



Laboratory Safety

Albany NanoTech Complex (ANC)

EHS Policy Statement

- NY CREATES is committed to:
 - Protecting the health and safety of its employees, partners, customers and public
 - Protecting the environment
 - Complying with regulatory standards

Lab User Responsibilities

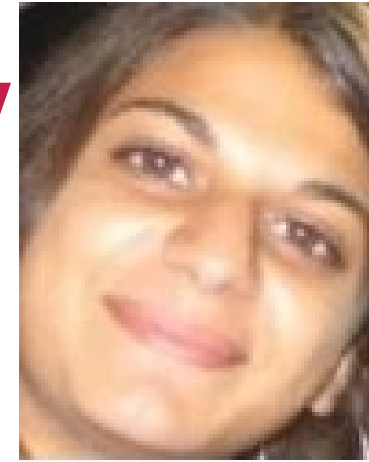
- All individuals are responsible for safety at ANC
- Take an active role in your safety and the safety of others
- Plan and perform tasks in a safe manner
- Follow NY CREATES and UAlbany (if applicable) safety policies and procedures
- Understand the potential hazards you may be exposed to
- Contact your manager if you feel you need additional safety training

Hazards in Laboratories

- Fires or Explosions
- Chemicals Spills or Releases
- Electrical/Mechanical
- Biological Agents
- Radiation
- Exposure to hazardous materials via:
 - Inhalation
 - Skin absorption
 - Injection
 - Ingestion



Case Study: UCLA Fatality



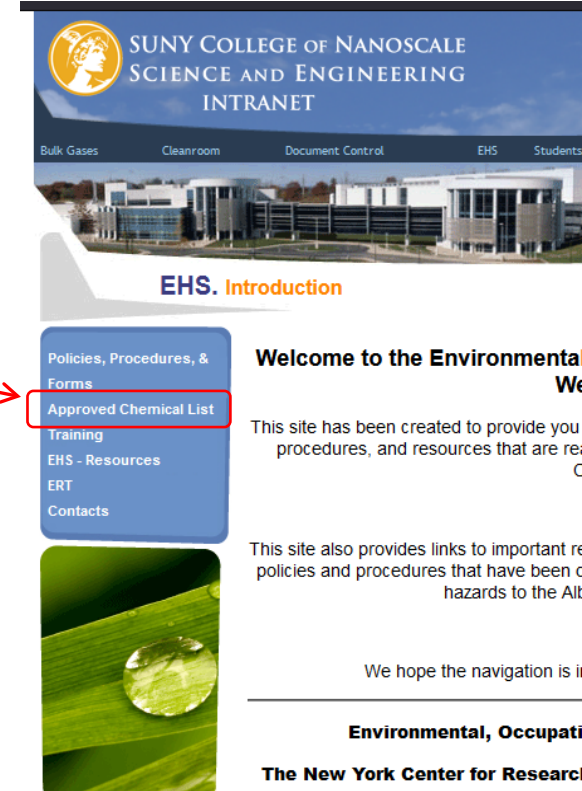
UCLA Fined for Fatal Lab Explosion

Untrained young aide also lacked protective gear, OSHA finds

- Sheri Sanghi
- UCLA Research Associate
- On Dec. 29, 2008, was working with a pyrophoric chemical
- The material spilled and ignited
- She received 3rd degree burns to 50% of her body
 - She was not wearing a lab coat
 - Her polyester sweater burst into flames
 - Coworker didn't bring her to the safety shower
 - Sheri died 18 days later
- Sheri was not told she had to wear a lab coat (flame resistant)

Obtaining Chemicals

- Approved Chemical List
 - On EHS Intranet Site
 - Use the HazMin Database
- Chemical Approval Process
 - Must obtain an SDS (Safety Data Sheet)
 - Fill out HazMin request form and submit with SDS to EHS
 - If material is hazardous may require that an SOP be developed
 - Once approved, you can order the chemical

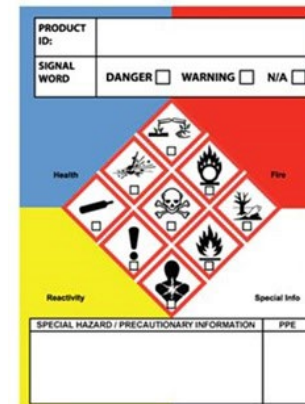


Safety Data Sheets (SDSs)

