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Contact Information:
PI: Julia Burton
Phone: 435-797-5375
Email: Julia.burton@usu.edu
Standard Operating Procedure: Cellulose Extraction and Purification

Materials for Extraction of Wood:
- Drying oven
- Heated stir plate and/or Ultrasonic bath
- Filter bags
- DDI water
- Volumetric flask
- NaOH
- glacial acetic acid
- Sodium chlorite
- Lab Balance
- 600 mL beakers
- Safety glasses
- Lab coat
- Rubber gloves
- Container for waste
- 400 mL plastic beakers with holes drilled in bottom to weigh bleaching samples down and reduce evaporation

Additional Materials for Extraction of Leaves:
- Toluene
- 500 ml round bottom flask
- Ethanol
- Soxhlet apparatus
- Container for waste

Extraction Procedures

1. Make filter bags (~1 in² per bag, see CelluloseExtractionBagGuide). ANKOM (phone 716-425-3940, fax 715-425-3941 F41 polyethylene fiber filter nonwoven bag material ($40/yd) and impulse electronic bag sealers.
2. If wood is being extracted there should generally be no need for soxhlet extraction (see Rinne et al. 2005). Therefore, bags for dated tree-rings should be made in groups of 10 compartments.
3. If leaves are being extracted, removal of abundant waxes will require soxhlet extraction. Soxhlets are of limited capacity to hold samples, so smaller numbers of compartments on groups of filter bags may be required (i.e. 6 instead of 10).
4. Dry and grind samples, ideally weigh ~300 to 500 mg, although much less is necessary for 13C analyses only. For 13C extraction to holocellulose (60-65% of wood mass) is sufficient. The minimum sample size of cellulose that can be combusted on most mass specs is about 20 mg, assuming moderate sample loss from filter bags and transfer the minimum mass of wood powder necessary is about 40 mg for holocellulose and 60 mg for alpha-cellulose (alpha-cellulose is 45-50% of the mass of wood). Adjust wood mass accordingly for the desired amount of sample replicates and isotopes, with some left over in case additional replicate analyses are required in the future. Note that weighing out less wood into each bag reduces the bleaching extraction time. This is because bags packed with a lot of wood so they look like fat pillows may cause the bleaching solution to ineffectively reach the center of the wood powder within each packet. These fat packets are also more difficult to roll and pack efficiently. So, only weigh out as much wood as will be needed. Note that much more wood for extraction may be required from sub-fossil wood samples where cellulose has been degraded.
5. Make sure bags are all heat-sealed effectively, so there are no holes where wood powder can escape. Note that ball grinders can grind wood so fine that much of the particles can be lost right through the filter bags. Chips of wood can be extracted, usually than more time bleaching than wood powder, but the effectiveness is much less for wood chips that approach 1 mm and is not effective for wood chips greater than 1 mm.
Additional procedures for leaf material that requires soxhlet extraction before bleaching:

6. Place bagged samples in soxhlet apparatus (if using, for leaves) Two rolled sets of bags can fit in a soxhlet – up to ~100 per soxhlet if bags are small and rolled tightly.
7. Fill round bottom flask with 300 ml 2:1 Toluene:Ethanol mixture.
8. Assemble soxhlet, flask condenser and run for 48 hrs (a bit of overkill for wood samples, but *not leaves* [we now routinely run wood for only 24 h. Our soxhlet refluxes every 5-6 min so we get over 250 refluxes in that time period]).
9. Turn off heat and remove samples from solvent. Let dry for ~24 hrs.
10. Repeat lipid extraction with 300 ml of ethanol, 48 h (24 h).
11. Dry samples for ~ 24 hrs.

**Bleaching Procedures**

1. Fill the heated sonic bath with deionized water (DDI) and turn on the heating element to get the water heating toward 69° C while prepping samples. Time can be saved by heating half of the solution in the sonic bath and heating the other half in a microwave or on a hot plate until it is boiling and then adding this hot water directly to the sonic bath.
2. Place two rolls of bags in each 600 ml beaker, whatever will fit (often 100-200 samples per beaker for bags that are not over-stuffed with wood).
3. We used to remove sugars, by adding ~500 ml DDI and boiling the samples for ~ 2 hrs, but this step should be unnecessary because later bleaching steps should break down sugars.
4. Instead, add 500 mL DDI to each beaker. To this add 4 to 8 g sodium chlorite and 2 – 4 ml glacial acetic acid to each beaker. *The original method used 2 g and 1 ml and even then the solution caused the disintegration of the glass filter bags. Polyethylene bags are more recalcitrant so we can save time by increasing the concentration.*
5. The solution should be bright yellow in color. When the solution gets clear it is necessary to add more sodium chlorite and acetic acid, in the same amounts noted above in step 4. At first this may only take 3-4 hours, but later in the reaction it may take longer. If the solution is only halfway clear before going home for the night, add only half of the usual amount of sodium chlorite and acetic acid. Make sure to top off beakers with DDI as evaporation lowers the level.
6. Usually bleaching takes < 5 days if the chemicals and temperature are kept at very 3-4 hrs. It can take from 1 to 2 weeks for large sample sizes or under inconsistent monitoring of chemicals and temperature. When the tissue is white, rinse samples several times ~500 ml DDI for 2-4 hours. Samples can then be run under tap water to remove any additional sodium chlorite (i.e. wash until the samples do not smell strongly of bleach, like that of a public swimming pool).

At this point, you have produced holocellulose.

**α-Cellulose Extraction** *(necessary for $^{18}$O and D/H analysis – hemicellulose has exchangeable Oxygens)*

1. Fill beaker with ~ 500 ml DDI, add ~ 85 g NaOH and stir for 1 hr at room temperature (17% w/v NaOH – *hemicellulose is soluble in a strong base*).
2. Rinse several times: ~500 ml DDI over a 2-4 hr period.
3. Fill beaker with ~ 450 ml DDI, add 50 ml glacial acetic acid and stir for 1 hr at room temperature (to neutralize the base and any remaining proteins that may stick to cellulose).

4. Rinse several times: ~ 500 ml DDI over a 2-4 hr period. Samples can then be run under tap water to remove any additional NAOH until the water/samples no longer smell.

5. Place filter bags/samples in oven at 60 °C and dry 6-24 hours as necessary. Remove samples from filter bags and place into microcentrifuge tubes.

References:

Working in Summer Conditions in the Field

Concept:

Field conditions in the summer can be unpredictable and dangerous. From pop-up thunderstorms to hot, sunny days, various health concerns can arise if the crew is not sufficiently prepared.

Primary Safety Concerns:

The primary safety concerns of working in the field include dehydration, overexposure to the sun, heat exhaustion, hypothermia (if cold and/or wet), snake or insect bites, and other health problems.

Procedure:

1. The field crew should discuss the signs and symptoms of the major health concerns listed above and be prepared to administer care in the field. For example, a dehydrated crew member may appear tired, complain of thirst, be disoriented or easily confused, and/or not urinating at regular intervals. Other crew members should encourage the person to take a break, sip water regularly, and try to decrease their body temperature.

2. The crew leader is responsible for being aware of the physical well-being of the crew. Taking regular water and snack breaks and asking everyone how they are is a normal part of looking after the crew.

3. Every crew member should carry enough water to remain hydrated throughout the day.

4. Stay situationally aware of the insects and venomous snakes around you. Alert others to the presence of dangerous creatures so they can also avoid hazardous interactions.

5. If a crew member has a medical condition that would be difficult to address in the field (i.e. allergic to bee stings or has asthma), they should notify the crew leader and make sure they have their necessary medications on hand. If necessary, they should alert others on how to administer them.

6. Personal protective equipment (PPE) that is recommended includes a full-brimmed hat, long-sleeved lightweight shirt, pants, and sunscreen.
Driving and Hiking in Rough Terrain

Concept:

Vehicle and foot travel over rough terrain requires heightened awareness of the dangers facing the well-being of the vehicle and the individual. Being comfortable with four-wheel drive and knowing individual physical limits will ensure a safer working environment.

Primary Safety Concerns:

The primary concerns with vehicular travel over rough terrain include getting a vehicle stuck, damaging a vehicle, and driver fatigue. The primary concern with foot travel is physical injury (i.e. rolled ankle, tripping, falling, or striking objects).

