Center for Drug Design
Departmental Safety Training
Topics

- University Health and Safety – new structure
- Safety Training – changes in links
- Proper use of fume hoods
- Moving chemicals safely through buildings
- TMS azide explosion – lessons learned
- Tools for proper Hazard analysis
Topics

- Radiation Safety - Non-User Training
- Biosafety - Biological Risk assessment
University Health and Safety

- Environmental Health and Safety
- Building Codes
- Department of Emergency Management
- Occupational Health and Safety
- Facilities Safety
- AVP Ken Kerns – 11/24/2014
2014 DEHS Training Update
Easier Access to Training Modules

- DEHS training can now be accessed by all users using the links on the DEHS website
- Change affects unpaid students, volunteers, and contractors
Easier Access to Training Modules
www.dehs.umn.edu
Easier Access to Training Modules

Click the Appropriate Red Box
Easier Access to Training Modules
Click the Title Link
Easier Access to Training Modules

- When the following screen appears, click “Yes” if you have a university ID or have previously created a self-registration account.
  - If you answered “Yes”:
    - Log in using your university ID. If you have a self-registration account, log in using the full email address you used to create the account.
  - If you answered “No”:
    - Fill in your name, email, and other required information to create your account.
    - When you register for additional courses, you will answer “Yes”.
Finding Training Records
New Resources Provided

View Your Training History

Employees
To view your training history in UMN Reports:
Type “Training History” in the Search Reports” bar to locate your report.

To view your training history in ULearn:
Log in to ULearn at http://www1.umn.edu/eb/learning/online.
Click on “View Your Transcript” under the “Learning” tab.
Click on the “Completed” tab.

Unpaid Students, Volunteers, and Contractors
To view your training transcript:
Log in to ULearn at http://www1.umn.edu/eb/learning/online.
Click on “View Your Transcript” under the “Learning” tab.
Click on the “Completed” tab.

To print your transcript:
Click on the “Printable Version” icon at the top right corner of the transcript.

Instructions for Instructors and Supervisors
To view the training transcripts of students in your class or workers in your lab:
Log in to ULearn at http://www1.umn.edu/eb/learning/online/
Follow the instructions found here.
Problems? Questions?

Cherie Lemer
612-626-7744
cmlemer@umn.edu
Safe Fume Hood Use
Proper Use of a Fume Hood

Ensure that the hood has a current inspection sticker (dated within the last year)

Velocity = ______ ______ ______ fpm

Date ______ / _______                Initials_________
Proper Use of a Fume Hood

Verify the hood is working before using

- Check the flow monitor (if present)
- Use a tissue to demonstrate flow into the hood
Proper Use of a Fume Hood

Conduct all work at least 6 inches inside the hood face

Bad

Better

Best
Proper Use of a Fume Hood

Close the sash(es) to the maximum position possible while still allowing comfortable working conditions.
Proper Use of a Fume Hood

DO NOT place equipment, materials or chemicals in the hood which block the slots or otherwise interfere with smooth hood airflow.
Proper Use of a Fume Hood

DO NOT remove sash panels or back baffles or modify the interior or exterior components of the hood
Proper Use of a Fume Hood

Labconoco
http://www.youtube.com/watch?v=q2Pp3wge2j8
Dartmouth
http://www.youtube.com/watch?v=GRQkI-t-hSg
UC Berkley
http://www.youtube.com/watch?v=A4AHxLnByts
Proper Use of a Fume Hood

If your fume hood is not operating correctly, report the issue immediately to Facilities Management by calling 624-2900
Topics

- General principles
- Situational awareness
- PPE or not PPE
- Carriers
- Handling
General Principles

- Must provide secondary containment
  - Ideally fully enclosed,
    - either original shipping box or
    - Fully enclosed bucket, jar or ziplock bag
General Principles

- use a cart
  - For # of carriers > 1
  - For volume > 4 L
Situational Awareness

