



Acids and Bases

Acids and bases include acids such as vinegar, higher concentrations of acetic acid, citrus fruits, citric acid, vitamin C, sour candy, cream of tartar, lead-acid batteries, sulfuric acid, and hydrochloric acid. Bases such as baking soda, sodium carbonate, alkaline batteries, dishwashing detergent, laundry detergent, floor or carpet cleaner, ammonia, drain cleaner, sodium hydroxide, and calcium hydroxide are also in this grouping.

Refer to the SDS for hazard identification, proper procedures for handling each specific chemical, and information on what to do in an emergency involving the chemical. For substances that are sold directly to the public, refer to the consumer warning labels or find the SDS for the product on the manufacturer's website. Some items do not come with SDSs or warning labels. Think critically about the hazards that these types of items may pose, particularly in an outreach setting.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">• Pour, scoop, or use a dropper to transfer an acid or a base from a source container.• Use a stirring rod or spoon to mix substances.	<ul style="list-style-type: none">• Can irritate or even burn the eyes or the skin• Can cause irritation to the respiratory tract or respiratory distress• May cause minor irritation to severe burns on contact	<p>Low Risk</p> <ul style="list-style-type: none">• Skin contact with sodium bicarbonate solution• Using vinegar in a dropper bottle• 15 mL of citric acid solution or sodium bicarbonate solution in a cup• Drips and drops of a weak acid, such as citric acid or sodium bicarbonate, onto the work surface <p>Medium Risk</p> <ul style="list-style-type: none">• Skin contact with lemon or lime juice <p>High Risk</p> <ul style="list-style-type: none">• Combining an acid with sodium carbonate or sodium bicarbonate in a pressurized container• Skin contact with 1 M hydrochloric acid• Using 1 M sodium hydroxide in a hands-on activity for children	<ul style="list-style-type: none">• Wear eye protection, protective clothing, and gloves.• Avoid contact with eyes.• Provide adequate ventilation.• Provide small amounts of source solutions, or place acid and base solutions in dropper bottles.• Use the minimum concentration necessary.• When diluting an acid, always add the acid to the water.• When diluting a base, always add the water to the base.	<ul style="list-style-type: none">• Immediately flush the eye with a steady stream of sterile saline solution or cold tap water for at least 5 minutes.• In cases of respiratory distress, move to fresh air.• Clean the affected area with plenty of water. Do not attempt to neutralize spills on the skin.
<ul style="list-style-type: none">• Clean up spills or dispose of acid or base solutions.	<ul style="list-style-type: none">• Acids or bases can react with other substances in solid or liquid waste containers.• Can react with plumbing if poured down the drain		<ul style="list-style-type: none">• Use small quantities of reactants.• Neutralize spills or waste solutions with weak bases or acids, such as baking soda and citric acid.	<ul style="list-style-type: none">• Pour solid baking soda or citric acid directly on the spill.• Use pH paper or another indicator to determine when the spill is neutralized.• Wipe up neutralized spills with paper towels, and place them with the solid trash.• Clean the area and the affected equipment with standard cleaning supplies.
<ul style="list-style-type: none">• Transporting acids and bases			<ul style="list-style-type: none">• Place acids and bases in separate bins or boxes when transporting.	



Acids and Bases (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Ensure adequate ventilation.
- Avoid touching your eyes.
- Use baking soda or citric acid (as appropriate) to neutralize solutions before disposing of them down a drain.

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Allergens and Sensitizers

Whenever working with a group of people, in particular children, avoid the use of common allergens and sensitizers. Reactions typically become increasingly severe with repeated exposure, so individuals may not be aware of the severity of their immune response until it is too late. Common allergens and sensitizers include peanuts, tree nuts, chicken eggs, dairy products, shellfish, wheat, poison ivy, various plant oils, pollen, mold, fabric softener, borax, latex, and insect venom. Allergens may cause a range of symptoms, from watery eyes, mild rash, or swelling to a full anaphylactic response.

