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Hazardous Waste Management

Office of Environmental Health and Safety

2016

Objectives

- To demonstrate the proper methods of laboratory hazardous waste management for compliance with state and federal regulations.
- To provide accident management and spill cleanup procedures.
- Comply with state and federal requiring employers to provide hazardous waste management training to employees

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Who Regulates Hazardous Waste?

- Environmental Protection Agency (EPA)
  - All aspects of hazardous waste
- Alabama Department of Environmental Management (ADEM)
  - Authority through EPA
- Department of Transportation
  - Transportation of hazardous waste
- Department of Homeland Security
  - Security threats associated with chemicals

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Resource Conservation and Recovery Act

- RCRA
- ADEM – Administrative Code Division 14
- Protect human health and the natural environment from the potential hazards of waste disposal.
- Reduce the amount of waste generated through reduction and recycling.
- Ensure the management of waste in an environmentally sound manner.

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Cradle to Grave

- Hazardous waste is regulated from the moment it is created through the time of final disposal.
- Generator is responsible for their waste forever.

Who is regulated by RCRA?

- Individuals who generate and accumulate wastes.
- All labs, studios, and shops that accumulate hazardous wastes are subject to unannounced inspections by Alabama Department of Environmental Management (ADEM) and/or EPA and can be fined.

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UAH Generator Responsibilities

- Proper identification of hazardous waste
- Proper management of hazardous waste including:
  - Use
  - Storage
  - Disposal

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Common EPA Violations

The 4 L's

- Lids – open containers or lids not screwed on tight.
- Leaks – Drips and evidence of spills on containers and lack of secondary containers
- Labels – improper or missing labels and identification
- Location – waste from multiple locations consolidated in one room

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The Cost of Violations

EPA and ADEM impose fines for non-compliance.

- Examples:
  - Boston University - $800,000
  - Penn State - $1 million
  - UC Berkeley - $1 million
  - Stanford University - $1 million
  - And unfortunately, UAH (2013) - $29,835

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So how do we keep that from happening again?

- Know what hazardous waste is.
- Minimize generation of hazardous waste.
- Know how to properly handle waste.
- Know how to label waste that you generate and where to keep it.
- Know the procedure for getting waste picked up.
- Know the spill response procedure.

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What is a hazardous waste?

- Waste that is dangerous or potentially harmful to our health or the environment.
- Hazardous Waste could be liquid, solid, gas, or sludge.
- Consider any chemical waste a potential hazardous waste.
- Other things to consider include discarded commercial products or by-products of manufacturing processes.
- Fluorescent bulbs, batteries, mercury containing devices and objects, and pesticides are part of a special category known as Universal Waste.

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How is waste classified?

- EPA divides hazardous waste into two categories:
  - Characteristic waste
  - Listed waste
    - F-list
    - K-list
    - P-list
    - U-list

Characteristic Waste

- Waste that exhibits one of these characteristics is hazardous waste:
  - Ignitable
  - Corrosive
  - Reactive
  - Toxic

  Sounds easy enough, right?

Ignitable Characteristic (D001)

- Waste is defined as Ignitable and labeled with D001 when it has one of these characteristics:
  - A liquid with a flash point below 60°C or 140°F
  - A non-liquid, which under standard conditions, is capable of causing fire through friction, absorption of moisture, or spontaneous chemical changes
  - An ignitable compressed gas
  - An oxidizer

Ignitable Waste

Examples of Ignitable Waste include: ethanol, sodium nitrate, hydrogen gas, xylene and acetone.

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Corrosive Characteristic (D002)

- Waste is defined as Corrosive and labeled with D002 when it has one of these characteristics:
  - The pH is less than 2(Coca-Cola ranges 2.3-3.5).
  - The pH is greater than 12.5
  - It can readily corrode or dissolve flesh, metal, or other materials. (This is determined by an EPA testing protocol.)