- Doors
  - Can swing open unexpectedly
  - Can bang bottle or box out of hands, carrier or off cart
- corners
  - Can’t see people coming or object that wasn’t there yesterday
  - Speed around
Situational Awareness

- Elevators
  - Doors can bang shut
  - Bump at gap,
  - Freight vs people
  - Avoid going on with patients
Situational Awareness

- floor changes
  - Transitions (carpet to tile to linoleum)
  - Tiles junction bumps
PPE or not PPE

- Package & handle so PPE is not needed, but...
- Sometimes necessary and or prudent to bring with:
  - Gloves
  - Lab coat
  - Wipes?
Carriers

- Types & what to be aware of for each (Inspecting for integrity)
  - Buckets & carriers
    - Metal handle-
      - handle pops out,
      - bottle falls out
Carriers

- Types & what to be aware of for each (Inspecting for integrity)
  - Buckets & carriers
    - Rubber-
      - brittle fatigue failure from: age, light, chemicals
      - Bottle can fall out
Carriers

- Types & what to be aware of for each (Inspecting for integrity)
  - Buckets & carriers
    - Enclosed screw-top bucket-
      - handle can still come out
Handling - Smooth & Secure

- Picking up
  - 2-hands
Handling - Smooth & Secure

- Carrying
  - Jiggling, don’t have “loose” bottles in carrier
  - Swinging
  - Red cans safe carrying
Handling – red cans on carts

- Bottom is best
- Be aware that they can open up when put there
Carriers

- Types & what to be aware of for each (Inspecting for integrity)
  - Carts
    - Wider is better
    - Top vs bottom shelf
    - Lips edging containment
    - Metal vs rubbermaid
    - Wheel failure
Handling - Smooth & Secure - Carts

- Leaning on handle - tipping
Handling - Smooth & Secure - Carts

- Push vs Pull
Handling - Smooth & Secure - Carts

- Always balance your load
- Don’t make it too heavy
- Be aware of changing terrain
SMITH HALL CART SPILL
Smith Hall Spill

- Cart tipped over and 3 bottles of liquid hazardous waste broke during transport through the hallway near the elevator
- Building had to be evacuated
Why would this cart tip over?
What can be learned from this?

- Use sturdy carts
  - Wider wheel base is better
- Load heavy items on bottom shelf
- Make multiple trips instead of transporting a large quantity all at once
- Check the integrity of buckets and carts
- Use the buddy system
- When possible, use plastic bottles for liquid chemicals and waste
Thank You!

Sabine Fritz
Research Safety Specialist
fritz017@umn.edu
612-625-7227
Incident Overview

**When:** June 17th, 2014  
**Where:** Chemistry department, Smith Hall UMN  
**Who:** A 5th year graduate student in chemistry  
**What:** Detonation of a 200g synthesis of trimethylsilyl azide

Why did this happen and how can the lessons learned benefit you?
**Procedure – Synthesis of TMS Azide**

\[ \text{NaN}_3 + \text{TMSCl} \xrightarrow{\text{solvent}} \Delta \rightarrow \text{TMSN}_3 \]

- Basic procedure well established and peer-reviewed on preparative scale (100g of sodium azide)

Several modified versions have been examined in the literature

Reaction details: Overnight reflux followed by distillation of product
Reaction Details and Modifications

\[
\text{NaN}_3 + \text{TMSCI} \xrightarrow{\Delta \text{PEG 300}} \text{TMSN}_3
\]

- **Changes from literature**
  - **Solvent:** Changed for ease of final distillation
  - **Scale:** Twice the scale of most articles (200g production)
  - **Purity of reagents:** Newly purchased and not purified further

- **Production details**
  - Always heterogeneous – solid suspended in a liquid
  - Reaction occurs over ~12h
  - Final product is distilled to separate from byproducts and solvent
Documented “Warnings”

Warnings from synthetic procedures:

Caution! This reaction should be conducted behind a safety screen in a hood. If the system is not completely dry, the presence of toxic hydrazoic acid is probable.