Refer to Section 3 of the SDS for composition and information on ingredients. Look at the list of ingredients on the product packaging and, if applicable, the consumer warning label to identify possible allergens or sensitizers. Some items do not come with SDSs, warning labels, or even ingredient lists. Think critically about the hazards that these types of items may pose, particularly in an outreach setting.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> Eating or touching highly allergenic food items, such as nuts, eggs, or dairy products Note: If exploring food science, tasting or eating may be part of the activity. In these cases, use food safety protocols such as handwashing and working in a clean area before handling food items. Conduct food science activities in a kitchen or cafeteria away from other chemistry activities. 	<ul style="list-style-type: none"> Any substance that evokes an adverse immune response is an allergen. Common food allergens include milk, eggs, tree nuts, peanuts, fish, shellfish, wheat, and soy. Be on the lookout for the sudden appearance of itchy red skin, rashes, hives, pink swollen watery eyes, swollen lips, or respiratory distress. Be aware that nausea and vomiting are also symptoms of ingestion or other exposure to allergens. 	<p>Low Risk</p> <ul style="list-style-type: none"> Use of hand soap or laundry detergent <p>Medium Risk</p> <ul style="list-style-type: none"> Exposure to dust, mold, pollen, nickel, eggs, milk, cheese, wheat, or soy Inhaling or touching borax powder or solution, including slime containing sodium borate Touching or using latex gloves or other items made of natural or synthetic latex <p>High Risk</p> <ul style="list-style-type: none"> Exposure to insect venom, poison ivy, poison oak, or poison sumac plants or oils In some people, exposure by breathing, touching, or ingesting peanuts, tree nuts, or shellfish 	<ul style="list-style-type: none"> Discourage and prevent tasting and eating of food or non-food substances while doing hands-on science activities. Never eat in a lab. Read food labels, and avoid foods or ingredients that are common allergens. Inform participants of the presence of common allergens. Before conducting the activity, ask participants whether they have any health concerns about ingesting foods, to allow them to opt out of the activity. 	<ul style="list-style-type: none"> If possible, prepare an alternative way to engage participants with allergies. If this is not possible, people with known allergies should not participate in the activity. Consult with parents, guardians, or teachers, who will have emergency protocols in place. Do not administer first aid unless you are trained and authorized to do so. In cases of an anaphylactic response, call 911.
<ul style="list-style-type: none"> Touching or breathing allergenic substances or sensitizers, such as soap, detergent, fabric softener, borax, latex, or nickel 	<ul style="list-style-type: none"> Contact with soap, detergent, latex, insect venom, or plant oils, and breathing dust, mold, or pollen may cause an allergic response in some people. Contact with sodium borate (borax) may cause mild skin irritation to severe chemical burns on the skin. 		<ul style="list-style-type: none"> Wear nitrile gloves to limit or prevent exposure in people without confirmed allergies. People with confirmed allergies should not participate in the activity. Use materials with strong smells in a large, well-ventilated location. 	<ul style="list-style-type: none"> If contact with the skin occurs, rinse the affected area thoroughly with water. If eye contact occurs, immediately flush the eye with a steady stream of water for at least 5 minutes.



Allergens and Sensitizers (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Make participants aware of allergens and sensitizers before exposure to them.
- When possible, provide alternatives so that people with allergies can safely participate.
- Ensure adequate ventilation.
- Avoid touching your eyes.
- Wear gloves when making or playing with slime containing sodium borate.

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Broken Glassware

Broken glassware can easily occur with labware such as thermometers, beakers, flasks, or test tubes, as well as with household objects such as magnifying glasses, drinking glasses, or vases. Avoid the use of glassware in outreach settings. If possible, substitute glassware with plastic test tubes, beakers, graduated cylinders, and stirring rods.