Corrosive Waste

Examples of Corrosive Waste Include: Hydrochloric Acid, Glacial Acetic Acid, Sodium Hydroxide

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Reactivity Characteristic (D003)

- Waste is defined as Reactive and labeled with D003 when it has one of these characteristics:
  - It can explode or violently react when exposed to water or under normal handling conditions.
  - It can create toxic fumes or gases when exposed to water or under normal handling conditions.

Reactivity Characteristic

Peroxide Formers and Time Sensitive Chemicals

- Some chemicals are stable initially, but if they are stored too long they become unstable.
- Peroxide formers are capable of producing organic peroxides and causing explosions under heat or friction.
- The unusual stability of this class of compounds make them a serious fire and explosion hazard.
- If you are moving into a new lab and find these chemicals, contact OEHS for removal immediately.

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Reactivity Characteristic

Peroxide Formers and Time Sensitive Chemicals

How should they be handled?

- New peroxide formers should be labeled with the date they were opened. If this happens regular testing can be performed to check for peroxides.
- If the chemical is expired or has passed the appropriate date for testing (see chart on next slide), DO NOT OPEN. Before testing, check visually for crystals. If crystals have formed, DO NOT OPEN.
- Call OEHS at #2171 to collect all expired or crystallized peroxide formers and time-sensitive chemicals.

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Reactivity Characteristic

Peroxide Formers and Time Sensitive Chemicals

Severe Peroxide Hazard on Storage with Exposure to Air *Discard within 3 months*	
Diisopropyl ether (isopropyl ether)	Potassium metal
Divinylacetylene (DVA)	Sodium amide (sodamide)
Potassium amide	Vinylidene chloride (1,1 dichloroethylene)
Peroxide Hazard on Concentration Do Not Distill or Evaporate Without First Testing for the Presence of Peroxides *Discard or test for peroxides after 6 months*	
Acetaldehyde diethyl acetal (acetal)	Ethylene glycol dimethyl ether (glyme)
Cumene (isopropylbenzene)	Ethylene glycol ether acetates
Cyclohexene	Ethylene glycol ether acetates
Cyclopentene	Furan
Decalin (decahydronaphthalene)	Methylacetylene
Diacetylene (butadiene)	Methylcyclopentane
Dicyclopentadiene	Methyl isobutyl ketone
Diethyl ether (ether)	Tetrahydrofuran (THF)
Diethylene glycol dimethyl ether (diglyme)	Tetralin (tetrahydronaphthalene)
Dioxane	Vinyl ethers
Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides	
Normal Liquids *Discard or test for peroxides after 6 months*	
Chloroprene (2-chloro-1,3-butadiene)	Vinyl acetate
Styrene	Vinylpyridine
Normal Gases *Discard after 12 months*	
Butadiene	Vinylacetylene (MVA)
Tetrafluoroethylene (TFE)	Vinyl chloride

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Reactive Waste

- Examples of Reactive Waste include: sodium metal, reactive sulfides, potassium cyanide, and picric acid.

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Toxic Characteristic (D004-D043)

- Waste is defined as Toxic is material that can be harmful or fatal if you are exposed and can pollute the groundwater if released on land.
- There are currently 40 contaminants on the list (D004-D043) that include certain heavy metals, pesticides, and organic compounds.
- Lead, cadmium, chloroform, and vinyl chloride are some of these substances.

Toxic Characteristic (D004-D043)

EPA HAZARDOUS WASTE CODES

Code	Waste description	Code	Waste description
D001	Ignitable waste	D023	o-Cresol
D002	Corrosive waste	D024	m-Cresol
D003	Reactive waste	D025	p-Cresol
D004	Arsenic	D026	Cresol
D005	Barium	D027	1,4-Dichlorobenzene
D006	Cadmium	D028	1,2-Dichloroethane
D007	Chromium	D029	1,1-Dichloroethylene
D008	Lead	D030	2,4-Dinitrotoluene
D009	Mercury	D031	Heptachlor (and its epoxide)
D010	Selenium	D032	Hexachlorobenzene
D011	Silver	D033	Hexachlorobutadiene
D012	Endrin(1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5,8-dimeth-ano-naphthalene)	D034	Hexachloroethane
		D035	Methyl ethyl ketone
D013	Lindane (1,2,3,4,5,6-hexa-chlorocyclohexane, gamma isomer)	D036	Nitrobenzene
		D037	Pentachlorophenol
D014	Methoxychlor (1,1,1-trichloro-2,2-bis [p-methoxyphenyl] ethane)	D038	Pyridine
		D039	Tetrachloroethylene
D015	Toxaphene (C_{10} H_{10} Cl_8, Technical chlorinated camphene, 67-69 percent chlorine)	D040	Trichlorethylene
		D041	2,4,5-Trichlorophenol
D016	2,4-D (2,4-Dichlorophenoxyacetic acid)	D042	2,4,6-Trichlorophenol
D017	2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid)	D043	Vinyl chloride
D018	Benzene		