Procedure:

1. All drivers should be comfortable with four-wheel drive before attempting to drive over rough terrain. If not, they should switch out with a more experienced driver.
2. Driver fatigue is possible while driving on back roads because of the constant need for heightened awareness. If a driver is showing signs of stress or fatigue, they should switch out with another driver.
3. If a vehicle is stuck or damaged, the crew leader and crew should assess the situation. If they are unable to fix the problem and need outside assistance, they should seek help according to the communication plan. See Appendix B for the emergency response plan to use as an example.
4. If a crew member is injured while traversing rough terrain, the crew should evaluate the situation. The crew leader should do what they can to take care of the injury. If evacuation is necessary, the crew should follow the emergency response plan.
5. All crew members should evaluate their well-being and their surroundings. If they are unsure they are able to work safely in the environment, they should voice their concerns to the crew leader.
6. Crew members who have never driven in 4-wheel drive or need a refresher should consider watching a 4x4 training video such as the following:

How to Drive Off Road 4x4 Part 1: [https://www.youtube.com/watch?v=FcTTPV9JmIE](https://www.youtube.com/watch?v=FcTTPV9JmIE).

Start watching from 26-47 minutes, then from 51-55 minutes. Resume at 58:30 to the end. Keep in mind these examples are more extreme than most situations we will face in the field. Note: there are commercials dispersed throughout the video. If you have in earbuds, the volume increases dramatically for the commercials.

7. Personal Protective Equipment (PPE) recommended for rough terrain includes sturdy boots or sneakers and high-quality socks.
Travelling in Wilderness

Concept:
Travelling to remote sites to conduct field work often involves limited to no cell service and long travel times to the nearest amenities and medical facilities. Not having easy access to nearby amenities requires preparation and a well-thought-out communication plan.

Primary Safety Concerns:
The primary concerns with working in the wilderness include limited communication, remote vehicle repairs, and emergency response in case of physical injury.

Procedure:
1. Before leaving Logan, the individual or field crew needs to discuss their communication options when they reach the field site. If cell service is not available at the site, they should plan to carry a SPOT unit or satellite phone in case they need to seek help. They should designate an emergency contact in Logan who will be able to coordinate assistance if necessary. See Appendix B for the SageSTEP emergency response plan.

2. Make sure the vehicles are equipped with the basic tools necessary to deal with minor vehicle repairs out in the field. For example, spare tires and a jack should be in the vehicle in case a flat tire needs replaced.

3. Make sure the vehicles have enough fuel to reach the field site and return to the nearest gas station.

4. Crew leaders should train field technicians on how to react in a situation where a crew member is injured and needs medical attention.

5. The crew leader is responsible for maintaining an up-to-date Wilderness First Aid certification or comparable training. The USU Outdoor Recreation Program offers weekend training sessions throughout the semester.

6. Personal Protective Equipment (PPE) recommended is a serviceable first aid kit.
APPENDIX B: EMERGENCY RESPONSE PLAN

When faced with an emergency, use the following flow charts and other materials as a guide for deciding how to respond to the situation.

Documents Included:
- Utah State University “Hazard, Accident, and Incident Procedures” flow chart
- Wilderness First Aid “Evacuation Plan Flow Chart”
- “Call-In Procedures for Wilderness Emergency” template (modelled after Wilderness First Aid protocols for reporting a medical emergency)
- Utah State University “Property Loss/Bodily Injury Report” form
- Utah State University “Vehicle Accident Report” form

The field crew will have a SPOT unit on-hand throughout the field season. They will use it to check in daily when they are at sites without cell service. Julia Burton and other designated contacts will receive the message. If the field crew encounters a non-life-threatening situation, they will send out a “We need non-medical assistance” message. Julia or other designated party will be responsible for arranging assistance. If a life-threatening emergency arises that requires immediate evacuation, the field crew will send out an “SOS” message with the SPOT unit. This function alerts local emergency responders to their location and help will be sent immediately.

If a situation arises where the SageSTEP crew needs assistance, every effort will be made to send a small group in search of cell service before resorting to using the SPOT unit to call out for help. An example of a situation where the “We need non-medical assistance” button would be pressed would be if both vehicles are unable to travel to find cell service to call for a tow. The “SOS” button would only be used if it is determined by the field crew leader that the crew is not able to take the injured crew member to the nearest hospital and an immediate evacuation is the only reasonable option to ensure the injured crew member gets the medical care they need.

The field crew leader will go over the emergency response plan and related protocols at the beginning of the field season.
HAZARD, ACCIDENT AND INCIDENT PROCEDURES

HAZARD observed with potential to cause harm to people, property or the environment.

Is it an EMERGENCY situation?

Yes

Call 911

No

Go to:
http://www.usu.edu/riskmgmt/hazard.pdf and submit either a Service Request or a Hazard Report

INCIDENT occurs that either has or has not resulted in injury or illness to a person (any) or property damage or environmental harm.

Go to:

VEHICLE ACCIDENT occurs that either has or has not resulted in injury or illness to a person (any) or property damage of any kind.

Go to:

If an INCIDENT results a person having a WORK RELATED INJURY

Report the WORK RELATED INJURY to USU Human Resources
Evacuation Plan Flow Chart

Is the injury or illness severe enough to require additional medical treatment? Make this assessment in a timely fashion.

Is the person unable to continue with the trip?

Can the person walk out on their own without aggravating their condition?

Can the available evacuation routes be safely traveled by the person?

Will walking out and carrying gear create additional Accident Potential for the person or the group?

Send appropriate members of the group out to secure professional help.

This person needs a litter evacuation. Does the group have the skills, people, and equipment to safely evacuate the person?

Prepare for evacuation.

Allow the person to hike out with appropriate group support and with gear.

Allow the person to hike out with appropriate group support, but do not let them carry gear.
Call In Procedures for Wilderness Emergency

Calling In

1. Name and/or Organization: Utah State University Research Crew

2. Location (i.e. Area on Topo Map or Mile Marker on Road): ______________________

3. Critical or Stable: ________

4. Medical or Trauma: ________

5. Do you copy?

Patient Report

- Our phone number in case we get disconnected is ____________________________
- I have a ____ year old M/F who ____________________________
- Patient’s chief complaint is ____________________________________________
- Patient’s last set of vitals are
  - Heart Rate: ______
  - Respiration Rate: ______
  - Blood Pressure: ______
  - Level of Responsiveness: ______
  - Skin Color, Temperature, and Moisture: ______
  - Circulatory/Sensory/Motor: ______
  - Pupils Equal Round Reactive to Light: ______
- Evacuation request ____________________________________________________
Utah State University – Property Loss/Bodily Injury Report

Today's Date: ___________  Date of Incident: ___________  Time of Incident: ___________

Exact Incident Location: ________________________________
(Street, building, room, etc)

Report Person
Name: ______________________  USU Department: ______________________
Email: ______________________  Home Phone: ______________________
Address: ______________________  Work Phone: ______________________
City: ______________________  State: ______________________  Zip: ______________________

Incident Details
Police Called: ______________________  Police Dept: ______________________
Police Report #: ______________________

What happened?
Explain in detail the manner in which the incident or loss occurred. Please state the conditions present at the time of loss (e.g., weather, construction, cleaning).

Witnesses
Name: ______________________  Address: ______________________  Phone #: ______________________
Name: ______________________  Address: ______________________  Phone #: ______________________

For Bodily Injury Cases
Victim's Name: ______________________  Phone #: ______________________
Address: ______________________
City: ______________________  State: ______________________  Zip: ______________________

Describe Injury: ______________________

Was medical treatment provided?: □ Yes  □ No

For Property Loss
If the loss is structural in nature or involves equipment, include a list of the items damaged, lost, or stolen and an estimate of the repair/replacement costs. Include any photos, receipts, and documentation of the lost/damaged items.