When considering the hazards of broken glassware, also consider the hazards associated with the contents of the glass container. Be sure to refer to the Outreach Hazard Guide that

corresponds to the chemical(s) inside the broken container, as well as to the Outreach Hazard Guide for *Spills and Splashes*. If you choose to accept the risks associated with broken glass and use glass items in your outreach, bring a cardboard box to collect, seal, and dispose of broken glass. Also, bring a small broom, dustpan, packing tape, a permanent marker, splash goggles, and protective gloves. If glass breaks, use the marker to label the box with “broken glass” and, if applicable, the name of the compound that the glass container once held. Take the sealed box with you back to your home, office, or lab to dispose of properly.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> Transporting and using glassware Use of glass thermometers or glass stirring rods 	<ul style="list-style-type: none"> Glass can break. Broken pieces can cut and scratch skin. Glass sharps could enter the eye, scratch the cornea, or become embedded in the eye. Symptoms are pain, sensitivity to light, and blurry vision. If a thermometer is inserted into a rubber stopper, the thermometer can break and be embedded in the hand or scratch the skin. 	<p>Low Risk</p> <ul style="list-style-type: none"> Using a glow stick with a glass ampule sealed inside the plastic tube Participant using a glass alcohol thermometer with plastic or metal backing Disposing of broken glass in a sealed, labeled cardboard box <p>Medium Risk</p> <ul style="list-style-type: none"> Skin contact with lime juice Participant using a glass stirring rod Participant using a glass alcohol thermometer without plastic or metal backing Trained presenter heating glassware Using a designated broom and dustpan to collect broken glass <p>High Risk</p>	<ul style="list-style-type: none"> Wear splash goggles when using glassware. Inspect glassware and equipment before use, to ensure that it is not broken or damaged. Avoid the use of glassware in outreach settings. If possible, substitute glassware with plastic test tubes, beakers, graduated cylinders, and stirring rods. When transporting glassware, wrap it in paper or bubble wrap and place it securely in a box. If heating, use Pyrex or a similar heat-resistant material. Use a lubricant when inserting a thermometer into a rubber stopper. Do not force the thermometer into the stopper. 	<ul style="list-style-type: none"> Irrigate the wound with a steady stream of water. If a shard remains, sanitize tweezers with alcohol before removing the shard. Wash your hands thoroughly before touching or attempting to remove glass from the eye. Immediately flush the eye with a steady stream of sterile saline solution or cold to lukewarm water for at least 5 minutes. If a small piece of glass is embedded in the eye, do not try to remove it. Seek emergency medical care.
<ul style="list-style-type: none"> Collect and dispose of broken glassware properly. 	<ul style="list-style-type: none"> Broken glass may cut skin or enter a wound. 	<ul style="list-style-type: none"> Participant using a mercury thermometer Picking up broken glass with bare hands and a paper towel Inserting a thermometer without plastic or metal backing into a rubber stopper Exposure to shattered glass at high impact 	<ul style="list-style-type: none"> Wear gloves and protective eyewear to clean up broken glass. Bring a dustpan and brush reserved for this purpose, protective gloves, a box, a permanent marker, and packing tape to the event any time you use glass off-site. 	<ul style="list-style-type: none"> Use a dustpan and brush to collect glass. Place debris in a small cardboard box or a broken glass disposal box. Tape the box closed. Write “broken glass” on the outside of the box. Place the dustpan and brush in a paper or plastic bag, to limit exposure to glass dust and small shards. Take the box back to your lab, home, or office and dispose of the sealed box with the solid trash.



Broken Glassware (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Avoid using glassware in outreach settings.
 - Broken glassware is sharp and can cut through skin. The contents of the broken glass container can enter skin, causing further irritation.
- If using glassware for a demo, bring a broken glass kit with you.
- Wear splash goggles and protective gloves whenever using glassware and especially when cleaning up broken glass.
- Do not bring or use mercury thermometers with K–12 students.
 - Mercury is a serious chronic health hazard. Although it is not readily absorbed through the skin, its greatest health hazard is due to inhalation of its vapors, usually as a result of a spill. Mercury compounds (e.g., alkyl mercury) are extremely toxic and must be handled with extreme caution.
- Consult the Outreach Hazard Guide for each type of substance inside the glassware.

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Cryogenics include dry ice, liquid nitrogen, and compressed gases. For compressed gas containers, a sudden lowering of pressure caused by an open valve or a break in the container may allow a once-compressed gas to expand quickly and cause a significant drop in temperature. Storage and handling of cryogenics require special planning, because they may displace oxygen or hyperoxygenate an area.