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Listed and Acutely Toxic Waste

- In addition to characteristic wastes, EPA has four categories of Listed waste. This is exactly what it sounds like – a list of waste products that are considered hazardous and must be labeled by their listed code.
- You can find these in the RCRA regulations or by searching EPA's List of Lists.
- The List of Lists is a handy resource because it not only tells you if the chemical falls under RCRA, but also some other commonly applicable regulations for hazardous chemicals.

Listed and Acutely Toxic Waste

EPA-listed wastes:

- F-list: This list identifies wastes from common manufacturing and industrial processes, such as solvents that have been used in cleaning or degreasing operations.
- K-list (source specific wastes): This list includes certain wastes from specific industries, such as petroleum refining or pesticide manufacturing.
- P-list and U-list (discarded commercial chemical products). These lists include specific commercial chemical products in their unused form.
- P-listed wastes are considered acutely toxic and even their empty containers must be managed as hazardous waste.

Universal Waste

- Some hazardous waste falls under a sub-category called Universal Waste.
- These categories are identified in RCRA.
- The regulations governing these wastes are somewhat different because they can typically be recycled.
- Primarily at UAH, we collect the following types of Universal Waste:
  - Fluorescent and other mercury containing bulbs
  - Batteries
  - Thermostats and gauges
- If you have these types of waste or would like more information about proper disposal, please contact OEHS at x2171.

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Universal Waste

Improper Storage

Picture 24 - Storage Shed#4 – Three spent mercury bulbs on top of Non PCBs ballasts.

Picture 10 - Universal Waste Storage Shed#1 – Storage of open, unlabeled and not dated containers of spent alkaline, lithium and lead acid batteries

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Sharps Disposal

- Sharps containers for disposal of these items should be conveniently located and easily accessible in all work places where sharps are used.
- If your department does not have a contract with an outside service for collection of sharps containers, please contact OEHS for pick-up.

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Non-Hazardous Waste

- Materials that are not considered hazardous waste must be disposed as solid waste.
- Empty containers must have the labels defaced or removed.
- Paper products that are not saturated with hazardous materials and/or biomedical waste can be disposed as non-hazardous waste.
- Broken glass and pipettes must be placed in a broken glass rigid disposal container.
- This material should be disposed of with regular trash.

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Now that we know what hazardous waste is. . .

- Know what hazardous waste is.
- Minimize generation of hazardous waste.
- Know how to properly handle waste.
- Know how to label waste that you generate and where to keep it.
- Know the procedure for getting waste picked up.
- Know the spill response procedure.

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Minimization of Hazardous Waste

- Since elementary school, we've had the phrase drilled into our heads "Reduce! Reuse! Recycle!"
- One of RCRA's goals is to reduce the amount of waste generated through reduction and recycling.
- How can UAH apply this principle to hazardous waste?

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Reduce

- Practice the concept of Source Reduction by simply ordering the smallest quantity of chemical materials.
- Purchase mercury free instruments.
- Substitute non-hazardous chemicals whenever possible.
- Reduce the scale of laboratory experiments to reduce the volume of waste being produced whenever possible.

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Reuse

- Some solvents can be recovered and reused. For example, in the art department, mineral spirits is often filtered and reused.
- Sometimes a project ends and there are unused reagents or commercial products left over. These materials can often be redistributed within the university to areas that will be able to use them. Please contact OEHS if you have excess chemicals.
- If you need only a small quantity of a chemical for one-time use, you can check the SDS Online system to see if there are labs on campus that are already using that chemical. Please contact OEHS for assistance.