Provide your preliminary plans for recovery and relocation
(if applicable):

Signature: ______________________  Date: ______________________

Please submit this report and all supporting documentation to USU Risk Management
6600 Old Main Hill, Logan, UT 84322 - risk@usu.edu
# Utah State University - Vehicle Accident Report

**Today's Date:**

**Date of Accident:**

**Time of Accident:**

**Exact Accident Location:**

**Nearest City to Accident:**

<table>
<thead>
<tr>
<th>USU Vehicle</th>
<th>Responsible Department:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lic. Plate #:</td>
<td>Veh. Year: Make/Model:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USU Driver</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver's Name:</td>
<td>Driver's Lic. #: DL State: UT</td>
</tr>
<tr>
<td>Driver's Email:</td>
<td>Home Phone: Work Phone:</td>
</tr>
<tr>
<td>Driver's Address:</td>
<td>City: State: UT Zip:</td>
</tr>
</tbody>
</table>

**Purpose of Vehicle Use:**

---

**Accident Details** - Please attach police reports, drivers insurance exchange, or other documentation as applicable.

**Estimated Speed:**

**Weather Conditions:**

**Road Surface:**

**Paved:**

**Police Called:**

**Police Dept:**

**Police Report #:**

**What happened?:**

**Description of Damages to Veh:**

**Describe any Bodily Injury:**

---

**Witnesses**

Name: Address: Phone #: |

Name: Address: Phone #: |

**Other Vehicle(s) - If there is more than one other vehicle involved, please submit additional report(s).**

<table>
<thead>
<tr>
<th>Driver's Name:</th>
<th>Driver's Lic #: DL State: UT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>State: UT Zip:</td>
</tr>
<tr>
<td>City:</td>
<td>State: UT Veh Year: Make/Model:</td>
</tr>
</tbody>
</table>

**Description of Damage to Veh:**

**Describe any Bodily Injury:**

**Insurance Co:**

**Policy #:**

**Agent Name:**

**Agent Phone #:**

**Signature:**

**Date:**

---

Please submit this report and all supporting documentation to USU Risk Management Services

6600 Old Main Hill, Logan, UT 84322 risk@usu.edu
CHEMICAL HYGIENE PLAN

Laboratory Location (building and room): NR 231
Department or Campus Unit: Dept. of Wildland Resources
Campus Unit Safety Coordinator: Rachel Curry
Principal Investigator: Julia Burton
Laboratory Safety Coordinator: N/A
(if different from PI)
Date of plan completion: March 2019
Person who completed the plan: Julia Burton
Title of person completing the plan: Research Asst. Professor

Annual review (including any necessary updating) of the plan is required. Once reviewed and updated it must be sent to the USU Chemical Hygiene Committee for approval, UMC 8315.

References in this document are made to the following text:

This manual along with other chemical safety and health references are available online at http://rgs.usu.edu/ehs/.
A. General Principles
   1. Minimize all Chemical Exposures
   2. Avoid Underestimation of Risk
   3. Provide Adequate Ventilation
   4. Institute a Chemical Hygiene Program
   5. Observe the PELs and TLVs
   6. Understand Routes of Exposure to Toxic Chemicals
   7. Maintain Readily Available Files of MSDSs

B. Chemical Hygiene Responsibilities
   1. Laboratory Worker
   2. Laboratory Supervisor and Principal Investigator
   3. Campus Unit Safety Coordinator
   4. USU EH&S Office and Chemical Hygiene Officer
   5. Department Head or Campus Unit Director
   6. University Administration

C. The Laboratory Facility
   1. Design
   2. Maintenance
   3. Usage
   4. Ventilation

D. Chemical Hygiene in This Laboratory
   1. Basic Chemical Hygiene Rules
   2. Additional Rules Specific to This Laboratory
   3. Chemicals Posing Significantly High Hazard
      3.1 Allergens
      3.2 Chemicals of High Acute Toxicity
      3.3 Reproductive Toxins (include embryo toxins)
      3.4 Chemical of High Chronic Toxicity (Carcinogens)
      3.5 Animal Work with Chemicals of High Chronic Toxicity
      3.6 Physical Hazards
   4. Chemical Hygiene Standard Operating Procedures (SOPs) specific to the laboratory – appended in a separate folder
   5. Chemical Procurement, Distribution, and Storage
   6. Environmental Monitoring
   7. Housekeeping and Maintenance
   8. Laboratory Audits
   9. Medical Program
   10. Personal Protective Apparel and Equipment
11. Records 26
12. Signs and Labels 27
13. Spills and Accidents 27
14. Information and Training 27
15. Waste Disposal 28

♦ E. Chemical Inventory - appended in a separate folder 29
♦ F. Safety Data Sheets (SDS) - appended in a separate folder 29
♦ G. Physical Hazards 29
♦ H. Laboratory Safety Training Certificates - appended in a separate folder 29

♦ Specific Laboratory Information Required
A. GENERAL PRINCIPLES FOR WORK WITH LABORATORY CHEMICAL

1. It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, precautions for handling all laboratory chemicals should be adopted. Skin contact with chemicals should be avoided as a cardinal rule.

2. Avoid underestimation of risk. Even for substances of no known hazard, exposure should be minimized; for work with substances which present hazards, special precautions should be taken. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

3. Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of local exhaust hoods and closed chemical containers.

4. Institute a chemical hygiene program. The OSHA Laboratory Standard requires a chemical hygiene program be developed and implemented for all laboratories. A mandatory chemical hygiene program designed to minimize exposures is needed, it should be an ongoing, continuing effort, not merely a one-time or short-term activity. Its procedures should be followed in academic teaching laboratories as well as research laboratories.

5. Observe the PELs and TLVs. The OSHA Permissible Exposure Limits (PEL’s) and the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLV’s) should not be exceeded. Engineering controls should be implemented if action levels are exceeded.

6. Understand Routes of Exposure to Toxic Chemicals. Toxic chemicals may enter your body through several routes:
   a. By inhalation through the nose or mouth.
   b. By absorption through the skin, eyes, and mucous membranes.
   c. By ingestion, via unwashed hands.
   d. By injection via broken glass, needles, knives, or other sharp instruments.

7. Proper control methods reduce risk of chemical related injury or illness by eliminating these routes of entry. Chemical hygiene control methods are divided into three categories:
   a. Engineering Controls:
      Local exhaust ventilation, glove boxes, safety interlocks
   b. Administrative Controls:
      Standard Operating Procedures (SOP’s), Risk Assessment, substitution of a less toxic material for a more toxic material, process or protocol changes.
   c. Personal Protection Equipment
      Safety glasses, goggles, face shields, respirators, and protective clothing (e.g. gloves, lab coats, aprons, and etc.)

8. Maintain readily available files of Safety Data Sheets. Safety Data Sheets contain safety and health information on the hazardous properties and proper handling of chemicals. Chemical users should make an effort to be familiar with the SDS’s for the chemicals with which they work. OSHA requires that workers have immediate access to SDS’s for each chemical in the work area. See section F to find out how to obtain SDS’s.
B. CHEMICAL HYGIENE RESPONSIBILITIES

Responsibility for chemical hygiene rests with various individuals and organizations including the:

1. **Laboratory Worker, who is responsible for:**
   a. Knowing and following the chemical hygiene rules.
   b. Planning and conducting each operation in accordance with the laboratory specific chemical hygiene procedures.
   c. Developing good personal chemical hygiene habits.

2. **Principal Investigator and Laboratory Supervisor who have primary responsibility for chemical hygiene in the laboratory, including responsibility to:**
   a. Ensure that workers know and follow the chemical hygiene procedures that protective equipment is available and in working order, and that appropriate safety and health training has been provided.
   b. Provide routine, formal chemical hygiene and housekeeping inspection; including inspections of emergency equipment.
   c. Know the current legal requirements concerning regulated substances.
   d. Determine the required levels of protective apparel and equipment.
   e. Ensure that facilities are adequate and training is current for any material being used or ordered for the laboratory.

3. **Campus Unit Safety Coordinator, as assigned by the department head or campus unit director who must:**
   a. Serve as liaison between USU EH&S Office and his/her Campus Unit.
   b. Know the current legal requirements concerning regulated substances.
   c. See that laboratory personnel are informed and trained, as required by the standard.

4. **The EH&S Office (ext. 7-2892) is a resource for improving chemical hygiene in the laboratories and for helping you comply with all safety and health regulations.** Some of the services provided by the EH&S Office to help you comply with the OSHA Lab Standard include:
   a. Making a boilerplate Chemical Hygiene Plans available.
   b. Review of laboratory specific Chemical Hygiene Plans.
   c. Conduct general lab safety training and provide chemical hygiene information.
   d. Annual inspections of lab hoods.
   e. Environmental monitoring when high exposures to chemicals are suspected.
   f. Periodic safety audits of lab facilities.
   g. Consultation in developing Standard Operating Procedures.
5. The Campus Chemical Hygiene Officer will be from the Environmental Health and Safety Office staff as assigned by the director and will:
   a. Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices.
   b. Provide information relating to procurement, use, and disposal of chemicals used in the lab.
   c. See that appropriate audits are performed.
   d. Help project directors identify appropriate equipment and adequate facilities.
   e. Know the current legal requirements concerning regulated substances.
   f. Seek ways to improve the chemical hygiene program.

6. Department Head or other Campus Unit Director, who is responsible for overall chemical hygiene in that unit.

7. President of Utah State University, the Vice-president for Research and other administrators who have ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene.

C. THE LABORATORY FACILITY

1. Design. The laboratory facility should have:
   a. An appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air.
   b. Adequate, well-ventilated chemical storage rooms.
   c. Properly functioning laboratory hoods and sinks.
   d. Other safety equipment including eyewash fountains and drench showers.
   e. Arrangements for waste disposal.

2. Maintenance. Chemical-hygiene-related equipment (hoods, incinerator, etc.) should be evaluated routinely.

3. Usage. The work conducted and to what extent the work is conducted must be appropriate for the physical facilities available and, especially, to the availability and quality of ventilation.