Refer to the SDS for hazard identification, proper procedures for handling each specific chemical, and information on what to do in an emergency involving the chemical. For substances that are sold directly to the public, refer to the consumer warning labels or find the SDS for the product on the manufacturer's website. Also consult the Outreach Hazard Guides for *Pressurized Containers* and for *Flammables and Ignition Sources*, if relevant.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">• Handling cryogenic substances such as dry ice, liquid nitrogen, or compressed oxygen	<ul style="list-style-type: none">• Cryogenic solids, liquids, and their extremely cold vapor can rapidly freeze human tissue, causing cold burns, frostbite, and extensive tissue damage. Even brief exposure can cause permanent eye damage.• Boiling and splashing always happen when filling a warm container with a cryogenic liquid and when inserting objects into cryogenic liquids.	<p>Low Risk</p> <ul style="list-style-type: none">• Activity facilitator wears cotton gloves while transferring a small piece of dry ice from one container to a small plastic wine carafe <p>Medium Risk</p> <ul style="list-style-type: none">• Transporting dry ice in the trunk of a car with the windows of the passenger cabin partially open <p>High Risk</p> <ul style="list-style-type: none">• Riding in an elevator with a cryogenic substance• Getting splashed with a cryogenic liquid while transferring some to a warm container	<ul style="list-style-type: none">• Wear special cryogenic gloves or loosely fitting insulated cotton gloves every time you handle a cryogenic substance or a non-insulated container containing a cryogenic substance.• Wear a long-sleeved shirt or lab coat, pants without cuffs, and closed-toe shoes when handling cryogenic substances.• Wear a face shield over chemical splash goggles during transfer and handling of cryogenic liquids.• Use a splash shield when working with cryogenic liquids.• Store, transport, and handle all cryogenic substances in a well-ventilated area.• Presenters or audience members should not expose parts of the body to liquid nitrogen on purpose.• Liquid nitrogen used for making ice cream must be food grade. The resulting ice cream must be placed in containers only used for food.• Use tongs to handle dry ice.	<ul style="list-style-type: none">• If contact with skin or eyes occurs, immediately place the affected area under warm (60–90 °F or 15–32 °C) running water for 15 minutes or longer, to prevent frostbite or other damage. Do not use hot water or dry heat; this could cause further tissue damage. Do not rub the affected skin area.
<ul style="list-style-type: none">• Storing cryogenic substances	<ul style="list-style-type: none">• Pressure buildup within a container can cause an explosion.• Cryogenic substances are simple asphyxiants and can displace oxygen when they vaporize, causing asphyxiation, which may result in unconsciousness and even death.• Cryogenic substances may cause oxygen in air to condense near them. This area of excess oxygen increases the flammability of nearby materials and may cause an explosion.		<ul style="list-style-type: none">• Use well-insulated containers, approved for use with cryogenics, to store and transport cryogenic substances.• Ensure that containers holding cryogenic substances have loose-fitting lids, functioning pressure release valves, or vents.• Obtain dry ice as close to your event start time as possible.• Store cryogenic substances in a well-ventilated area.• Remove combustible substances from areas where cryogenic liquids are stored or used.• Store cryogenic substances in rooms with adequate ventilation.	<ul style="list-style-type: none">• If people show any symptom of oxygen deprivation, such as shortness of breath, hoarseness, confusion, nosebleeds, or loss of consciousness, immediately evacuate everyone to the outdoors. Increase ventilation before returning.• Use low-oxygen alarms when storing or using cryogenic materials.