- SDSs contain safety information including:
 - Physical/chemical properties (pH, flash point, etc.)
 - Toxicity and incompatibility data
 - Storage and shipping requirements
 - Required PPE
 - Emergency response procedures
 - NFPA Codes
 - GHS pictograms

Chemical Labels

- Chemicals from suppliers must be labeled
- Do not remove or deface mfg. labels
- Secondary containers must be labeled with chemical name and hazard warning
- May use: NFPA or GHS label



Chemical Hygiene Plan (CHP)

- EHS-00082 Policy for Chemical Hygiene Plan
- Complies with OSHA 29CFR1910.1450 – available on Intranet
- Guidance on storage and handling of chemicals in laboratories
- If rated 3 or greater in NFPA, the material is a HPM (Hazardous Process Material) and may require a lab specific SOP (Standard Operating Procedure)

Good Laboratory Practice

- Engineering Controls: Chemical Fume Hoods
 - Use for handling hazardous chemicals
 - Check that it has a current annual air flow test label
 - Work at least 6" in from the edge of the hood
 - Keep head/body outside of hood
 - Lower sash when working in hood; keep down throughout work
 - Do not clutter
 - When used correctly and maintained, excellent control for removing hazardous air contaminants.
 - Reminder PPE is still required when using hoods.



Bad Hood!

Good Laboratory Practice

- Engineering Controls: Other Controls
 - Biological Safety Cabinet (BSC)
 - Sterile environment for biologicals, not for chemicals
 - Filters air, not for volatile chemicals
 - Gas Cabinet
 - Ventilated enclosure for hazardous compressed gases
 - Glovebox or Glovebag
 - Inert environment for pyrophoric or water-reactive chemicals
 - Inerting atmospheres
 - For pyrophoric or water-reactive chemicals
 - Interlocks
 - Face shield, goggles
- All of these work by keeping a barrier between you and the hazardous material!

Good Laboratory Practice

- Storage of Chemicals:
 - Use the least hazardous material possible
 - Do not stockpile chemicals, use small quantities
 - Keep closed/covered when not in use
 - Proper storage of chemicals
 - Store (and segregate) by hazard classification
 - Flammables – Flammable Storage cabinet or fridge
 - Corrosives – Acid/Base Storage cabinet
 - Oxidizers – away from flammables
 - Check SDS for storage requirements, i.e., temperature, light
 - 1st in, 1st out – use oldest chemicals first



Good Laboratory Practice

- Transferring Chemicals:
 - Use appropriate PPE: gloves, safety glasses, arm guards, apron, face shield
 - Use local exhaust ventilation (hood, snorkel)
 - Keep away from ignition sources - flammable substances
 - If mixing solutions - ensure that the chemicals are compatible and proper mixing protocols are established
- Transporting Chemicals:
 - Use cart and/or secondary containment (bottle carriers)