4. Ventilation.
   a. General laboratory ventilation. This system should:
      i. Provide a source of air for breathing and for input to local ventilation devices.
      ii. It should not be relied on for protection from toxic substances released into the laboratory.
      iii. Ensure that laboratory air is continually replaced with acceptable levels of fresh air, thereby preventing increased concentrations of toxic substances during the working day.
iv. Direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

b. **Hoods.** A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals. Each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be provided. Questions related to chemical hood adequacy, need, etc. should be directed to Environmental Health and Safety.

c. **Other local ventilation devices.** Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed. Each canopy hood and snorkel should have a separate exhaust duct.

d. **Special ventilation areas.** Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment devices before release into the regular exhaust system. Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure.

e. **Modifications.** Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.

f. **Performance.** Rate: 4-12 room air changes/hour is normally adequate general ventilation, for laboratories, if local exhaust systems such as hoods are used as the primary method of control.

g. **Quality.** General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas. Airflow into and within the hood should not be excessively turbulent. Ideally the hood face velocities should be 100 fpm (feet per minute) +/−25 fpm at the working sash height (generally 16").

h. **Evaluation.** Quality and quantity of ventilation should be evaluated on installation, regularly monitored, and reevaluated whenever a change in the local ventilation devices is made. EH&S Office personnel monitor hood flow rates regularly and are available for other ventilation monitoring and advice.
D. CHEMICAL HYGIENE IN THE LABORATORY

Laboratory workers will know and follow the rules, procedures and recommendations in this Chemical Hygiene Plan.

1. Basic Chemical Hygiene Rules

The following will be used for essentially all laboratory work with chemicals:

a. Accidents and spills:
   i. Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention.
   ii. Ingestion: Encourage the victim to drink large amounts of water. Refer to the Safety Data Sheet.
   iii. Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention.
   iv. Clean-up: Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal.

b. Avoidance of "routine" exposure: Develop and encourage safe habits. Avoid unnecessary exposure to chemicals by any route.
   i. Do not smell or taste chemicals.
   ii. Vent any apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, and etc.) into local exhaust devices.
   iii. Inspect gloves and other personal protective equipment before use.
   iv. Do not allow release of toxic substances in cold rooms and warm rooms, since these contain re-circulated atmospheres.

c. Choice of chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate.

d. Eating, smoking, etc.: Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present. Wash hands before conducting these activities. Do not allow storage, handling, preparation, or consumption of food and beverages in areas which are used for laboratory operations.

e. Equipment and glassware: Handle and store laboratory glassware with care to avoid damage. Do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for its designed purpose.
f. **Exiting:** Thoroughly wash areas of exposed skin before leaving the laboratory.

g. **Horseplay:** Avoid practical jokes or other behavior which might confuse, startle, or distract another worker.

h. **Mouth suction:** Do not use mouth suction for pipetting or starting a siphon.

i. **Personal apparel:** Confine long hair and loose clothing. Wear shoes at all times in the laboratory. Sandals, perforated or open-toed shoes should not be worn. Always wear long pants, not skirts or short pants. Wear a lab coat.

j. **Personal housekeeping:** Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored. Clean up the work area on completion of an operation or at the end of each day.

k. **Personal protection:** Assure that appropriate eye protection is worn by all persons, including visitors, where chemicals are stored or handled. Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, wash them before removal, and replace them periodically. Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls, inspecting the respirator before use. Use any other protective and emergency apparel and equipment as appropriate. Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken. Remove laboratory coats immediately on significant contamination.

l. **Planning:** Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.

m. **Unattended operations:** Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation.

n. **Use of hood:** Use the hood for operations which might result in release of toxic chemical vapors or dust. In general, use the hood whenever feasible to limit exposure to laboratory workers. As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm. Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made; keep materials stored in hoods to a minimum and do not allow them to block vents or air flow. Leave the hood "on" when it is not in active use, if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off".

o. **Vigilance:** Be alert to unsafe conditions and see that they are corrected when detected.
p.  **Waste disposal:** Assure that each laboratory operation includes plans and training for waste disposal. Deposit chemical waste in appropriately labeled chemically compatible receptacles and follow USU Hazardous Waste Guidelines. The following chemicals will not be discharged to the sewer: concentrated acids or bases, toxic, flammable substances, reactive materials, malodorous, lachrymatory, explosive, or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage, or obstruct flow. Consult the EH&S Office if you have disposal questions on a particular chemical waste.

q.  **Working alone:** Avoid working alone in a building. Do not work alone in a laboratory if the procedures being conducted are hazardous.

r.  **Chemicals with unknown hazards:** Chemicals whose hazardous properties have not been evaluated (no SDS available) will be considered highly toxic and handled as such. (See sections 3.4 and 3.5 of this CHP)

2. **Additional Rules specific to this laboratory**

a.  **Aim:** To assure that hazards specific to the lab are addressed.

   Examples of additional rules:
   i. Requirement that visitors check-in at office and wear eye protection.
   ii. Requirement that cabinet doors to chemical storage be kept closed.

   **Insert a separate page listing any Additional Rules specific to the lab, after this page.**
3. Chemicals posing significantly high hazards

3.1 Work with Allergens

**Allergens or sensitizers.** A chemical allergy is an adverse reaction by the immune system to a chemical. Such allergic reactions result from previous sensitization to that chemical or a structurally similar chemical. Once sensitization occurs, allergic reactions result from exposure to extremely low doses of the chemical. Individuals differ widely in their tendency to become sensitized to allergens. Examples of chemical substances that cause allergic reactions in some individuals include: diazomethane, dicyclohexylcarbodiimide, formaldehyde and phenol derivatives, various isocyanates, benzylic and allylic halides, acid anhydrides, and metals such as nickel, beryllium, platinum, cobalt, tin, and chromium.

a. Wear suitable gloves to prevent hand contact with allergens of substances of unknown allergenic activity. Thoroughly wash hands immediately after working with these materials.

b. Utilize chemical hoods or other local exhaust ventilation to limit exposure.

c. Review each use of these materials with the research supervisor and review ongoing uses annually or whenever a procedural change is made.

d. Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

e. Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.
f. List of allergens (sensitizers) used in this lab:

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS number (if known)</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl Alcohol</td>
<td>64-17-5</td>
<td>Various</td>
</tr>
</tbody>
</table>
3.2 Work with Chemicals of High Acute Toxicity

**Acute toxicity** is the ability of a chemical to cause a harmful effect after a single exposure. Acutely toxic agents cause local toxic effects, systemic toxic effects, or both. This class of toxicants includes corrosive chemicals, irritants, and allergens. Examples include: diisopropylfluorophosphate, hydrofluoric acid, and hydrogen cyanide.

a. **Aim:** To minimize exposure to these toxic substances by any route using all reasonable precautions.

b. **Applicability:** These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities.

c. **Location:** Use and store these substances only in areas of restricted access with special warning signs.

   i. Always use an approved hood or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance.
   ii. Trap released vapors to prevent their discharge with the hood exhaust.

e. **Personal protection:** Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate). Always wash hands and arms immediately after working with these materials.

f. **Records:** Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved.

g. **Prevention of spills and accidents:** Be prepared for accidents and spills. Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity.

   i. Store breakable containers of these substances in chemically resistant trays. Also, work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.
   ii. If a major spill occurs outside the hood, evacuate the area and call 9-1-1.

h. **Waste:** Following use thoroughly decontaminate clothing or shoes. If possible, chemically decontaminate by chemical conversion. Store waste or other contaminated objects in closed, suitably labeled, impervious containers. Dispose of in accordance with USU Hazardous Waste guidelines.

i. **Listing of chemicals in this lab considered to be of high acute toxicity:**
<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS number</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glacial Acetic Acid</td>
<td>64-19-7</td>
<td>Various</td>
</tr>
<tr>
<td>Sodium Chlorite</td>
<td>7758-19-2</td>
<td>Various</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>1310-73-2</td>
<td>Various</td>
</tr>
</tbody>
</table>
3.4 Work with Chemicals of High Chronic Toxicity (Carcinogens)

A carcinogen is a substance capable of causing cancer. Carcinogens are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure and their effects may become evident only after a long latency period. Carcinogens are particularly insidious toxins because they may have no immediate apparent harmful effects.

Compounds that are known to pose the greatest carcinogenic hazard are referred to as select carcinogens. A select carcinogen is defined in the OSHA Laboratory Standard as a substance that meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen.
2. It is listed as known to be a carcinogen in the latest Annual Report on Carcinogens issued by the National Toxicology Program (NTP).
3. It is listed under Group I (carcinogenic to humans) by the International Agency for Research for Cancer (IARC).
4. It is listed under IARC Group 2A (probably carcinogenic to humans) or 2B (possibly carcinogenic to humans), or under the category “reasonably anticipated to be a carcinogen” by the NTP.