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Recycle

- In addition to other recycling efforts on campus, OEHS has programs in place to recycle fluorescent bulbs, batteries, and used oil.
- While these items may ultimately be recycled, they cannot be placed in the green bins around campus.
- Please contact OEHS at x2171 if you have these materials to be collected.
- Please contact the Sustainability Coordinator at X2545 if you have other recycling questions.

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Proper Waste Handling

- Know what hazardous waste is.
- Minimize generation of hazardous waste.
- Know how to properly handle waste.
- Know how to label waste that you generate and where to keep it.
- Know the procedure for getting waste picked up.
- Know the spill response procedure.

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Drain Policy and Waste Pickup

- No chemical wastes at UAH may be poured down the drain or placed in the trash.
- No matter what you've heard before, dilution is NOT the pollution solution.
- If in doubt, contact your supervisor or OEHS. OEHS makes the final determination of whether a waste is hazardous.
- All accumulated wastes should be treated as hazardous within the department.
- Contact OEHS at x2171 for waste pickup.

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Need more information?

- There are several ways to find out more about the hazards of your waste:
  - Consult your supervisor.
  - Consult the EPA Waste Lists.
  - Refer to the product's Safety Data Sheet.
  - Contact OEHS at #2171.

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Container Management

- Chemical waste must be stored in containers (including lids) composed of materials that are compatible with the waste.
- Chemical waste containers must be in good condition and free of leaks and residue on the outside of the container.
- Keep containers closed at all times except when adding or removing contents. **Evaporation of wastes is a violation**.
- For liquids, fill containers to about 90% of the container volume. Do NOT fill containers to the top. Leave at least 2 inches of space in liquid waste containers to allow for liquid expansion and decanting.

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Which container is compatible?

- Flammable liquids – original manufacturers or UL listed containers
- Concentrated acids or bases – original containers, or 2.5 Liter ‘acid’ safety bottles
- Solid waste – plastic high density polyethylene bottles
- Aqueous waste – glass bottles or HDPE plastic
- DON’T USE: Milk jugs, soda bottles, food containers, mason jars, para-film, open top beakers, containers with loose lids!

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Don’t mix the waste streams!

- Divide waste into separate streams
  - Acids
  - Bases
  - Oxidizers
  - Photographic Waste
  - Solids
  - Mercury
- Mixing a hazardous waste with a non-hazardous waste does not generally render it non-hazardous – it increases the volume of the hazardous waste. Do not mix!
- Never mix incompatible materials in the same container.
- Consult OEHS prior to mixing chemical wastes.

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Other rules for mixing. . .

- Solvents should be separated where possible as halogenated (chloroform and methylene chloride) and non-halogenated (propanol, methanol, and toluene).
- BUT this doesn't mean "Halogenated Solvents" and "Non-halogenated Solvents" are adequate labels for this waste. It must still be labeled with the individual components and percentages.
- Inorganic wastes containing barium, lead, and cadmium may be mixed together.

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Closing Chemical Waste Containers

- Chemical waste containers must be tightly closed to prevent leakage or spillage.
- Containers should be closed with a screw-type lid or other appropriate device.
- Plastic wrap, aluminum foil, para-film, and other temporary lids are unacceptable.
- A container holding chemical waste must ALWAYS be closed, except when waste is actually being added.
- If a waste container is used to collect waste from a continuous process (i.e., drainage from a process collected with tubing inserted into a bottle such as HPLC), the container must still be sealed using rubber stoppers with tubing inserts or other appropriate means. It is not acceptable to leave funnels in chemical waste containers. Secondary containment is required.

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Empty Containers of Acute Hazardous Waste

- Empty containers that contained acutely hazardous wastes are managed as hazardous wastes.
- If you are in doubt about whether the material was acutely hazardous, contact OEHS or place the container in the closed container in the satellite accumulation area and OEHS will make the determination.