Cryogenics (Continued)

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">Transporting cryogenic substances	<ul style="list-style-type: none">Vapor from a cryogenic substance can displace oxygen in an enclosed area such as a car, van, or bus, quickly causing asphyxiation.		<ul style="list-style-type: none">If the vehicle has a trunk that is separate from the passenger cabin, place dry ice in the trunk during transport.Whether dry ice is in the trunk or, out of necessity, in the passenger cabin, open the vehicle's windows.Minimize the amount of time the cryogenic substance is in the vehicle.Do not transport flammable and cryogenic liquids together.	<ul style="list-style-type: none">If people or animals show any symptom of oxygen deprivation, pull over, stop the vehicle, and immediately step out of the vehicle. Leave the doors open, and walk away from the vehicle.
<ul style="list-style-type: none">Disposal of cryogenic substances	<ul style="list-style-type: none">Placing cryogenic substances in a trash can or a sink can damage the container or basin, crack pipes, and give the public unsupervised access to the substance.		<ul style="list-style-type: none">Allow the remaining cryogenic substance to sublimate in a large, well-ventilated room that is not accessible to the public.Never tightly cap a container of a cryogenic substance.	<ul style="list-style-type: none">Follow the protocols listed above, depending on the situation.

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Do not perform demos in which parts of the human body will be placed in danger (such as placing dry ice in the mouth or dipping the hands into a hazardous liquid).
- Handle liquid nitrogen slowly, to minimize boiling and splashing.
- Only activity facilitators (not participants) should handle cryogenic substances.
- Do not transport dry ice in a passenger elevator.
- Wear loose-fitting insulated gloves while handling a cryogenic substance. Gloves only protect from short exposure, not from long exposure such as immersing a hand in the liquid.
- Ensure adequate ventilation.
- Ensure that the containers used can withstand the low temperatures.

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Flammables and Ignition Sources

Flammables are substances that burn, such as organic solvents, vapors, and dusts. Ignition sources include a candle, Bunsen burner, toaster oven, hot plate, or even the interior of a car on a hot day.

Refer to the SDS for hazard identification, proper procedures for handling the chemicals, and information on what to do in an emergency involving the chemicals. For substances that are sold directly to the public, refer to the consumer warning labels or find the SDS for the product on the manufacturer's website.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> • Use of a flammable substance 	<ul style="list-style-type: none"> • Many organic solvents are flammable and can easily catch on fire in the presence of heat or a flame. • Demos involving open flames and flammable materials present an unacceptable risk of flash fires and deflagrations, which can cause serious injuries to participants and observers. Flammable vapors can flow across the table and onto the floor, where they can be ignited by a flame, a spark (e.g., from static electricity), or a hot surface. 	<p>Low Risk</p> <ul style="list-style-type: none"> • A small spill leads to a small fire. <i>Happens occasionally; minor injury</i> • A small sample (1 mL) catches fire and burns out. <i>Happens rarely; injury requiring first aid</i> <p>Medium Risk</p> <ul style="list-style-type: none"> • A small sample (5–10 mL) catches fire and is smothered. <i>Happens occasionally; injury requiring first aid</i> • A small puff of combustible dust is placed in an open flame. <i>Happens frequently; minor injury</i> • Touching a hot surface burns skin. <i>Happens occasionally; injury requiring first aid</i> 	<ul style="list-style-type: none"> • Be mindful of the fire triangle when using flammables, and keep flammable substances away from ignition sources (heat, a flame, or a source of static electricity). • Remove excess solvents from the work area. • Do not add more solvent to a demo once heat has been used. NEVER pour fuel from a bottle onto a flame. Do not perform any demo with this as part of a written procedure! Watch this video about flame jetting to see why. • Keep lighters and matches separate from flammable substances during storage and transport of materials. • Use shields if flammable substances are ignited. • Do not use flammable substances in rooms with carpet. 	<ul style="list-style-type: none"> • In case of fire, follow the fire emergency protocols of the host facility. See the Conversation Checklist. • If the fire is very small, cover it with a lid, a wet towel, or a fire blanket to smother it. • There should be an ABC-type fire extinguisher within reach. • If a person is on fire, use “stop, drop, and roll” and try to smother the flames.
<ul style="list-style-type: none"> • Use of ignition sources to start a fire 	<ul style="list-style-type: none"> • Touching a heated surface or flame could burn skin. • Ignition sources could start unintended fires. 	<p>High Risk</p> <p>These should not be done!</p> <ul style="list-style-type: none"> • Pouring methanol onto an ignition source <i>Happens occasionally; serious injury or death</i> • Heating a crucible with a Bunsen burner and touching it with your fingers <i>Happens frequently; injury requiring first aid</i> 	<ul style="list-style-type: none"> • Clear the work area before using a flame or heat source. Keep flames away from flammable substances. • Always use caution around open flames. • Use a flame or heat source only with the approval of the host facility. Some municipalities may require a fire permit from the local fire department. • Exercise caution when using a heat source. Tape cords to the floor to prevent tripping. Turn off and unplug hot plates as soon as they are no longer needed. • Do not touch anything that might be too hot to handle. • Wear oven mitts when moving items into or out of a toaster oven. 	<ul style="list-style-type: none"> • For first-degree burns, hold the burn or scald under cool running water for 20 minutes. Seek medical attention.