Examples: dimethyl mercury and nickel carbonyl, benzo-a-pyrene, N-nitrosodiethylamine, formaldehyde, and other human carcinogens or substances with high carcinogenic potency in animals.

a. **Access:** Conduct all transfers and work with these substances in a "designated and controlled area".
   i. Controlled areas include: a restricted access chemical hood, glove box, or portion of a lab designated for use of highly toxic substances.
   ii. These restricted areas will be posted with warning signs, to ensure that people with access to the lab are aware of the substances being used and necessary precautions.
   iii. These substances will be stored separately with access restricted.

b. **Signs and labels:** Assure that the designated and controlled area is conspicuously marked with warning and restricted access signs and that all containers of these substances are appropriately labeled with identity and warning labels.

c. **Approvals:** Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor.

d. **Non-contamination/Decontamination:**
   i. Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood.
   ii. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area.
   iii. Decontaminate the controlled area before normal work is resumed there.
e. **Exiting:** On leaving a controlled area remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.

f. **Housekeeping:** Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder.

g. **Medical surveillance:** If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance.

h. **Records:** Keep accurate records of the amounts of these substances stored and used, the dates of use, and names of users.

i. **Spills:** Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.

j. **Storage:** Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.

k. **Glove boxes:** For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water. For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood.

l. **Waste:** Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel. Dispose of waste in accordance with USU Hazardous Waste guidelines.
p. List of chemicals in this lab considered to be of high chronic toxicity (Carcinogens):

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS Number</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>Various</td>
</tr>
<tr>
<td>Ethyl Alcohol</td>
<td>64-17-5</td>
<td>Various</td>
</tr>
</tbody>
</table>
a. **Access:** For large scale studies, special facilities with restricted access are preferable.

b. **Administration of the toxic substance:** When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters.

c. **Aerosol suppression:** Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood).

d. **Personal protection:** When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator).

e. **Waste disposal:** Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products; otherwise, package the waste appropriately and dispose of waste according to USU Hazardous Waste Guidelines.
f. List of chemicals of high chronic toxicity (carcinogens) involved with animal work in this lab:

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS number (if known)</th>
<th>Manufacturer</th>
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</table>
3.6 Work with Materials that pose a significant Physical Hazard

OSHA defines a physical hazards as a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.

Other physical hazards include:
- Cryogens
- Electric hazards
- High pressure reactions
- Magnetic fields
- Radio frequency, microwave, ultra violet, and infrared radiation
- Vacuum work
- Cutting, sawing, or grinding
4. Standard Operating Procedures (SOPs) specific to this laboratory

a. **Aim:** to assure that hazardous operations specific to the lab are conducted in a prudently safe manner.

b. **Content:** Chemical Hygiene SOPs may be incorporated into general lab procedural protocols or may be written up separately. These SOPs contain 1) the major hazards associated with a task and/or chemicals and 2) controls to avoid exposure. Examples of SOPs can be found in Prudent Practices, chapters 1B, 1C and 1D. A guide to preparing Chemical Hygiene SOPs is available from the Campus EH&S Office.

Examples of procedures or tasks that support implementation of SOPs.

1) Use of perchloric acid.
2) End of day clean-up procedures.
3) Mixing of acrylamide gels—will be conducted in a "controlled area", with local exhaust (i.e. a lab hood) and measures taken to limit exposure including preventing skin contact.
4) Use of Ethidium Bromide - similar to number 3 above.

c. **Insert any SOPs specific to the lab after this page – appended in a separate folder.**
5. Chemical Procurement, Distribution, and Storage

a. **Procurement:** Before a substance is received, information on proper handling, storage, and disposal will be known to those who will be involved. No container will be accepted without an adequate identifying label.

b. **Stockrooms/storerooms:**
   i. Incompatible substances will be segregated in a well-identified area with local exhaust ventilation.
   ii. Chemicals which are highly toxic or other chemicals whose containers have been opened will be in unbreakable secondary containers.
   iii. Stored chemicals will be examined periodically (at least annually) for replacement, deterioration, and container integrity.
   iv. Chemicals with sensitive shelf lives, such as peroxide formers, will be dated and used or disposed of properly within suggested shelf life period.
   v. Stockrooms/storerooms will not be used as preparation or repackaging areas, will be open during normal working hours, and will be controlled by one person.

c. **Distribution:** When chemicals are hand carried, the container will be placed in suitable secondary containment (e.g. an outside container or bucket). Freight-only elevators will be used if possible.

d. **Laboratory storage:**
   i. Amounts permitted will be as small as practical. Storage on bench tops and in hoods is inadvisable.
   ii. Exposure to heat or direct sunlight will be avoided.
   iii. Periodic inventories will be conducted, with unneeded items being discarded, returned to the storeroom/stockroom, or made available to other users.
   iv. Care will be taken to protect the integrity of chemicals, (prevent contamination etc.) so that the chemicals can be of use to others.
   v. Proper storage will ensure that incompatible chemicals are stored separately.
   vi. Chemicals referred to in 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6 will be stored in areas of restricted access.

6. Environmental Monitoring

a. Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices or when a highly toxic substance is stored or used regularly (e.g. 3 times/week).

7. Housekeeping and Maintenance
a. **Cleaning:** Floors will be cleaned regularly.

b. **Maintenance:**
   i. Eye wash fountains should be inspected by users at intervals of not less than 3 months.
   ii. All labs will have ready emergency access to an eye wash station and drench shower, and the location will be communicated to all workers.
   iii. Respirators for routine use will be inspected periodically. All respirator users will be enrolled in the USU Respirator Program, will be trained, and fit tested.
   iv. Other safety equipment will be inspected regularly (e.g., every 3-6 months) and prior to use.
   v. Procedures to prevent restarting of out-of-service equipment will be established.

c. **Passageways:** Stairways and hallways will not be used as storage areas. Access to exits, emergency equipment, and utility controls will never be blocked.

d. **Aisles and Walkways:** Aisles and walkways will be kept clear and free of obstruction. Boxes, bottles of chemical, waste containers, lab equipment, and other materials should not be stored on the floor in aisles or walkways.

8. **Laboratory Audits**

a. **Frequency:** Formal housekeeping and chemical hygiene audits of the laboratory will be held at least quarterly.

b. **Documentation:** Dated copies of the completed quarterly audits will be filed at the end of this plan. A copy of the Safety Audit will be sent to the EH&S Office.

c. Informal inspections should be continual.

9. **Medical Program**

a. **Compliance with regulations:** Regular medical surveillance will be established to the extent required by regulations.

b. **Routine surveillance:** Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical will consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable.
c. **First aid:**
   i. Personnel trained in first aid will be available during working hours.
   ii. In case of a medical emergency call 911.
       Tell the dispatcher:
       - Location of the patient (building & room number)
       - Name and condition of the patient (alert, conscious, breathing)
   iv. USU employees with non-life threatening injuries should be evaluated at IHC WorkMed, 412 North 200 East, 435-713-2700.
   v. Supervisors must be notified of any work related injury or illness. Supervisors are required to fill out appropriate worker’s compensation forms available on the HR website.
   vi. All laboratory injuries or illnesses must be reported to the Chemical Hygiene Officer.

10. **Protective Apparel and Equipment**

These will include for each laboratory:

a. Protective apparel compatible with the required degree of protection for substances being handled.

b. An easily accessible drench-type safety shower.

c. An eyewash fountain.

d. A fire extinguisher.

e. Respiratory Protection - Any worker issued a respirator must be trained in its appropriate use and undergo medical determination of fitness. This is a simple process, through which EH&S can guide you. For additional information, contact EH&S at 797-2892.

f. Fire alarm and telephone for emergency use will be available nearby.

g. Other items designated by the laboratory Safety Coordinator.

11. **Records**

a. Accident records will be written and retained.

b. Chemical Hygiene Plan records will document that the facilities and precautions are compatible with current knowledge and regulations.

c. Inventory and usage records for high-risk substances will be kept.
d. Medical records will be retained by the institution in accordance with the requirements of state and federal regulations.

12. Signs and Labels

Prominent signs and labels of the following types will be posted:

a. Emergency telephone numbers including: emergency personnel/facilities, supervisors, laboratory personnel, and other pertinent contact persons.

b. Chemical container labels showing contents of containers (including waste receptacles) and associated hazards. All containers must have a legible label.

c. Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits and areas where food and beverage consumption and storage are permitted. Food and beverages will not be allowed in areas where chemicals are stored or handled.

d. Warnings at areas or equipment where special or unusual hazards exist. This includes controlled areas for use of chemicals described in 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6.