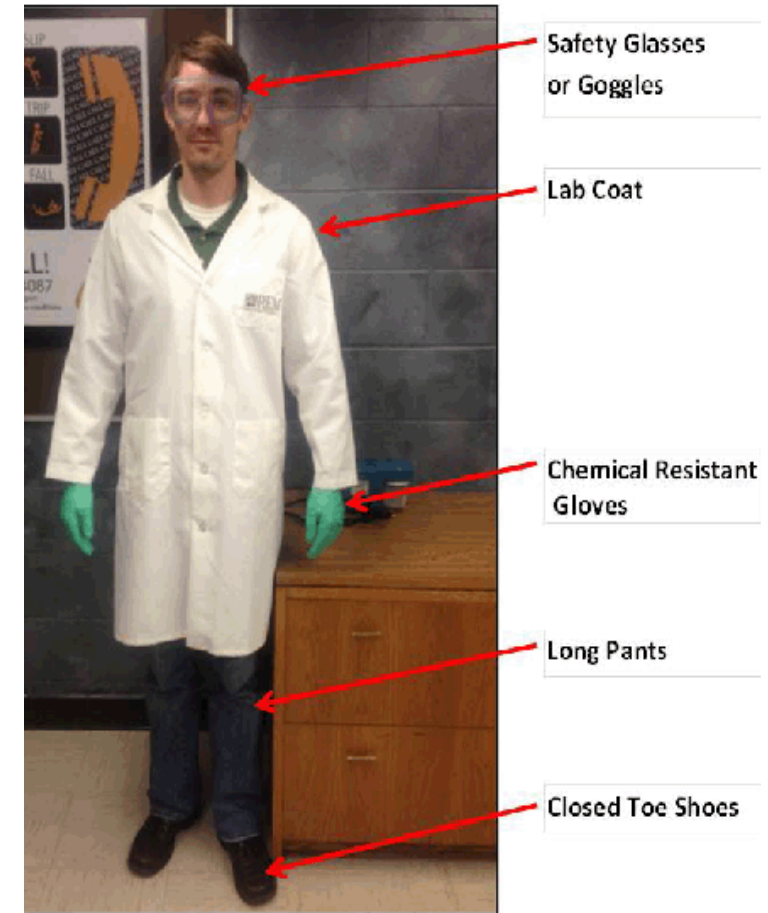
Good Laboratory Practices

- Compressed Gases:
 - Secure in an upright position, strap or chain about 2/3 up from bottom of cylinder
 - Protect from damage or tipping
 - If not in use, protective cap over neck
 - Use status tag to indicate: Full, In Use, or Empty
 - Contact AcademicESG@sunypoly.edu to remove when empty
 - Do not store/use incompatible gases next to each other



Good Laboratory Practice

- Personal Protective Equipment (PPE):
 - Required Laboratory PPE:
 - Lab Coat* and Eye & Face Protection*
(*When handling or immediately adjacent to someone handling chemicals)
 - Gloves (Minimum of chemical resistant gloves)
 - Closed toe and heel shoes
 - Additional PPE required based upon task:
 - Face shield and/or goggles
 - Apron, arm covers
 - Flame resistant lab coat
 - Chemical gloves (i.e., TRIonics)
- Always check PPE prior to use!