Stability and Handling: All azides prepared including TMSA are thermally stable in usual handling. Most of them can be distilled at reduced pressure. The stability of these azides to shock are not ascertained exactly.

SDS for TMS-Azide:

<table>
<thead>
<tr>
<th>GHS Classification</th>
<th>NFPA Rating</th>
<th>Precautions for safe handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable liquids (Category 2)</td>
<td>Health hazard: 4</td>
<td>Avoid contact with skin and eyes</td>
</tr>
<tr>
<td>Acute toxicity, Oral (Category 3)</td>
<td>Fire: 3</td>
<td>Use explosion-proof equipment.</td>
</tr>
<tr>
<td>Acute toxicity, Inhalation (Category 3)</td>
<td>Reactivity Hazard: 0</td>
<td></td>
</tr>
<tr>
<td>Acute toxicity, Dermal (Category 3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Environmental Health & Safety
Explosion

I walked from my office through the lab to the hallway, noticed something was wrong, approached the hood and reached in to make an adjustment...then it went off...
Scene Pictures
Scene Pictures
Direct Causes and Factors

Likely causes (official cause unknown):
1. NaN₃ + PEG 300 (moisture?) to yield \textit{hydrazoic acid}
2. Overheating of NaN₃ \textit{colorless, volatile, toxic and explosive liquid}

Explosive decomposition of hydrazoic acid:

\[
2 \left[ \text{HN₃} \right] \rightarrow \text{H₂} + 3\text{N₂}
\]

Contributing factors:
Moisture, contaminants in the reagents, stirring, scale
Root Cause – Hazard Assessment

- Flawed Hazard Assessment:
  - Significant problems with identification and evaluation of the hazards in the procedure

- Unaddressed Hazards:
  - Scale
    - overwhelmed available controls
  - Unequal mixing
    - thick mixture, magnetic stirring not efficient
  - Purity and choice of reagents
    - used new but not purified
    - solvent substitution not vetted on large scale
Root Cause – Hazard Assessment

Risk of Hazard = severity x probability

- **Severity**: scale, inherent properties material
- **Probability**: experiment conditions
Hierarchy of Controls

- Elimination
- Substitution
- Engineering
- Warning
- Admin
- PPE

Order of application: First (Most effective) to Last (Least effective)
Hierarchy of Controls

- **Elimination**: Remove the hazard
  - Eliminate the procedure
  - Change your setup

- **Substitution**: Replace the hazard
  - Use a non-hazardous or less hazardous reagent
  - Use a milder route or process
Hierarchy of Controls

- **Engineering:** Change the process or equipment to reduce the hazard
  - Fume hood
  - Blast shield
  - Steel vessel

- **Warning:** Post signs warning of the danger
  - Sign in your area with details and contact information
  - External sign (room door, fridge door)
Hierarchy of Controls

- **Administrative:** Establish policies to reduce risk or limit exposure
  - Draft Standard Operating Procedures (SOPs) to detail correct procedures

- **Personal Protective Equipment:** Last line of defense (“seatbelt”)
  - safety goggles/glasses
  - lab coat
  - gloves
Hazard Analysis
Apply Lessons Learned

- **Hazard Analysis**
  - Limits synthesis
  - Add physical hazards
  - Training

- **Hazard Communication**
  - Warning relevant journals
  - Policy on group meetings
  - SOPs

- **Safety Culture**
  - Spread Awareness
Role-Specific Responses

- **PIs, Managers, Committees**
  - Set upper limits
  - Train on factors affecting probability & severity

- **Experiment Planners**
  - Design around primary reaction vessel
  - Discuss warning signs with researchers

- **Experiment Performers**
  - Follow group policies
  - Communicate with others, signage
  - Be Mindful
Resources and Contact Information