13. Spills and Accidents

a. Spill response plan will be established and communicated to all personnel. It will include procedures for: ventilation failure, evacuation, medical care, reporting, prevention, containment, cleanup, and drills.

b. There will be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms.

c. All accidents or near accidents will be carefully analyzed with the results distributed to all who might benefit. All chemical spills must be reported to the supervisor.

d. For questions on spill clean-up procedures consult the SDS or call EH&S at 797-2892.

e. In the event of a chemical spill emergency, dial 911.

14. Information and Training Program

a. **Aim:** To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs. Laboratory Safety Training seminars are available through EH&S.
b. **Emergency and Personal Protection Training:** Every laboratory worker will know the location and proper use of available protective apparel, emergency equipment and procedures.

Such training as well as first aid instruction will be available to and encouraged for everyone who might need it. First aid courses are offered through the local Red Cross Chapter.

c. **Handling:** Receiving and stockroom/storeroom personnel will know about hazards, handling equipment, protective apparel, and relevant regulations.

d. **Frequency of Training:** The training and education program will be a regular, continuing activity - not simply an annual presentation. All laboratory personnel are required to attend the Laboratory Safety Initial training course offered by EH&S. Periodic Lab Safety Refresher training can be scheduled for laboratories and/or departments. A variety of training materials are available from the EH&S office.

e. **Literature/Consultation:** Literature and consultation concerning chemical hygiene is readily available to laboratory personnel, through EH&S 797-2892. Laboratory personnel are encouraged to use these information resources.

15. **Waste Disposal Program**

a. **Aim:** To assure that the potential minimal harm to people and the environment resulting from the disposal of chemical waste is minimized.

b. **Content:** Chemical waste and radioactive waste disposal requests can be made online at [http://rgs.usu.edu/ehs/htm/hazardous-waste-pickup](http://rgs.usu.edu/ehs/htm/hazardous-waste-pickup).

c. **Discarding Chemical Stocks:** Designate chemicals that are no longer need as waste. Every possible effort should be made by laboratory personnel to identify exactly or generally chemicals contained in any unlabeled containers. In the event waste chemicals may be potentially explosive (e.g. picric acid, ethers etc.) they must not be opened or moved by laboratory personnel.

All departing employees, including faculty, students, and staff must ensure that all chemicals in his/her work area are properly distributed. All chemicals must be discarded, returned to storage, or given to a fellow researcher.

d. **Frequency of Disposal:** Waste must be stored in a secure place within the laboratory and removed at a regular interval.

e. **Method of Disposal:** All discarded chemicals are shipped off-site and handled at approved disposal facilities. USU personnel should not attempt to minimize chemical waste through practices such as elementary neutralization, chemical
reactions, dilution, or evaporation, unless these practices are part of the experiment. Disposal by pouring waste chemicals down the drain is unacceptable.

E. Chemical Inventory

Glacial Acetic Acid
Sodium Chlorite
Sodium Hydroxide
Ethyl Alcohol

F. Safety Data Sheets

Safety Data Sheets contain information on the hazardous properties and proper handling of chemicals. OSHA requires chemical handlers be familiar with the chemicals with which they work. OSHA also requires that workers have ready access to an SDS for each chemical in the work area. You will receive a SDS with or shortly after the arrival of an ordered chemical product. Request a copy of the SDS for each product you purchase. SDSs should be maintained in a notebook or file that is easily accessible to employees in the lab. Most chemical manufacturers and distributors have SDSs available on their websites.

G. Physical Hazards

Numerous physical hazards may be present in the laboratory. Physical hazards are responsible for the majority of workplace injuries. Many of the above recommendations are directed primarily toward prevention of toxic exposure and related health effects rather than prevention of physical injury. However, failure to take precautions against physical injury will often have the secondary effect of causing toxic exposures. Please note that the most current version of the USU Chemical Hygiene Plan (2013) has been modified to specifically address physical hazards in section 3.6. Below are some of the major categories of physical hazards which also have implications for chemical hygiene:

1. Compressed gases
2. Electrically powered laboratory equipment
3. Fires or explosions
4. Procedures involving temperature extremes (both low and high)
5. Pressurized and vacuum operations (including use of compressed gas cylinders)
6. Slippery surfaces or tripping hazards
7. Use of power tools (cutting, sanding, grinding)
8. Sharps

The Fire Marshal's Office offers advice on fire and electrical safety, and sponsors a hands on extinguisher training session. The USU Lab Safety Audit Form includes sections on basic control methods for both physical and health hazards in laboratories.

H. Lab Safety Training Certificates - appended in a separate folder
Material Safety Data Sheet
Acetic acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Acetic acid
Catalog Codes: SLA3784, SLA1438, SLA2101, SLA3604, SLA1258
CAS#: 64-19-7
 RTECS: AF1225000
 TSCA: TSCA 8(b) inventory: Acetic acid
 CI#: Not applicable.
 Synonym: Acetic acid; glacial acetic acid
 Chemical Name: Acetic Acid, Glacial
 Chemical Formula: C2-H4-O2

Contact Information:
Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396
US Sales: 1-800-901-7247
International Sales: 1-281-441-4400
Order Online: ScienceLab.com
CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300
International CHEMTREC, call: 1-703-527-3887
For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS #</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid</td>
<td>64-19-7</td>
<td>100</td>
</tr>
</tbody>
</table>

Toxicological Data on Ingredients: Acetic acid: ORAL (LD50): Acute: 3310 mg/kg [Rat]. 4960 mg/kg [Mouse]. 3530 mg/kg [Rat]. DERMAL (LD50): Acute: 1060 mg/kg [Rabbit]. VAPOR (LC50): Acute: 5620 ppm 1 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, mucous membranes, skin, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated
or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

## Section 4: First Aid Measures

### Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

### Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

### Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

### Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

### Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

### Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

### Serious Ingestion:
Not available.

## Section 5: Fire and Explosion Data

### Flammability of the Product:
Flammable.

### Auto-Ignition Temperature:
463°C (865.4°F)

### Flash Points:

### Flammable Limits:
LOWER: 4% UPPER: 19.9%

### Products of Combustion:
These products are carbon oxides (CO, CO2).

### Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials, of metals.

### Explosion Hazards in Presence of Various Substances:

### Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

### Special Remarks on Fire Hazards:
Reacts with metals to produce flammable hydrogen gas. It will ignite on contact with potassium-tert-butoxide. A mixture of ammonium nitrate and acetic acid ignites when warmed, especially if warmed.

### Special Remarks on Explosion Hazards:
Acetic acid vapors may form explosive mixtures with air. Reactions between acetic acid and the following materials are potentially explosive: 5-azidotetrazole, bromine pentafluoride, chromium trioxide, hydrogen peroxide, potassium permanganate, sodium peroxide, and phosphorus trichloride. Dilute acetic acid and dilute hydrogen can undergo an exothermic reaction if heated, forming peracetic acid which is explosive at 110 degrees C. Reaction between chlorine trifluoride and acetic acid is very violent, sometimes explosive.

**Section 6: Accidental Release Measures**

**Small Spill:**
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

**Large Spill:**
Flammable liquid. Corrosive liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. If the product is in its solid form: Use a shovel to put the material into a convenient waste disposal container. If the product is in its liquid form: Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Absorb with an inert material and put the spilled material in an appropriate waste disposal. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

**Section 7: Handling and Storage**

**Precautions:**
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, metals, acids, alkalis.

**Storage:**
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

**Section 8: Exposure Controls/Personal Protection**

**Engineering Controls:**
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

**Personal Protection:**
Splash goggles. Synthetic apron. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).

**Personal Protection in Case of a Large Spill:**
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:**
TWA: 10 STEL: 15 (ppm) [Australia] TWA: 25 STEL: 27 (mg/m³) [Australia] TWA: 10 STEL: 15 (ppm) from NIOSH TWA: 25 STEL: 37 (mg/m³) from NIOSH TWA: 10 STEL: 15 (ppm) [Canada] TWA: 26 STEL: 39 (mg/m³) [Canada] TWA: 25 STEL: 37 (mg/m³) TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [United States] [1999] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 25 (mg/m³) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

**Section 9: Physical and Chemical Properties**
Physical state and appearance: Liquid.
Odor: Pungent, vinegar-like, sour (Strong.)
Taste: Vinegar, sour (Strong.)
Molecular Weight: 60.05 g/mole
Color: Colorless. Clear (Light.)
pH (1% soln/water): 2 [Acidic.]
Boiling Point: 118.1°C (244.6°F)
Melting Point: 16.6°C (61.9°F)
Critical Temperature: 321.67°C (611°F)
Specific Gravity: 1.049 (Water = 1)
Vapor Pressure: 1.5 kPa (@ 20°C)
Vapor Density: 2.07 (Air = 1)
Volatile: Not available.
Odor Threshold: 0.48 ppm
Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.2
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Heat, ignition sources, incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents, reducing agents, metals, acids, alkalis.
Special Remarks on Reactivity: Reacts violently with strong oxidizing agents, acetaldehyde, and acetic anhydride. Material can react with metals, strong bases, amines, carbonates, hydroxides, phosphates, many oxides, cyanides, sulfides, chromic acid, nitric acid, hydrogen peroxide, carbonates. ammonium nitrate, ammonium thiosulfate, chlorine trifluoride, chlorosulfonic acid, perchloric acid, permanganates, xylene, oleum, potassium hydroxide, sodium hydroxide, phosphorus isocyanate, ethylenediamine, ethylene imine.
Special Remarks on Corrosivity: Moderate corrosive effect on bronze. No corrosion data on brass
Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 3310 mg/kg [Rat]. Acute dermal toxicity (LD50): 1060 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5620 ppm 1 hours [Mouse].