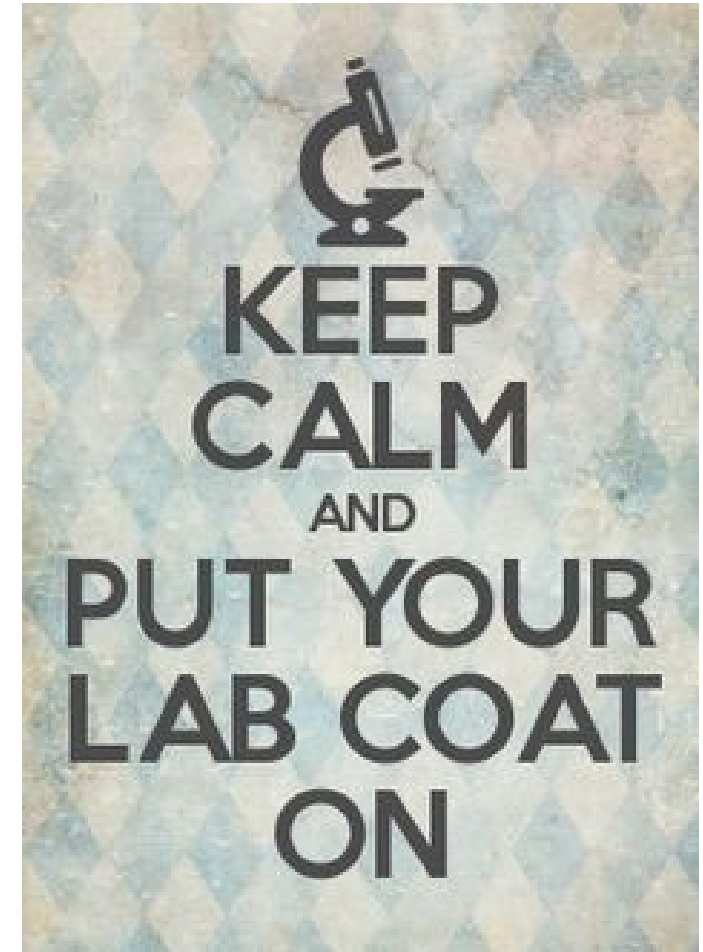


PPE - Eye and Face Protection

- Personal Protective Equipment (PPE):
 - Eye and Face Protection
 - Eye protection (e.g., safety glasses, goggles) and face protection (e.g., face shield) is required to be worn in posted areas and during tasks that create eye and/or face hazards.
 - Safety glasses with side shields are required to be worn to protect the eyes from flying particles, objects, chips, etc.
 - Goggles are required to be worn to protect the eyes from corrosive chemical (e.g., acid, base) splash hazards, dust hazards, etc.
 - Under face shields, safety glasses with side shields or goggles must also be worn depending on the type of hazard.
 - Although safety glasses must always be worn in laboratories, the following tasks are considered exempt from the safety glasses requirement. The intention of these exemptions is to permit those that are performing such tasks to temporarily allow them to remove their safety glasses:
 - In research or teaching labs while: working in front of a computer terminal (providing there is no eye hazard), chemical, and/or infectious material contact or exposure.
- Always check PPE prior to use!

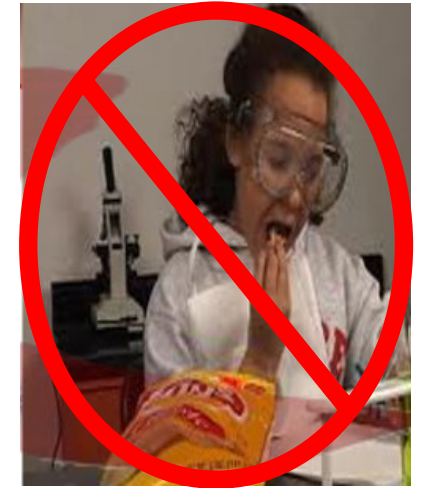
Good Laboratory Practice

- Why wear a lab coat?
 - If splashed, can quickly remove lab coat
 - Removing outer layer of clothing reduces chemical contamination by ~80%
 - Protects your clothing from destructive chemicals (dyes, corrosives)



Good Laboratory Practice

- Housekeeping and Hygiene:
 - Keep a clean work area
 - No eating or drinking in lab
 - Clean up incidental spills
 - Use disposable spill pads or trays to contain spilled material
- Clean surfaces with:
 - Water
 - 70% Ethanol (in BSC)
 - 10% Bleach



Good Laboratory Practice

- Housekeeping and Hygiene:

- Hand hygiene
- Design experiments to limit touching chemicals
- Change nitrile gloves frequently, especially if chemicals contact gloves
- Nitrile are for incidental contact, not direct contact
- Wash hands when changing gloves
- Prevents unintentional ingestion or skin contamination
- Prevents disease transmission (i.e., cold & flu)!



Emergency Procedures

- Any lab emergency
 - Evacuate lab (if necessary)
 - Call Security at (518) 437-8600
 - Wait for ERTs to respond
 - Panic Button in NFE labs
- Fire: RACE
 - Rescue – Get yourself and others out of danger
 - Alarm – Activate fire alarm, pull station by exit doors
 - Contain – Close doors to room or area on fire
 - Evacuate – Go to rally point



Emergency Procedures

- Chemical Splash
 - Call Security and request ERT assistance
- If a person has chemical on them:
 - Assist them to the shower/eyewash
 - Remove contaminated clothing
 - Wash for a minimum of 15 minutes
- ERTs will respond and provide first aid and arrange for transport to hospital

Did You Know:

Showers/ eyewashes
must be within a 10
second walk!!



Emergency Procedures

- Chemical Spill – Significant:
 - Significant ≥ 1 pint or highly hazardous material
 - Call Security (518) 437-8600
 - Determine if anyone needs assistance
 - Barricade area & alert others in the area
 - Wait for ERTs and Security in a safe area
 - Provide additional information
 - Get SDS if able



Emergency Procedures

- Chemical Spill – Small
 - < 1 pint (500 mL) of a known substance.
 - Leave the container where it falls.
 - Do not attempt to handle the material or container with bare hands.
 - Alert room occupants of the spill.
 - If material is flammable, turn off ignition sources.
 - Have needed equipment and PPE; review SDS if necessary.
 - Collect all contaminated material and place in waste container.
 - Label waste container and put in satellite accumulation area.
- If unsure – Call Security!!