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Other Empty Containers

- A container of non-acute hazardous waste, other than a pressurized cylinder is empty if:
  - All wastes have been removed that can be removed through manual pouring, and
  - IF the container is less than or equal to 119 gallons, no more than one inch of residue remains on the bottom of the container, or no more than 3 percent by weight of the total capacity of the container
  - IF the container is a compressed gas cylinder that contained hazardous material, it is empty when the pressure in the container approaches atmospheric pressure.

- Empty plastic and brown glass chemical containers may be rinsed with water and disposed of in a sealed box with trash. Caps must be removed and labels must be defaced and marked “EMPTY”.

You have selected the right container, now what?

- Know what hazardous waste is.
- Minimize generation of hazardous waste.
- Know how to properly handle waste.
- Know how to label waste that you generate and where to keep it.
- Know the procedure for getting waste picked up.
- Know the spill response procedure.

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Chemical Waste Labeling

- All chemical waste containers must have yellow chemical waste labels affixed on the bottle.
- These labels are available from OEHS.
- The label must contain the following information:
  - PI Name or Generator Name
  - Building
  - Room Number
  - Telephone Number
  - Exact contents of the container including components and percentages

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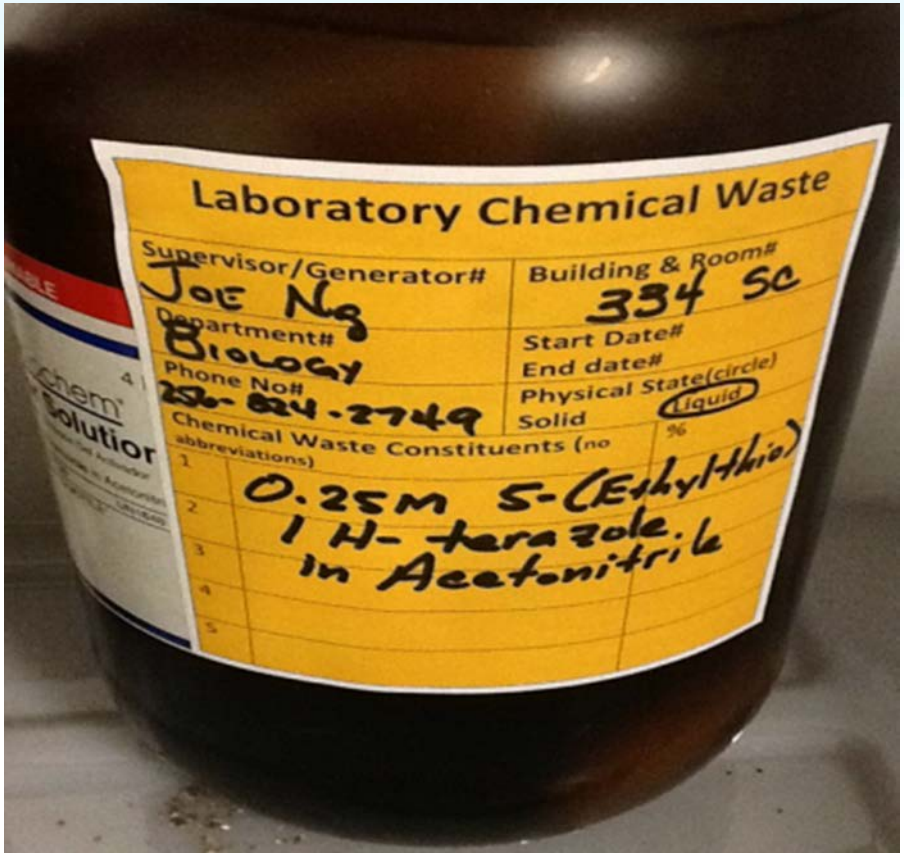
Yellow Waste Label Example



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Satellite Accumulation Area: SAA

- A specific area should be designated in the laboratory as a chemical waste storage area. The area must be marked with “Waste Storage Area” signage (available from OEHS).
- Waste must be stored in the room it was generated in and cannot be transferred to any area that requires passage through a door.
- Chemical waste must be stored with secondary containment so that spills cannot reach sinks or floor drains.
- Incompatible chemical wastes must be segregated to prevent reaction.