Flammables and Ignition Sources (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

Before the event

1. Obtain the written consent of the host facility well in advance of the event if planning to use flame, fire, hot plates, portable toaster ovens, flammable materials, or combustion reactions.
2. Notify security and/or administrators that you will be performing demos. If public space will be used for demos involving fire, contact the local fire department to determine whether the demos meet local fire and building use codes.
3. Review SDSs, and pay particular attention to Section 5 for firefighting measures and special extinguishing materials.
4. Pack a fire blanket and dry chemical (ABC-type) fire extinguisher with up-to-date inspection tags.
5. Cars can heat up quickly, with temperatures exceeding the flash points of flammable substances. The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) defines flammable substances as those with flash points between 73 °F and 140 °F (23 °C and 60 °C). Substances with flash points below 73 °F (23 °C) should not be transported to or used in outreach settings.
6. Prepare and follow a safety checklist for all combustion demos involving the use of a flammable liquid.
7. Provide PPE such as eye protection, aprons, and safety equipment for participants who will be working with flames.

During the event

1. Comply with all local fire and safety rules and regulations as well as those of the host organization.
2. Have a person in your group who is trained and prepared to use a fire blanket and dry chemical (ABC-type) fire extinguisher, and keep these items within reach while monitoring demos.
3. Use of flammables requires special considerations, education, and training. Serious injuries have occurred when flammable solvents were used in outreach settings when they were used to demonstrate combustion reactions. Never pour flammable solvents in the presence of ignition sources!
4. Ensure that observers will be at a safe distance of 10 feet (3 m) or more and are protected by a physical barrier, such as a polycarbonate shield, from the demo area. If this physical separation is impossible because of the small size of the space, do not conduct the demo in that area!
5. Know where the exits in the building are located, and communicate this to all volunteers.
6. Ensure adequate ventilation for all combustion activities.
7. Extinguish matches in a dedicated labeled beaker of water.
8. Do not dispense a powder near an ignition source, a flame, or a source of static electricity.
9. Keep flammable solvents away from electrical equipment, such as a hot plate or toaster oven.
10. Dispense only the amount of liquid required BEFORE beginning the demo. Cap the solvent bottle and REMOVE it from the demo area before applying the ignition source.
11. Never open a bottle of flammable liquid in the presence of a flame, hot surface, or other ignition source. When you open the bottle and tilt it to pour the liquid out, the first thing that leaves the bottle is an invisible, highly flammable cloud of vapor. In the presence of a flame, hot surface, or spark, this vapor will ignite immediately!
12. Never add more flammable liquid to a combustion demo once it is under way.
13. Never reach over an exposed flame or hot plate or leave a flame or hot plate unattended.
14. If flammable substances must be warmed, use only small quantities in a hot water bath and ensure adequate ventilation to remove vapor.

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Hot Surfaces and Liquids

Hot surfaces and hot liquids are of particular concern when working with young children, because contact burns and scalds occur more quickly and at lower temperatures than in adults. Hot surfaces and liquids look the same as those at ambient temperature, so there is no visual warning that these items will cause mild to severe injury.