Waste Disposal

- No waste goes down the drain or in the trash
- All labs have a designated SAA (Satellite Accumulation Area) for waste
- Contact EHS with any disposal questions: sunypolyehs@sunypoly.edu
- Hazardous Waste:
 - Meets one of the following characteristics:
 - Ignitable (FP < 140°F)
 - Corrosive (pH < 2 or > 12.5)
 - Reactive (H2O reactive, oxidizer, pyrophoric)
 - Toxic

Hazardous Waste

- Labeling:
 - Hazardous waste must be labeled as described below.
 - NAME of person responsible for generating waste and their department.
 - START DATE: the date you first put waste into the container.
 - FILL DATE: the date you place the full container in the satellite accumulation area.
 - CONTENTS: The type of waste that was generated – boxes must be checked to include the following:
 - Type: SOLID or LIQUID or MIXED
 - Hazard: IGNITABLE/FLAMMABLE, CORROSIVE, TOXIC or REACTIVE
 - Name of the ingredient that makes the waste hazardous

HAZARDOUS WASTE

ACCUMULATION (Check box if satellite ☐)

☐ Solid Waste ☐ Liquid Waste ☐ Mixed Waste

☐ Ignitable (Flashpoint < 140°F)

☐ Reactive ☐ Toxic

☐ Corrosive (pH < 2.0) or (pH > 12.5)

Start Date: Fill Date:

Container Name: Department/Building/Tenant:

Chemical/Inertials (product name or major chemical component):

HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

Other Waste

- Non-Hazardous Waste:
 - Doesn't meet the EPA criteria for Hazardous Waste
 - Do not pour down drain or put in trash
 - Label with "Non-Haz" Label and put in SAA
- Universal Waste:
 - Batteries, lamps, & mercury-containing devices ONLY
 - Label and put in SAA
 - Indicate type of items (i.e., lamps) and date



Satellite Accumulation Area

- ALL WASTE IS PLACED IN THE SAA
- Use separate bins to contain waste types (i.e., acids, bases, solvents)
- Signage is posted at the SAA on what chemicals are compatible and can be mixed
- Store only in designated area, do not mix with stock chemicals

Hazardous Chemicals

- Chemicals of Concern:
(commonly used in labs)

- Flammables
- Corrosives
- Oxidizers
- Water Reactive
- Pyrophorics
- Peroxide formers
- Toxics
- Nanomaterials



- Specific Chemicals:
(examples in labs)

- Arsenic
- Formaldehyde
- Methylene chloride
- Mercury
- Sodium azide
- HF (hydrogen fluoride)
- Perchloric acid
- Chloroform
- TMAH (Tetramethylammonium hydroxide)

Work Alone Policy - EHS-00045

- Whenever possible – have 2 or more people in the lab when working with chemicals
- A “Buddy” is required when working with highly hazardous materials, such as: (partial list)
 - TMAH, HF, Pyrophoric chemicals
- “Buddy” is to call Security and assist worker in case of emergency
- PI will determine when a “Buddy” is needed
- Lab Access:
 - Normal lab access in 7AM – 9PM
 - For extended access PI must submit request to Access Control (ANT-00001-F1)

Flammables



- Based upon Flash Point (on SDS)
- Keep away from ignition sources
- Flammable liquids must be stored separately from strong oxidizers, shielded from direct sunlight, and away from heat sources
- Approved Storage Locations:
 - Explosion proof refrigerators. Label as follows:
 - FOR CHEMICAL STORAGE ONLY
 - DO NOT STORE FOOD OR BEVERAGES IN THIS REFRIGERATOR
 - Flammable liquid storage cabinet:
 - Must be self-closing and grounded
 - Conspicuously labeled:
 - “FLAMMABLE – KEEP FIRE AWAY”.



Pyrophoric or Water Reactive Chemicals



- A pyrophoric substance will ignite in air at or below 130°F.
- Water Reactive materials react exothermically with water, and may produce hazardous gases such as HCl, hydrogen.
- Examples include silane, phosphorus, tributylaluminum, lithium compounds
 - Wear flame retardant lab coat when handling
 - Store under an atmosphere of inert gas
 - Handle in a nitrogen purged environment (glovebox or other containment)
 - Use inerting apparatus in a fume hood
 - PI will provide additional training
 - There are specific policies on receipt and transfer of pyrophoric materials

Corrosives



- Determined by pH (see SDS)
- Corrosives are destructive to human tissue
- Severity of damage depends on concentration of corrosive
- Severe exposure may cause permanent damage
- Wear gloves when handling corrosives
- FIRST AID – Flush a minimum of 15 minutes
- AAA – Always Add Acid to water
- Corrosive Storage:
 - Acids and bases must be segregated. If stored in the same cabinet, use separate plastic trays, tubs, or buckets.
 - Store below eye level.