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Satellite Accumulation Area: SAA

- The SAA should be:
  - At or near the related work process
  - Under the control of the generator
  - Holding no more than 55 gallons of most chemicals or 1 quart of acutely hazardous chemicals
  - Organized by hazard: flammable, toxic, corrosive, reactive – these should be separated by containment or distance

Remember! Secondary Containers and Weekly Inspections are strongly recommended.

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Satellite Accumulation Area: SAA

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Satellite Accumulation Area: SAA Management

- Waste containers stored in a SAA must be:
  - In good condition
  - Compatible with the waste being stored
  - Kept closed at all times except when filling
  - Labeled with a yellow chemical waste label from OEHS
  - Stored inside secondary containment bins
- Original containers of unused materials do not need a waste label if the original label is clearly legible.
  - Waste must always remain in the lab
  - Never store waste in Public Areas such as hallways.

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Clean SAA

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You have selected the right container, now what?

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- Know the spill response procedure.

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Waste Pickup

- Each month OEHS contacts the laboratory personnel to let them know which building is scheduled for waste pickup. Pickups are usually scheduled for Friday afternoons.
- When you are contacted, please ensure all waste is labeled properly, complete the waste inventory form from uah.edu/oehs, and contact OEHS to let them know you want to be included in the pickup.
- If you need a waste pickup at a time other than your regularly scheduled month, please contact OEHS at x2171 or submit the waste inventory form via e-mail.
- There is no charge for a waste pickup.

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Waste Pickup – What Not to Do

- Don’t move the chemicals from the SAA. OEHS will pick them up directly from that location.
- Don’t leave open bottles in the hood to evaporate. OEHS will collect closed bottles.
- Don’t forget to label the contents. Waste disposal is free. Identification of unknowns may have a charge associated with classification before they can be transported per DOT regulations.

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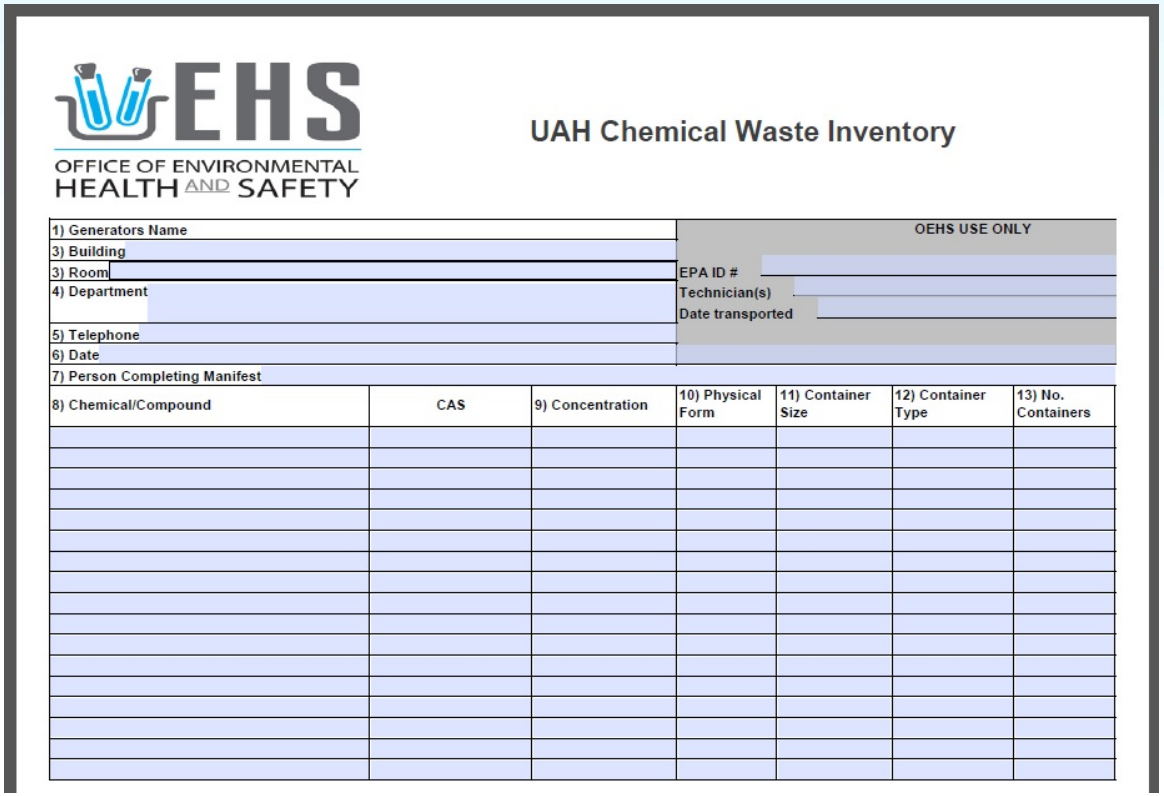
Waste Inventory Sheet