- Prudent Practices in the Laboratory
- ACS: Identifying and Evaluating Hazards in Research Laboratories
- UMN Environmental Health and Safety:
  
  **Sabine Fritz**  
  Research Safety Specialist  
  Phone: (612) 625-7227  
  E-mail: fritz017@umn.edu

  **Jodi Ogilvie**  
  Chemical Hygiene Officer  
  Phone: (612) 301-1214  
  E-mail: jogilvie@umn.edu
Radiation Safety
Annual Refresher Training

Radiation Protection Division
Department of Environmental Health & Safety
General Radiation Safety Information

Annual Background Radiation Dose
US Average: 300 mrem

- Radon – 200 mrem/yr
- Rocks & soil – 30 mrem/yr
- Human body – 40 mrem/yr
- Cosmic – 30 mrem/yr

U.S. Average: ~ 300 mrem/yr
Minnesota: ~ 300 mrem/yr
Colorado: ~ 400 mrem/yr
Dose Limit to Individual Members of the Public

Whole body (TEDE)* ..................
100 mrem/yr.
The dose to an individual in any unrestricted area from external sources shall not exceed 2 mrem in any one hour.

Occupational Dose Limits

Whole body (TEDE)* ..............
5,000 mrem/yr.
Extremity .......... 50,000 mrem/yr.

*TEDE: Total Effective Dose equivalent
Topics in Radiation Safety

- General requirements (posting, training, security)
  - Food and beverage prohibition
  - Proper attire, PPE
  - Contamination surveys and instrumentation
  - Radioisotope spills and emergencies
  - ALARA considerations
  - Other ___

- Permit holder responsibilities
- Radioisotope Purchasing and Transfer
- Radioactive waste management & disposal
- GM operation and survey protocol
- Record keeping
- Personnel monitoring
- Prenatal exposure guide
General Requirements

- Posted rooms are restricted areas.
- Training of staff is required.
  - Visitors must be escorted at all times.
- Material must be secured from unauthorized removal or access while in storage.
- Material must be kept under constant surveillance when not in storage.
Topics in Radiation Safety

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Topics in Radiation Safety

- General requirements (posting, training, security)
- Food and beverage prohibition
- **Proper attire, PPE (Lab Safety Plan)**
- Contamination surveys and instrumentation
- Radioisotope spills and emergencies
- ALARA considerations
- Other

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Topics in Radiation Safety

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Contamination Surveys

Lab staff are required to monitor and survey their own work stations, storage locations, etc., at specified frequencies.

The Radiation Protection Division periodically surveys all radioisotope laboratories.

Laboratory equipment must be free of contamination before being removed from the lab for disposal or repair.
Topics in Radiation Safety

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Spills and Emergencies

What is an emergency?

- Contamination on skin or clothes.
- Ingestion, absorption/puncture or inhalation of radioactive material.
- Spread of contamination outside the immediate workstation (floor, benchtop, fume hood, etc.).
- Contained spills that you are not comfortable assessing or cleaning alone.
- Unknown or unidentifiable liquid or residue near storage areas or radioactive waste containers.
Spills and Emergencies
What should you do?

1. Remain calm.
2. Let everyone know that you may have an incident.
3. Contact the Radiation Protection Division (RPD).
4. Everyone must remain in the area until RPD arrives to survey them.
Spills and Emergencies
How to contact the RPD

Monday – Friday, 8:00AM – 4:30PM:
612-626-6002

24 Hours A Day:
911

Remain in the area and wait for help to arrive.
Topics in Radiation Safety

- General requirements (posting, training, security)
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- **ALARA considerations**
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- Prenatal exposure guide
- Other ___
Radiation Exposure Control

**ALARA:**
- As Low As Reasonably Achievable

Exposure control, both internal & external

**Internal**
- Food and beverage prohibition
- Inhalation protection

**External**
- Time, distance & shielding
- Safe handling procedures
Topics in Radiation Safety

☑ General requirements (posting, training, security)
☑ Food and beverage prohibition
☑ Proper attire, PPE
☑ Contamination surveys and instrumentation
☑ Radioisotope spills and emergencies
☑ ALARA considerations