Hydrofluoric Acid (HF)



- Causes deep, painful, slow-healing burns
- Burns may not be apparent for up to 24 hr.
- Fluoride ion destroys soft tissue & decalcifies bone
- Call Security if exposures occur (518) 437-8600
- ERTs have calcium gluconate to treat skin contact

Day 1



Day 6



Day 12



90 Days



Tetramethylammonium Hydroxide (TMAH)



- Causes injury or death from skin contact at or above 1% TMAH in water.
- On-site uses of TMAH at < 1-25%
- Required PPE:
 - Chemical resistant gloves, face shield, apron, arm sleeves, goggles
- Highly toxic and fast acting
- Call security immediately (518) 437-8600
- Signs and symptoms
 - 2nd to 3rd degree burns of skin
 - Irregular breathing and heartbeat
 - Progressing to coma, shock and, in most cases, death

Peroxide Formers

- Common peroxides formers include THF, ethyl ether & dioxanes.
- Form (crystals) upon exposure to air and light.
- Must be disposed after 1 year.
- Labels on containers must include:
 - The date of receipt: (MM/DD/YY)
 - The date opened: (MM/DD/YY)
 - Responsible employee: (Owner of the material)
 - “Peroxide Former” or “Peroxidizable”
- Classes of peroxide formers.

Class A	Class B	Class C
Forms explosive levels of peroxides without concentration	Forms explosive levels of peroxides on concentration	May autopolymerize as result of minor peroxide accumulation



Oxidizers



- Includes Perchloric Acid, Hydrogen Peroxide, and Silver Nitrate
- Initiate or promote combustion of materials
 - Release oxygen
 - Keep away from flammable/combustible materials
 - Allow for venting of vessels – pressurization hazard
- For Perchloric Acid
 - Can NOT be kept for more than 1 year or explosive crystals can form- date bottle upon receipt
 - Bottle Dating: receipt, opened and disposal date
 - Discolored perchloric acid - Call Security at 518-437-8600

Toxics

- Able to cause disease, illness, or death.
- Includes:
 - Carcinogens
 - Mutagens
 - Organ Toxicity
 - Sensitizers
 - Reproductive Toxins
 - Teratogens
- Everything can be toxic!
 - The dose makes the poison

Health Hazard
Carcinogen



Skull & Crossbones
Acute Toxicity



Exclamation Mark
Irritants

Indicators of Toxicity

- Levels at which 50% of lab animals expired:
 - LD50 – Lethal Dose 50%
 - LC50 – Lethal Concentration 50%
- Exposure Limits:
 - PEL – Permissible Exposure limit
 - TLV – Threshold Limit Value
 - STEL – Short term exposure limit
 - TWA – Time Weighted average
 - C – Ceiling
- The lower the number, the more toxic!!
- If you have questions, contact EHS.

Heavy Metals

- Arsenic (Arsine):
 - Must receive additional arsenic training annually. EHS-00052 Arsenic Protection Program
 - Lung Cancer
 - Can cause nausea and vomiting, decreased production blood cells, abnormal heart rhythm, damage to blood vessels & “pins and needles” sensation in hands and feet.
- Mercury:
 - Permanently damage the brain, kidneys, and developing fetuses.
 - May result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.
 - Short-term exposure may cause lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.
- Lead:
 - Damages the brain and kidneys, ultimately causes death.
 - In pregnant women, high exposure to lead may cause miscarriage.
 - In men, can damage the organs responsible for sperm production.
- Chromate (hexavalent chrome):
 - Known human carcinogen.
 - can cause damage to liver, kidney, circulatory and nerve tissues, as well as skin irritation.
- Cadmium:
 - Severely irritates the stomach (vomiting and diarrhea).
 - Chronic: buildup in the kidneys and possible kidney disease, lung damage, and fragile bones.



