hazard.**



## 2. Types of Hazard Controls

Hierarchy of Controls		
More Effective (Best)	Elimination	<p>Elimination - The best way to control a hazard.</p> <p>Best to do this as early as possible.</p> <p>An example of elimination would be to use an electric forklift truck rather than a gas operated forklift truck to eliminate carbon monoxide in a warehouse.</p>
	Substitution	<p>Substitution – Used when a hazard cannot be eliminated completely.</p> <p>The idea is to substitute chemicals, equipment, or hazardous materials with ones that are less hazardous.</p> <p>An example of this would be using paint that does not contain lead-based pigments. A potential problem is when the product being used as a substitute is as dangerous as the original. For this reason, it is important to find out if the product is truly less hazardous than the original.</p>
Least Effective (Worst)	Engineering	<p>Engineering - using technology to change the work environment, a machine, or some equipment in order to reduce the hazard.</p> <p>For example, machine guards, backup alarms, guardrails, covers, slip resistant surfaces, and using machines to move heavy objects instead of carrying them.</p>
	Administrative	<p>Administrative Controls - Changing the way and the structure of how work is done.</p> <p>Example: Instead of one employee exposed to a particular hazard for eight hours a day, the employer could assign four workers to work for two hours each. This could be used for repetitive tasks or for any exposure to a chemical hazard.</p>
	Personal Protective Equipment (PPE)	<p>Personal protective equipment (PPE) – the least efficient way to protect workers because it does not get rid of the hazard. If equipment fails, workers are still exposed to the risk.</p> <p>Examples include protective wear for the eyes, ears, and face, gloves, and protective clothes.</p>

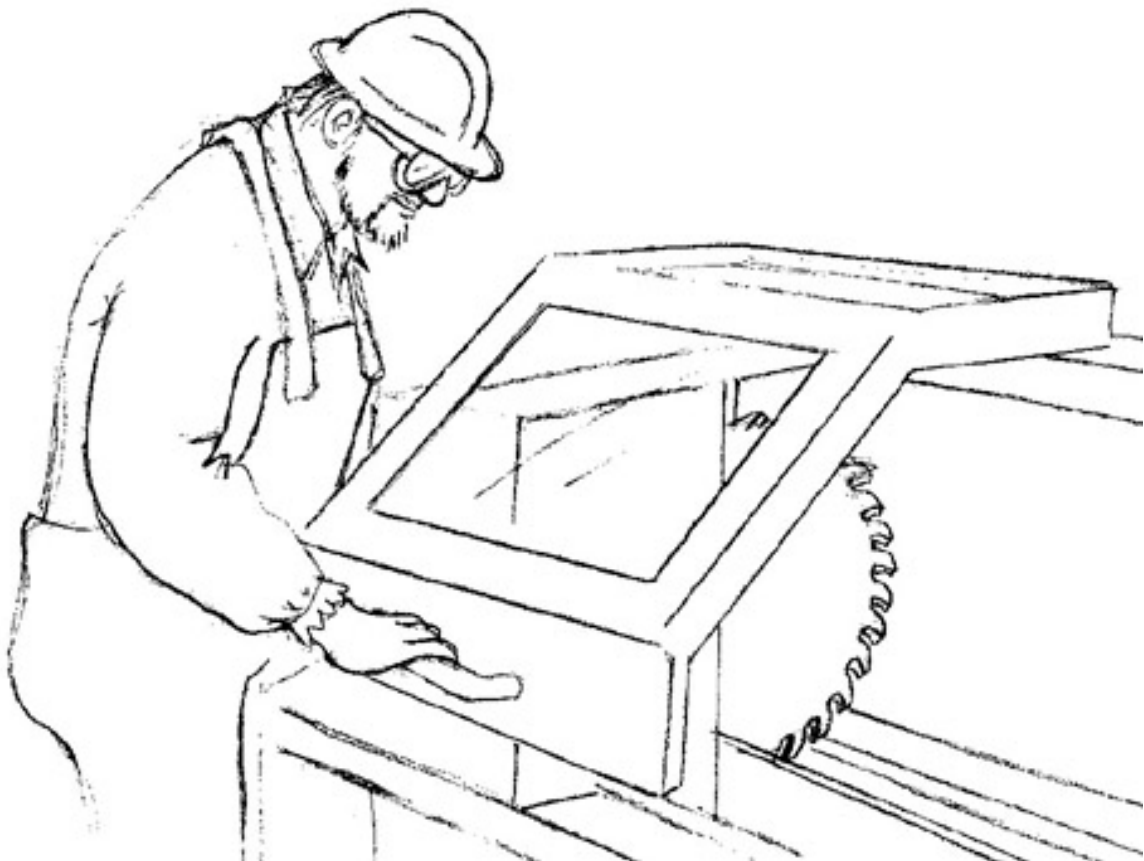
### 3. Machine Guarding

Machine guards are barriers which prevent access to machine danger areas.