☑ Permit holder responsibilities
☑ Radioisotope Purchasing and Transfer
☑ Radioactive waste management & disposal
☑ GM operation and survey protocol
☑ Record keeping
☑ Personnel monitoring
☑ Prenatal exposure guide

Other
Topics in Radiation Safety

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- Other ___

Permit holder responsibilities

- Radioisotope Purchasing and Transfer
- Radioactive waste management & disposal
- GM operation and survey protocol
- Record keeping
- Personnel monitoring
- Prenatal exposure guide
Permit Holder Responsibilities

- Training of staff who have access to radioactive material labs or storage areas.
- Security of radioactive materials.
- Control of radioactive contamination.
Topics in Radiation Safety

- General requirements (posting, training, security)
- Food and beverage prohibition
- Proper attire, PPE
- Contamination surveys and instrumentation
- Radioisotope spills and emergencies
- ALARA considerations
- Other ___

- Permit holder responsibilities
  - Radioisotope Purchasing & Transfer
    - Radioactive waste management & disposal
    - GM operation and survey protocol
    - Record keeping
    - Personnel monitoring
    - Prenatal exposure guide
Radioisotope purchasing and transfer

All radioactive material must be acquired through the Radiation Protection Division

- Regular Orders
- Free or trial offers
- External transfer
- Internal transfers
<table>
<thead>
<tr>
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<tr>
<td>Other ___</td>
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</tbody>
</table>
Radioactive Waste

All I Really Need to Know I Learned in Kindergarten

Put things back where you found them.

Clean up your own mess.
Topics in Radiation Safety

- General requirements (posting, training, security)
- Food and beverage prohibition
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- ALARA considerations
- Other ___

- Permit holder responsibilities
- Radioisotope Purchasing and Transfer
- Radioactive waste management & disposal
- GM operation and survey protocol
- Record keeping
- Personnel monitoring
- Prenatal exposure guide
Surveys and Instruments

Reference Reading
Topics in Radiation Safety

- General requirements (posting, training, security)
- Food and beverage prohibition
- Proper attire, PPE
- Contamination surveys and instrumentation
- Radioisotope spills and emergencies
- ALARA considerations
- Permit holder responsibilities
- Radioisotope Purchasing and Transfer
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- GM operation and survey protocol
- Record keeping
- Personnel monitoring
- Prenatal exposure guide
- Other ___
Record Keeping Requirements

Training documentation
- New employee - on-line/lab
- Annual refresher training

Inventory of all material
- New stock vials
- Ongoing use of material
- Radioactive waste inventory

Contamination surveys
- Routine surveys
- Quarterly reports
- Counter printouts
Topics in Radiation Safety

- General requirements (posting, training, security)
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- Proper attire, PPE
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- Radioisotope spills and emergencies
- ALARA considerations

- Permit holder responsibilities
- Radioisotope Purchasing and Transfer
- Radioactive waste management & disposal
- GM operation and survey protocol
- Record keeping

- Personnel monitoring & Dosimetry

- Prenatal exposure guide

University of Minnesota
Environmental Health & Safety
Dosimetry

Requirements are in your radiation safety manual and at [www.dehs.umn.edu](http://www.dehs.umn.edu)

No external dosimeters are necessary (or even effective) for users of H-3, C-14, P-33, S-35 or Ca-45.

The only fee associated with the program is if badges or rings are not returned on time.
Topics in Radiation Safety

- General requirements (posting, training, security)
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- Proper attire, PPE
- Contamination surveys and instrumentation
- Radioisotope spills and emergencies
- ALARA considerations
- Other ___
- Permit holder responsibilities
- Radioisotope Purchasing and Transfer
- Radioactive waste management & disposal
- GM operation and survey protocol
- Record keeping
- Personnel monitoring

Prenatal exposure guide
If a woman chooses to declare her pregnancy, then certain conditions & requirements apply.