Chlorinated Solvents:



- Includes Chloroform and Methylene Chloride (MC)
 - Causes dizziness, fatigue, headache, & nausea
 - Irritating to skin and eyes - chloracne
 - Possible human carcinogen
 - Not combustible, but if burned can create toxic gases (HCl and phosgene)
 - Poor warning properties
-
- MC: OSHA PEL = 25 ppm, TLV = 10 ppm, odor threshold = 135 ppm
 - Chloroform: OSHA PEL = 50 ppm, TLV = 25 ppm, odor threshold = 150 ppm

Other Commonly Used Toxics

- Formaldehyde & Formalin
 - Highly irritating gas (dissolved in water)
 - Human carcinogen (throat)
 - OSHA limit of 0.75 ppm PEL & 2 ppm STEL
- Sodium Azide
 - Highly toxic – affects CNS and brain
 - In water, forms hydrazoic acid – inhalation hazard
 - Explosion hazard (reaction with CH_2Cl_2)
- Ethidium Bromide
 - Strong mutagen
 - Irritant
- Phenol
 - Very toxic by skin absorption (fatal)
 - Damage to CNS, liver, and kidneys
 - Causes severe burns – may not be felt immediately



It sounds like a possible culprit may have been hydrazoic acid.

Piranha



- Also known as SPM (Sulfuric Peroxide Mix)
- Piranha is a solution of sulfuric acid and hydrogen peroxide used for cleaning wafers
- Piranha is corrosive
 - Required PPE: acid gloves, face shield, goggles, sleeves/apron, or impermeable coat
- Reaction is exothermic
- Disposal requirements:
 - Cool solution for at least 1 hour
 - Put in a high-density plastic jug with vented cap.
 - Haz Waste Label: corrosive & reactive

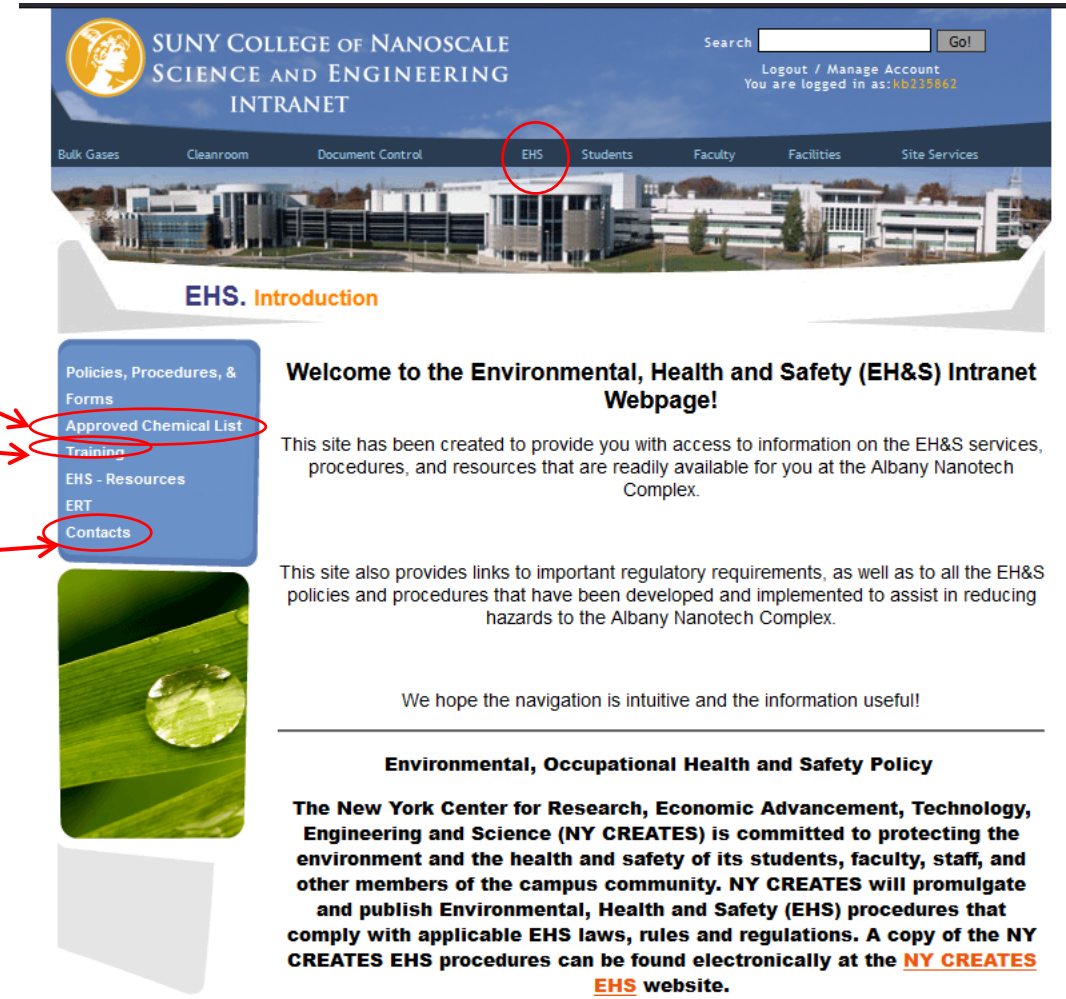
HAZARDOUS WASTE	
ACCUMULATION (Check box if satellite <input type="checkbox"/>)	
<input type="checkbox"/> Solid Waste	<input checked="" type="checkbox"/> Liquid Waste <input type="checkbox"/> Mixed Waste
<input checked="" type="checkbox"/> Ignitable (Flashpoint < 140°F)	
<input checked="" type="checkbox"/> Reactive <input type="checkbox"/> Toxic	
<input type="checkbox"/> Corrosive (pH < 2.0) or (pH > 12.5)	
Start Date	Date
End Date	Date
Contact Name _____ Name _____ Department/Building/Room _____	
Chemical(s) _____	
Piranha	
HANDLE WITH CARE!	
CONTAINS HAZARDOUS OR TOXIC WASTES	