UEHS
OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY

UAH Chemical Waste Inventory

1) Generators Name	OEHS USE ONLY
3) Building	
3) Room	EPA ID #
4) Department	Technician(s)
	Date transported
5) Telephone	
6) Date	
7) Person Completing Manifest	

8) Chemical/Compound	CAS	9) Concentration	10) Physical Form	11) Container Size	12) Container Type	13) No. Containers

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Uh-oh! Now what?

- Know what hazardous waste is.
- Minimize generation of hazardous waste.
- Know how to properly handle waste.
- Know how to label waste that you generate and where to keep it.
- Know the procedure for getting waste picked up.
- Know the spill response procedure.

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Spill Clean-up

- When responding to a small chemical or hazardous waste spill,
  - Refer to the SDS for the material's hazards and potential to react with other materials.
- Contact OEHS for spill clean-up assistance when:
  - It is a large spill.
  - Spills involve extremely hazardous chemicals.
  - There is inadequate ventilation in the spill area.
  - Proper spill clean-up materials are not available.
  - Personnel involved are not comfortable cleaning up the spill.
  - The spilled chemical enters the drain, soil, or water body.

When Cleaning the Spill

- Consult the SDS and wear proper PPE prior to cleanup.
- Spread absorbent around and over liquid's surface.
- Collect wet absorbents and transfer them in plastic bucket or bag using dustpan and brush.
- Label the contents of bucket/bag using yellow waste tags.
- Call OEHS for waste pick-up.

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It’s okay to ask for help.

- Don’t hesitate to call OEHS if you are unsure about the cleanup procedure.
- Remember! It is almost impossible to put the toothpaste back in the tube.
- Asking questions before the cleanup may keep you safe and ultimately make the cleanup more efficient.
- If you think you’ve goofed in your cleanup, call OEHS as soon as possible. The sooner we begin corrective action, the less impact the mistake will have.

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Accident Management

- Dial 6911 from campus phones in emergencies.
- Call Office of Environmental Health and Safety
  - For assistance with spills that you are uncomfortable handling.
  - **To clean up mercury spills**.
- After hours or on weekends, call campus police who will contact OEHS.

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On-site Hazardous Materials Management

These additional steps can help you handle your waste more efficiently and make sure you are prepared for the unexpected:

- Annual review of chemicals
- Removal of surplus chemicals and chemical waste
- Evaluation of gas cylinders, unknowns, and potential explosives
- Laboratory and Stockroom Cleanouts

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Summary

- Containers must be in good condition
- Waste must be placed in a compatible container.
- Container must be clearly and legibly labeled with the yellow “Chemical Waste Label”.
- The label must be firmly attached to the container.
- Containers must be placed next to or near the process that generates the waste.
- Containers must be kept closed at all times except when adding or removing waste.
- Containers must be segregated by hazard class.
- Containers and SAA must be inspected at least weekly for leakage.

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Take Quiz

Thank you for your time and attention.

If you have questions or need assistance, please visit the OEHS website at uah.edu/oehs or call x6053.

Have a safe day!

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