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, mucous membranes, skin, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material and may cause reproductive effects based on animal data. No human data found.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Extremely irritating and corrosive. Causes skin irritation (reddening and itching, inflammation). May cause blistering , tissue damage and burns. Eyes: Extremely irritating and corrosive. Causes eye irritation, lacrimation, redness, and pain. May cause burns, blurred vision, conjunctivitis, conjunctival and corneal destruction and permanent injury. Inhalation: Causes severe respiratory tract irritation. Affects the sense organs (nose, ear, eye, taste), and blood. May cause chemical pneumonitis, bronchitis, and pulmonary edema. Severe exposure may result in lung tissue damage and corrosion (ulceration) of the mucous membranes. Inhalation may also cause rhinitis, sneezing, coughing, oppressive feeling in the chest or chest pain, dyspnea, wheezing, tachypnea, cyanosis, salivation, nausea, giddiness, muscular weakness. Ingestion: Moderately toxic. Corrosive. Causes gastrointestinal tract irritation (burning and pain of the mouth, throat, and abdomen, coughing, ulceration, bleeding, nausea, abdominal spasms, vomiting, hematemesis, diarrhea). May Also affect the liver (impaired liver function), behavior (convulsions, giddines, muscular weakness), and the urinary system - kidneys (Hematuria, Albuminuria, Nephrosis, acute renal failure, acute tubular necrosis). May also cause dyspnea or asphyxia. May also lead to shock, coma and death. Chronic Potential Health Effects: Chronic exposure via ingestion may cause blackening or erosion of the teeth and jaw necrosis, pharyngitis, and gastritis. It may also behavior (similar to acute ingestion), and metabolism (weight loss). Chronic exposure via inhalation may cause asthma and/or bronchitis with cough, phlegm, and/or shortness of breath . It may also affect the blood (decreased leukocyte count), and urinary system (kidneys). Repeated or prolonged skin contact may cause thickening, blackening, and cracking of the skin.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 423 mg/l 24 hours [Fish (Goldfish)]. 88 ppm 96 hours [Fish (fathead minnow)]. 75 ppm 96 hours [Fish (bluegill sunfish)]. >100 ppm 96 hours [Daphnia].
BOD5 and COD: BOD-5: 0.34-0.88 g oxygen/g

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification:
CLASS 3: Flammable liquid. Class 8: Corrosive material

**Identification:** Acetic Acid, Glacial UNNA: 2789 PG: II

**Special Provisions for Transport:** Not available.

## Section 15: Other Regulatory Information

**Federal and State Regulations:**

**Other Regulations:**

**Other Classifications:**

**WHMIS (Canada):**
CLASS B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F). CLASS E: Corrosive liquid.

**DSCL (EEC):**
R10- Flammable. R35- Causes severe burns. S23- Do not breathe gas/fumes/vapour/spray [***] S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

**HMIS (U.S.A.):**
- Health Hazard: 3
- Fire Hazard: 2
- Reactivity: 0
- Personal Protection: H

**National Fire Protection Association (U.S.A.):**
- Health: 3
- Flammability: 2
- Reactivity: 0

**Protective Equipment:**
Gloves (impervious). Synthetic apron. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

## Section 16: Other Information

**References:** Not available.

**Other Special Considerations:** Not available.

**Created:** 10/09/2005 03:35 PM

**Last Updated:** 05/21/2013 12:00 PM

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Material Safety Data Sheet  
Sodium chlorite MSDS

Section 1: Chemical Product and Company Identification

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Sodium chlorite</th>
</tr>
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<tr>
<td>Catalog Codes</td>
<td>SLS4636</td>
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<tr>
<td>CAS#</td>
<td>7758-19-2</td>
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<tr>
<td>RTECS</td>
<td>VZ4800000</td>
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<td>TSCA</td>
<td>TSCA 8(b) inventory: Sodium chlorite</td>
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<tr>
<td>Chemical Formula</td>
<td>NaClO2</td>
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Contact Information:

Sciencelab.com, Inc.  
14025 Smith Rd.  
Houston, Texas 77396  
US Sales: 1-800-901-7247  
International Sales: 1-281-441-4400  
Order Online: ScienceLab.com  
CHEMTREC (24HR Emergency Telephone), call:  
1-800-424-9300  
International CHEMTREC, call: 1-703-527-3887  
For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS #</th>
<th>% by Weight</th>
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</thead>
<tbody>
<tr>
<td>Sodium chlorite</td>
<td>7758-19-2</td>
<td>100</td>
</tr>
</tbody>
</table>

Toxicological Data on Ingredients: Sodium chlorite: ORAL (LD50): Acute: 165 mg/kg [Rat]. 350 mg/kg [Mouse]. 300 mg/kg [Guinea pig].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (corrosive). Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures
Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation persists, seek medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

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### Section 5: Fire and Explosion Data

<table>
<thead>
<tr>
<th>Flammability of the Product:</th>
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<tbody>
<tr>
<td>Auto-Ignition Temperature:</td>
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</tr>
<tr>
<td>Flash Points:</td>
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</tr>
<tr>
<td>Flammable Limits:</td>
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<tr>
<td>Products of Combustion:</td>
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<tr>
<td>Fire Hazards in Presence of Various Substances:</td>
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<td>Explosion Hazards in Presence of Various Substances:</td>
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<tr>
<td>Fire Fighting Media and Instructions:</td>
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<tr>
<td>Special Remarks on Fire Hazards:</td>
<td>Not available.</td>
</tr>
<tr>
<td>Special Remarks on Explosion Hazards:</td>
<td>Not available.</td>
</tr>
</tbody>
</table>

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### Section 6: Accidental Release Measures

**Small Spill:** Use appropriate tools to put the spilled solid in a convenient waste disposal container.

**Large Spill:**
Oxidizing material. Stop leak if without risk. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal.

---

### Section 7: Handling and Storage
Precautions:
Keep locked up Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material Do not ingest. Do not breathe dust. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as reducing agents, combustible materials.

Storage:
Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.
Odor: Not available.
Taste: Not available.
Molecular Weight: 90.45 g/mole
Color: Not available.
PH (1% soln/water): Not available.
Boiling Point: Not available.
Melting Point: Decomposes. (180°C or 356°F)
Critical Temperature: Not available.
Specific Gravity: Not available.
Vapor Pressure: Not applicable.
Vapor Density: Not available.
Volatility: Not available.
Odor Threshold: Not available.
Water/Oil Dist. Coeff.: Not available.
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water.
Solubility: Soluble in cold water.
Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with reducing agents, combustible materials.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 165 mg/kg [Rat].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 5.1: Oxidizing material.