There are four general types of machine guards:

<b>Fixed Guarding</b>	<p>Provides a fixed barrier to machine danger areas.</p> <p>Is a permanent part of the machine.</p> <p>Is not dependent of moving parts of the machine to function.</p> <p>Preferable to all other types because of its relative simplicity.</p>
<b>Interlocking Guarding</b>	<p>Shuts off or disengages power, stops the moving parts and prevents starting of the machine when the guard is open; should require the machine to be stopped before the worker can reach into the danger area.</p> <p>When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, the moving parts of the machine are stopped, and the machine cannot cycle or be started until the guard is back in place.</p> <p>Can provide maximum protection Allows access to the machine for removing jams without time consuming removal of the fixed guards</p>
<b>Adjustable Guarding</b>	<p>Provides a barrier that may be adjusted to facilitate a variety of production operations.</p> <p>Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock.</p> <p>Hands may enter danger area - protection may not be complete at all times.</p>

<b>Fixed Guarding</b>	<p>Provides a fixed barrier to machine danger areas.</p> <p>Is a permanent part of the machine.</p> <p>Is not dependent of moving parts of the machine to function.</p> <p>Preferable to all other types because of its relative simplicity.</p>
<b>Self-Adjustable Guarding</b>	<p>This guard protects the operator by placing a barrier between the danger area and the operator.</p> <p>Provides a barrier that moves according to the size of the stock entering the danger area.</p> <p>As the operator moves the stock into the danger area, the guard is pushed away, providing an opening which is only large enough to admit the stock.</p> <p>After the stock is removed, the guard returns to the rest position.</p> <p>Does not always provide maximum protection</p>



## Task 3

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**In your groups, read the two case studies below and review the factsheets pages 45 - 49. Then working together, use the factsheets and your own experience to answer the questions on the next page.**

### Case Study 1

In preparation for the next day's work, a clean-up crew was using a high-pressure water hose to clean machines in a poultry plant. One of the two workers was preparing to wash down a feather-picking machine, and the other was washing down a scalding machine. The first employee cranked on his machine to get inside and wash out feathers that had lodged throughout the machine during the feather picking process. Electric cords were pinched between the metal crank and the metal frame of this machine, and the insulation on the cords was pierced. As a result, an energized conductor was contacting the metal frame of the machine. Because the machine was turned off at the time, the workers were unaware of the condition of the cord. The first employee then moved between the two machines to begin the wash down. When he contacted the energized machine frame, he was electrocuted. His coworker received an electric shock when he tried to pull the first employee from the area. The second employee was hospitalized for his injury.

### Case Study 2

A sanitation worker at a poultry plant was cleaning out a chiller machine. The motor that powers the paddles inside the chiller was accidentally turned on by a coworker who was cleaning a different chiller. Neither the main power control nor the chiller control box had been locked or tagged out. The employee was struck by and caught between the rotating paddle blades and the interior wall of the chiller. He died of severe chest injuries approximately 28 hours after the accident.

Source: U.S. Department of Labor, Occupational Safety and Health Administration, *Poultry Processing Industry e-tool for Sanitation Workers*



# 1. Lockout/Tagout Procedures

Many times when workers remove guards or machine components to effectively clean or maintenance equipment they are exposed to hazardous energy from the machines.

In order to isolate the machine or equipment from its energy sources, lockout/tagout procedures are used.

Lockout/tagout procedures help ensure that a machine or equipment is disconnected from its energy source and will not operate while a worker is cleaning the machine.

Before a worker begins to clean a machine or equipment, steps must be taken to ensure that the machine or equipment is completely disconnected from its energy source and locked out tagged out.

Sometime, the machine or equipment must be re-energized for a limited period of time for testing or repositioning purposes. During the testing or positioning period, it is important to make sure other workers are protected from the machine or equipment's hazardous energy. Once the machine or equipment has been positioned, the equipment or machine must be disconnected and locked or tagged out before cleaning continues.

