CSHEMA

Campus Safety Health and
Environmental Management Association

Chemical Safety

Contact Chapman University EH&S
with any questions on university-specific practices

SAFETY
FIRST

Overview

- Chemical hazard classes
- Communication of hazards
- Routes of exposure
- Hierarchy of controls
- Special laboratory hazards

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Hazard Classes

- Hazardous chemicals will display one or more of the following characteristics:
  - Flammable
  - Reactive
  - Toxic
- They may also present unique danger

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Flammability / Explosive Risk

- Some chemicals present a fire or explosion hazard.
- These materials may be present in your lab in the form of a solid, liquid, or gas.
- Sources of ignition must be controlled or eliminated when working with flammable or explosive materials.
- Appropriate PPE can reduce injury in the event of a fire.

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Flammability / Explosive Risk

- Lab personnel should receive fire safety training.
- Training should include information on:
  - Communication (9-1-1)
  - Egress and evacuation
  - Use of fire extinguishers

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Reactivity

- Some chemicals react violently when exposed to other materials.
- “Other materials” might include lab chemicals, but may also include wood, plastic, or metal furnishings.
- Some chemicals react on contact with air and/or water.
- Energy is released rapidly and often unexpectedly.

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Reactivity *(Continued…)*

- Oxidizers are an important type of reactive material.
- Oxidizers are frequently corrosive.
- It is important to separate oxidizers from organics.
- Special reactive materials are discussed later.

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Toxicity

- Toxic substances cause injury to the body when we are exposed to them.
- The severity of injury or illness is dependent on a number of factors, but the most important factor is the dose.
- Dose is proportional to the amount of chemical in the environment and the duration of exposure.

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Toxicity *(Continued…)*

- The toxic effects of many chemicals are not well characterized.
- Carcinogens frequently do not have a “safe” level of exposure.

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Communication of Hazards

- Lab managers must ensure hazards are communicated to their personnel.
- Employees have a “right to know” the hazards in their work place.
- Communication takes many forms:
  - Formal classroom training
  - Hands-on training inside the lab
  - Continuous informal conversations
  - MSDS’s, signage, and labels

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Communication of Hazards *(Continued…)*

- A Chemical Hygiene Plan (CHP) needs to be in place in all labs.
- Emergency procedures are part of the CHP.
- MSDSs must be readily available to all personnel.
- Every container must have a label.

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Toxicology and Route of Exposure

- Toxic substances may enter the body through one of the following routes:
  - Inhalation
  - Ingestion
  - Skin absorption
  - Punctures
- Not all chemicals are toxic by all routes of exposure.

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Inhalation Hazards

- Inhalation (breathing) hazards consist of gases, vapors, and aerosols.
- Cylinders of toxic gas should be stored in ventilated gas cabinets.
- Even “inert” gases can displace oxygen and cause asphyxiation.
- Vapors start as liquids but readily evaporate and act like gases.

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Inhalation Hazards *(Continued…)*

- Aerosols are small particles that can be generated from chemical or mechanical processes.
- Regardless of the form, fume hoods are the best way to control exposures to inhalation hazards.
- Respirators should be used only when other means of control are not sufficient.

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Ingestion

- Ingestion can occur when contaminated hands touch the mouth.
- It is important to wear gloves in the lab and wash your hands after handling chemicals.
- It is important not to eat or drink in the lab.

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Skin Absorption

- Certain chemicals may be absorbed through your skin.
- Gloves and protective clothing are needed to prevent contact with these chemicals.
- Skin irritation can also be caused by contact with chemicals.

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Punctures

- Sharps can puncture the skin.
- Broken glassware, pipettes, and syringes are examples of sharps
- Contaminated sharps can deliver a chemical into the body.
- Use sharps containers to reduce exposure

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Hierarchy of Controls

- No matter the material, there should be controls to reduce the hazard to workers.
- These controls should be implemented based on their effectiveness and their feasibility.
- There is usually a trade-off between effectiveness and feasibility.
- When grouped in order of decreasing effectiveness, this list is known as the “hierarchy of controls”.

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Hierarchy of Controls *(Continued…)*

- Ranked from most effective to least effective, these measures are generally accepted as the hierarchy:
  - Elimination
  - Substitution
  - Engineering controls
  - Administrative controls
  - Personal protective equipment

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Hierarchy of Controls *(Continued…)*

- Elimination completely removes a hazard, but may also eliminate the work.
- Substitution involves using a less hazardous material.
- Either method is most likely to be successful if considered during design.

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Hierarchy of Controls *(Continued…)*

- Engineering controls usually involve changing the physical environment in which the hazard is located.
- Placing a hazardous process in a fume hood is a common engineering control.
- Enclosing the process or using other forms of local ventilation are other examples of engineering controls.

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Hierarchy of Controls *(Continued…)*

- Personal Protective Equipment (PPE) does nothing to reduce the hazard.
- Employees must know how to use PPE effectively.
- We must count on employees to use the PPE as directed.
- In the long-term, PPE is less cost effective.

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Hierarchy of Controls *(Continued…)*

- Administrative controls usually involve employee rotation and are not appropriate in most cases.
- Personal protective equipment (PPE) is usually the easiest control to implement, but is also the least effective.

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Special Hazards

- Some chemicals should be considered "special hazards" in the laboratory.
- These include OSHA's list of "particularly hazardous chemicals"
  - Select carcinogens
  - Reproductive agents
  - Materials exhibiting high degree of acute toxicity
- Labs using these materials may be required to follow specific OSHA guidelines.

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Special Hazards *(Continued…)*

- In addition to materials that are highly toxic, some materials present special physical hazards.
  - Pyrophoric agents ignite on contact with air
  - Water reactives may explode on contact with water or humidity
  - Peroxides and azides can be very unstable.
  - Cryogens can damage tissues and represent both an asphyxiation and explosion hazard

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