Identification: Sodium chlorite : UN1496 PG: II

Special Provisions for Transport: Not available.
Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Sodium chlorite Massachusetts RTK: Sodium chlorite TSCA 8(b) inventory: Sodium chlorite


Other Classifications:

WHMIS (Canada):
CLASS C: Oxidizing material. CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):
- Health Hazard: 1
- Fire Hazard: 0
- Reactivity: 0
- Personal Protection: E

National Fire Protection Association (U.S.A.):
- Health: 1
- Flammability: 0
- Reactivity: 1
- Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:30 PM
Last Updated: 05/21/2013 12:00 PM

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Material Safety Data Sheet  
Sodium hydroxide MSDS

Section 1: Chemical Product and Company Identification

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<tr>
<th>Product Name: Sodium hydroxide</th>
<th>Contact Information:</th>
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<tbody>
<tr>
<td><strong>Catalog Codes:</strong> SLS3298, SLS1081, SLS2503, SLS3925, SLS1705</td>
<td><strong>Sciencelab.com, Inc.</strong></td>
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<tr>
<td><strong>CAS#: 1310-73-2</strong></td>
<td><strong>14025 Smith Rd.</strong></td>
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<td><strong>RTECS:</strong> WB4900000</td>
<td><strong>Houston, Texas 77396</strong></td>
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<td><strong>TSCA:</strong> TSCA 8(b) inventory: Sodium hydroxide</td>
<td><strong>US Sales:</strong> 1-800-901-7247</td>
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<td><strong>International Sales:</strong> 1-281-441-4400</td>
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<td><strong>Synonym:</strong> Caustic Soda</td>
<td><strong>Order Online:</strong> ScienceLab.com</td>
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<tr>
<td><strong>Chemical Name:</strong> Sodium Hydroxide</td>
<td>CHEMTREC (24HR Emergency Telephone), call:</td>
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<tr>
<td><strong>Chemical Formula:</strong> NaOH</td>
<td>1-800-424-9300</td>
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<tr>
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<td>International CHEMTREC, call: 1-703-527-3887</td>
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<td></td>
<td>For non-emergency assistance, call: 1-281-441-4400</td>
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Section 2: Composition and Information on Ingredients

<table>
<thead>
<tr>
<th>Composition:</th>
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<tbody>
<tr>
<td>Name</td>
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<tr>
<td>Sodium hydroxide</td>
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Toxicological Data on Ingredients: Sodium hydroxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:  
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. The amount of tissue damage depends on length of contact. Skin contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:  
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to mucous membranes, upper respiratory tract, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.
Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: metals

Explosion Hazards in Presence of Various Substances:

Fire Fighting Media and Instructions: Not available

Special Remarks on Fire Hazards:
sodium hydroxide + zinc metal dust causes ignition of the latter. Under proper conditions of temperature, pressure and state of division, it can ignite or react violently with acetaldehyde, ally alcohol, allyl chloride, benzene-1,4-diol, chlorine trifluoride, 1,2 dichlorehylen, nitroethane, nitromethane, nitoparaffins, nitropropane, cinnamaldehyde, 2,2-dichloro-3,3-dimethylbutane. Sodium hydroxide in contact with water may generate enough heat to ignite adjacent combustible materials. Phosphorous boiled with NaOH yields mixed phosphines which may ignite spontaneously in air. sodium hydroxide and cinnamaldehyde + heat may cause ignition. Reaction with certain metals releases flammable and explosive hydrogen gas.

Special Remarks on Explosion Hazards:
Sodium hydroxide reacts to form explosive products with ammonia + silver nitrate. Benzene extract of allyl benzenesulfonyl chloride prepared from allyl alcohol, and benzene sulfonyl chloride in presence of aqueous sodium hydroxide, under vacuum distillation, residue darkened and exploded. Sodium Hydroxide + impure tetrahydrofuran, which can contain peroxides, can
cause serious explosions. Dry mixtures of sodium hydroxide and sodium tetrahydroborate liberate hydrogen explosively at 230-270 deg. C. Sodium Hydroxide reacts with sodium salt of trichlorophenol + methyl alcohol + trichlorobenzene + heat to cause an explosion.

### Section 6: Accidental Release Measures

| Small Spill: | Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid. |
| Large Spill: | Corrosive solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities. |

### Section 7: Handling and Storage

**Precautions:**
Keep container dry. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, metals, acids, alkalis, moisture.

**Storage:** Keep container tightly closed. Keep container in a cool, well-ventilated area. Hygroscopic. Deliquescent.

### Section 8: Exposure Controls/Personal Protection

**Engineering Controls:**
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

**Personal Protection:**
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent.

**Personal Protection in Case of a Large Spill:**
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:**
STEL: 2 (mg/m3) from ACGIH (TLV) [United States] TWA: 2 CEIL: 2 (mg/m3) from OSHA (PEL) [United States] CEIL: 2 (mg/m3) from NIOSH Consult local authorities for acceptable exposure limits.

### Section 9: Physical and Chemical Properties

**Physical state and appearance:** Solid. (Deliquescent solid.)

**Odor:** Odorless.

**Taste:** Not available.

**Molecular Weight:** 40 g/mole

**Color:** White.
pH (1% soln/water): 13.5 [Basic.]

Boiling Point: 1388°C (2530.4°F)

Melting Point: 323°C (613.4°F)

Critical Temperature: Not available.

Specific Gravity: 2.13 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatile: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Incompatible materials, moisture, moist air

**Incompatibility with various substances:** Highly reactive with metals. Reactive with oxidizing agents, reducing agents, acids, alkalis, moisture.

**Corrosivity:** Not available.

**Special Remarks on Reactivity:**
Hygroscopic. Much heat is evolved when solid material is dissolved in water. Therefore cold water and caution must be used for this process. Sodium hydroxide solution and octanol + diborane during a work-up of a reaction mixture of oxime and diborane in tetrahydrofuran is very exothermic, a mild explosion being noted on one occasion. Reactive with water, acids (mineral, non-oxidizing, e.g. hydrochloric, hydrofluoric acid, muriatic acid, phosphoric), acids (mineral, oxidizing e.g. chromic acid, hypochlorous acid, nitric acid, sulfuric acid), acids (organic e.g. acetic acid, benzoic acid, formic acid, methanoic acid, oxalic acid), aldehydes (e.g. acetaldehyde, acrolein, chloral hydrate, foraldehyde), carbamates (e.g. carbonolote, carbofuran), esters (e.g. butyl acetate, ethyl acetate, propyl formate), halogenated organics ( dibromoethane, hexachlorobenzene, methyl chloride, trichloroethylene), isocyanates (e.g. methyl isocyanate), ketones (acetone, acetophenone, MEK, MIBK), acid chlorides, strong bases, strong oxidizing agents, strong reducing agents, flammable liquids, powdered metals and metals (i.e aluminum, tin, zinc, hafnium, raney nickel), metals (alkali and alkaline e.g. cesium, potassium, sodium), metal compounds (toxic e.g. beryllium, lead acetate, nickel carbonyl, tetraethyl lead), nitriles (e.g. potassium nitride, sodium nitride), nitriles (e.g. acetonitrile, methyl cyanide), nitro compounds (organic e.g. nitrobenzene, nitromethane), acetic anhydride, chlorohydrin, chlorosulfonic acid, ethylene cyanohydrin, glyoxal, hydrosulfuric acid, oleum, propiolactone, acylonitrile, phorosous pentoxide, chloroethanol, chloroform-methanol, tetrahydroborate, cyanogen azide, 1,2,4,5 tetrachlorobenzene, cinnamaldehyde. Reacts with formaldehyde hydroxide to yield formic acid, and hydrogen.

**Special Remarks on Corrosivity:** Very caustic to aluminum and other metals in presence of moisture.

**Polymerization:** Will not occur.

Section 11: Toxicological Information

**Routes of Entry:** Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. May cause damage to the following organs: mucous membranes, upper respiratory tract, skin, eyes.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Rabbit] - Route: Oral; Dose: 500 mg/kg

Special Remarks on Chronic Effects on Humans: May affect genetic material. Investigation as a mutagen (cytogenetic analysis)

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Not available.
BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material
Identification: : Sodium hydroxide, solid UNNA: 1823 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sodium hydroxide Illinois chemical safety act: Sodium hydroxide New York release reporting list: Sodium hydroxide Rhode Island RTK hazardous substances: Sodium hydroxide Pennsylvania RTK: Sodium hydroxide Minnesota: Sodium hydroxide Massachusetts RTK: Sodium hydroxide New Jersey: Sodium hydroxide Louisiana spill reporting: Sodium hydroxide California Director's List of Hazardous Substances: Sodium hydroxide TSCA 8(b) inventory: Sodium hydroxide CERCLA: Hazardous substances.: Sodium hydroxide: 1000 lbs. (453.6 kg)

Other Regulations:
Other Classifications:

**WHMIS (Canada):** CLASS E: Corrosive solid.

**DSCL (EEC):**
R35- Causes severe burns. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37/39- Wear suitable gloves and eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

**HMIS (U.S.A.):**
- Health Hazard: 3
- Fire Hazard: 0
- Reactivity: 2
- Personal Protection: j

**National Fire Protection Association (U.S.A.):**
- Health: 3
- Flammability: 0
- Reactivity: 1
- Specific hazard:

**Protective Equipment:**
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

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### Section 16: Other Information

**References:** Not available.

**Other Special Considerations:** Not available.

**Created:** 10/09/2005 06:32 PM

**Last Updated:** 05/21/2013 12:00 PM

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