Source: U.S. Department of Labor, Occupational Safety and Health Administration, *Poultry Processing Industry e-tool for Sanitation Workers*



## 2. Cuts, Lacerations, and Amputations

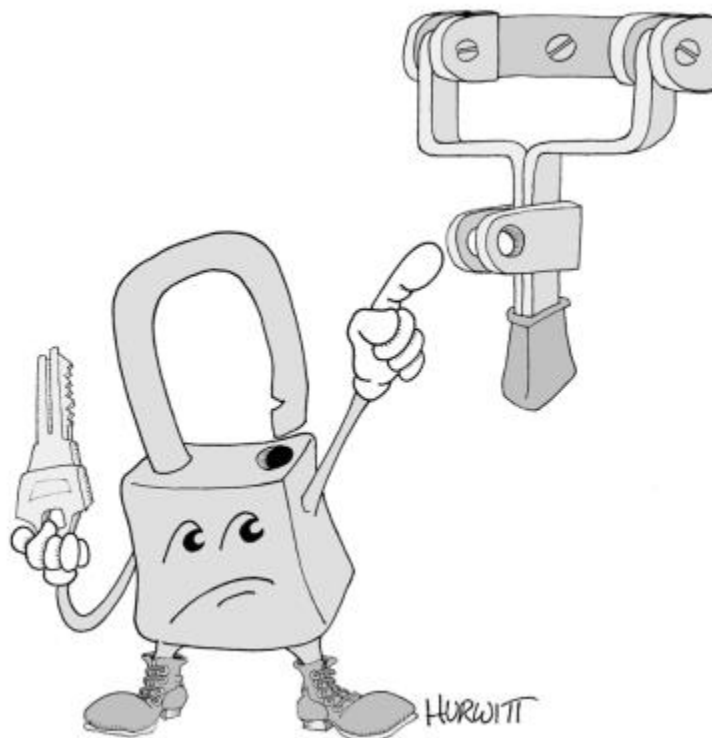
### Hazardous Situation:

As workers remove blades or other components from cutting equipment, they may receive cuts or lacerations. Any cut not treated at once will normally become infected as a result of working with poultry.

### Possible Solutions:

- Use equipment lockout/tagout procedures.
- Provide cut-resistant gloves to workers who remove blades from equipment.

Source: U.S. Department of Labor, Occupational Safety and Health Administration, *Poultry Processing Industry e-tool for Sanitation Workers*



### **3. Struck By, Struck Against and Caught In**

#### **Hazardous Situation:**

Workers cleaning or providing maintenance to powered equipment can get caught in the equipment if the motor is turned on. Serious injury or death can result.

#### **Possible Solutions:**

Use the following effective protection for minor cleaning or maintenance jobs that are routine, repetitive and performed as an essential part of the production process:

- Use energy control lockout/tagout procedures.
- Use interlocked barrier guards/gates.
- Use properly designed control switches or buttons that are placed in the open/off safe positions when the devices are under the exclusive control of the employee performing the task.
- Know the location and use of the control circuit devices.

Source: U.S. Department of Labor, Occupational Safety and Health Administration, *Poultry Processing Industry e-tool for Sanitation Workers*

## 4. Falls From Ladders or Equipment

### **Hazardous Situation:**

Workers climb on ladders or equipment to adequately reach all surfaces for cleaning and/or maintenance. Falls can result in fractures or contusions.

### **Possible Solutions:**

- Make sure platforms or portable ladders are the appropriate size and height for the job and in good condition.
- Do not climbing on equipment.

Source: U.S. Department of Labor, Occupational Safety and Health Administration, *Poultry Processing Industry e-tool for Sanitation Workers*

# 5. Electric Shock

## **Hazardous Situation:**

Workers may experience electrical shock from water contacting electrical connections or switch boxes or from improper reassembly of electric connections after disassembly for cleaning or maintenance.

## **Possible Solutions:**

- Lockout and tag the electric circuit when it is possible to do so.
- Use and maintain proper wiring and grounding.
- Make sure all electrical boxes are covered.
- Use equipment approved for wet locations.
- Inspect for worn or improperly maintained electrical fixtures and equipment.
- Source: U.S. Department of Labor, Occupational Safety and Health Administration, *Poultry Processing Industry e-tool for Sanitation Workers*

# Summary

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Workers who operate and maintain machinery suffer approximately 18,000 amputations, lacerations, crushing injuries, abrasions, and over 800 deaths per year. Amputation is one of the most severe and crippling types of injuries in the occupational workplace, and often results in permanent disability.

Machines can present several types of hazards including: rotating, reciprocating, transversing, cutting, pitching, shearing, and bending hazards.

OSHA requires employers to eliminate, substitute or use engineering controls to reduce hazardous conditions on the job.

Personal protective equipment (PPE) is the least effective way to control a hazard.

Machine guards are barriers which prevent access to machine danger areas.

Lockout/tagout procedures help ensure that a machine or equipment is disconnected from its energy source and will not operate while a worker is cleaning the machine.

Lockout/tagout procedures can help prevent a variety of injuries such as cuts, lacerations, amputations, electrical shock, getting stuck or caught in machinery or even death caused by hazardous situations.