Additional Safety Training

- Based upon your duties in the lab:
 - *Arsenic – Online
 - Biosafety and *Bloodborne Pathogens – Online via CITI for UAlbany students and professors
 - Compressed gas cylinder – Online
 - Cryogenics – Online
 - *Radiation – UAlbany provides for students and professors, online or in-class for NYCREATES/Corporate Tenants
 - *Lasers (Class 3b or 4) – UAlbany provides for students and professors, online for NYCREATES/Corporate Tenants
 - *Hazardous Waste – Online
- Additional training may be provided by Academic Engineering Support Group
- * Required annually

EHS Intranet Page

- Request a Chemical
- Online Training
- Send an e-mail



SUNY COLLEGE OF NANOSCALE SCIENCE AND ENGINEERING INTRANET

Search Go!

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Bulk Gases Cleanroom Document Control **EHS** Students Faculty Facilities Site Services

EHS. Introduction

Welcome to the Environmental, Health and Safety (EH&S) Intranet Webpage!

This site has been created to provide you with access to information on the EH&S services, procedures, and resources that are readily available for you at the Albany Nanotech Complex.

This site also provides links to important regulatory requirements, as well as to all the EH&S policies and procedures that have been developed and implemented to assist in reducing hazards to the Albany Nanotech Complex.

We hope the navigation is intuitive and the information useful!

Environmental, Occupational Health and Safety Policy

The New York Center for Research, Economic Advancement, Technology, Engineering and Science (NY CREATES) is committed to protecting the environment and the health and safety of its students, faculty, staff, and other members of the campus community. NY CREATES will promulgate and publish Environmental, Health and Safety (EHS) procedures that comply with applicable EHS laws, rules and regulations. A copy of the NY CREATES EHS procedures can be found electronically at the [NY CREATES EHS website](#).

Additional Resources

- EHS Dept. and Policies
- YOUR Principal Investigator
- Lab Specific Chemical Hygiene Plan (in Lab)
- Prudent Practices in the Laboratory (National Research Council)
 - <http://nap.edu/12654>
- Hazardous Chemical Handbook
- Biosafety in Microbiological and Biomedical Laboratories 5th Edition (CDC)
- CRC Handbook of Lab Safety 5th Edition

Close

- NY CREATES is committed to providing you a safe working environment.
- You are a key player in this effort.
- All individuals on site are expected to share this commitment.
- Each of us must comply with safety and environmental laws, Site safety policies, and your employers' requirements.
- Thank you in advance for your support and efforts toward environmental, health and safety at ANC and in the laboratory.