- Training Session
- Dosimetry service
- Separate Dose limit

INSTRUCTION CONCERNING PREGNATAL RADIATION EXPOSURE
Questions? Comments?

Don’t hesitate to call

6-6002

Radiation Protection Division
Department of Environmental Health & Safety
Biosafety at the U of M

Robin Tobias
Biosafety Specialist DEHS
tobia030@umn.edu
Overview

- Biological Risk Assessment
  - Biological/Biohazardous Agents
  - Risk Groups
- Biological Containment
- Oversight
- Resources
Risk Assessment

- Biological Agent – strain, route(s) of transmission, concentration, infectious dose, manipulations to agent
- Host – Experience, health status, PPE use, vaccination status (Animal, Plant or Human)
- Environment – Containment, work setting, regional issues (agriculture-centered, etc.)

All three must be considered in order to have a complete and effective risk assessment!
Biological Agents

**Biohazard:** An agent of biological origin that has the capacity to produce injurious effects on humans, animals or plants

- Recombinant DNA
- Viruses
- Bacteria
- Fungi
- Parasites
- Prions
- Blood and body fluids

****Some biological agents are NOT harmful (i.e. the bacteria cultures in your yogurt)****
Biohazardous Agents are classified into risk groups (RG) 1-4 based on their ability to cause disease and how easily the disease can be treated.

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Agent Risk Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG-1</td>
<td>Agents that are not associated with disease in healthy adult humans</td>
<td><em>Bacillus subtilis</em>, <em>Escherichia coli</em> K12, adeno-associated virus (AAV)</td>
</tr>
<tr>
<td>RG-2</td>
<td>Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are often available</td>
<td><em>Staphylococcus aureus</em>, <em>Salmonella</em> sp, Herpes simplex viruses, Adenovirus</td>
</tr>
<tr>
<td>RG-3</td>
<td>Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions may be available</td>
<td><em>Mycobacterium tuberculosis</em>, <em>Bacillus anthracis</em>, HIV</td>
</tr>
<tr>
<td>RG-4</td>
<td>Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available</td>
<td><em>Ebola virus</em>, <em>Marburg virus</em>, <em>Lassa virus</em></td>
</tr>
</tbody>
</table>
There are 4 levels of containment in biosafety, often abbreviated BSL-1, BSL-2, BSL-3 or BSL-4.

- Each biosafety level has its own specific containment controls that are required for the following:
  - Laboratory practices
  - Safety equipment
  - Facility construction
  - BMBL 5th Edition

Biosafety Levels are **NOT** the same as risk groups.
Biosafety Level 1 (BSL-1)
Biosafety Level 1 (BSL-1)

Same rules as a chemical lab with a few additional items:

- **Standard Microbial Practices**
- Biohazard sign must be posted on the door to the laboratory
- There must be a decontamination protocol for the lab
- Biological agents must be disposed in biohazardous waste (red bags) or autoclaved.
Biosafety Level 2 (BSL-2)
Biosafety Level 2 (BSL-2)

Same rules as a chemical lab and a BSL-1 lab with some additional requirements:

- Biosafety Cabinets (BSCs) for work with agents
- Secondary containment or time protocol for centrifugation of biological materials
- Vacuum lines protected with an in line HEPA filter
- Appropriate PPE for the lab protocols
- Secured access to the laboratory
- Covered, leak-proof, labeled waste containers
- Appropriate laboratory design and components
Biosafety Level 3 (BSL-3)
Biosafety Level 4 (BSL-4)
Oversight

- Institutional Biosafety Committee (IBC)
- DEHS
- Biosafety Level 3 Program
- US Center for Disease Control (CDC)
- National Institutes of Health (NIH)

When in doubt, contact the IBC or DEHS!!!
Questions?