Refer to the Outreach Hazard Guide for *Flammables and Ignition Sources*, along with this one, when using an electrical appliance, portable Bunsen burner, chafing fuel, or a tea light candle as a heat source. Also consult the applicable Outreach Hazard Guide for each type of substance being heated.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> Use a toaster oven or larger oven to warm or heat an item, such as plastic with recycling code number 6 (polystyrene), a pine cone, dough, clay, or food. Use an iron to melt crayons or plastic beads, or to transfer an image onto a piece of cloth. 	<ul style="list-style-type: none"> The interior and exterior surfaces of the oven will become hot enough to burn skin. The bottom and possibly the sides of the iron will become hot enough to burn skin. The object being heated will become hot enough to burn skin. 	<p>Low Risk</p> <ul style="list-style-type: none"> Using an oven or iron in a separate room away from members of the public Using the smallest amount of reactants possible, or diluting reactants to limit the resulting temperature of an exothermic reaction 	<ul style="list-style-type: none"> Wear insulated thermal gloves when placing objects into and removing them from an oven. Use a spatula to move hot items onto a cooling rack or other heat-resistant surface. Keep hot objects out of reach of children and other members of the public until the object has cooled completely. Use ovens or irons out of reach of children, and allow the objects to cool completely before handling them. 	<ul style="list-style-type: none"> Hold the burn or scald under cool running water for 20 minutes. Seek medical attention.
<ul style="list-style-type: none"> Conduct an exothermic chemical reaction, such as “Elephant’s Toothpaste” or “Genie in a Bottle”, Use an electric urn to heat water. Use a hot plate or griddle to heat a substance. Use a portable Bunsen burner, chafing fuel, or a tea light candle to heat or maintain the temperature of a substance. 	<ul style="list-style-type: none"> The surface of the vessel may become too hot to handle. Some alcohol thermometers may rupture at temperatures near or above 49 °C (120 °F), breaking the glass and releasing a flammable liquid. Electric urns heat water to 100 °C (212 °F). A temperature of 54 °C (130 °F) can result in a full-thickness burn within 30 seconds on a young child. The surface of the electric urn will remain too hot to touch long after the appliance is turned off. Someone may touch the surface of the urn and receive a contact burn. People may trip over the electrical cords, causing the person or the urn, or both, to fall. Hot water can melt plastic cups, causing them to warp. Hot liquids may spill from the misshapen cup. 	<p>Medium Risk</p> <ul style="list-style-type: none"> Using a toaster oven, hot plate, griddle, electric urn, portable Bunsen burner, chafing fuel, or a tea light candle on a stage or in an area stanchioned off from the public <p>High Risk</p> <ul style="list-style-type: none"> Using boiling water directly from the electric urn or thermos with members of the public 	<ul style="list-style-type: none"> Do not touch anything that might become too hot to handle. Do not use a thermometer with substances that are nearly as hot as or hotter than the upper limit of the thermometer. Wear splash goggles when using hot liquids. Do not use water hotter than 49 °C (120 °F) with members of the public. Be aware that tap water in some locations may be hotter than this. If using an electric urn, hot plate, or griddle, use the appliance in a separate room that is not accessible to the public. If this is not possible, use stanchions or other physical dividers to keep the public away from the appliance. If heating a substance in a container, use Pyrex or a similar heat-resistant material. Use a thermos with a lid to transfer liquid from the appliance to the activity space. Use insulated thermal gloves or a heat-resistant container to transfer solids from a hot plate or griddle to the activity space. Keep cords out of walkways. If this is not possible, use tape, such as floor marking tape, gaffer tape, or duct tape, to secure the cords to the ground. Keep in mind that duct tape leaves behind a sticky residue on cords and floor surfaces. Supply hot water not hotter than 49 °C (120 °F) to participants. Pour the hot water into small containers for use by activity participants. 	<ul style="list-style-type: none"> In the event of a spill, use stanchions, a chair, or another physical barrier to section off the area. Allow the spill to cool completely before cleaning. Hold the burn or scald under cool running water for 20 minutes. Seek medical attention.



Hot Surfaces and Liquids (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Wear thermal gloves, to protect skin.
- Use tongs or a spatula to move objects from hot surfaces.
- Use a thermos with a lid to transfer liquid from an electric urn or hot plate to the activity space.
- Use insulated thermal gloves or a heat-resistant container to transfer solids from a hot plate or griddle to the activity space.
- Use a thermometer to ensure that water used in the activity is not hotter than 49 °C (120 °F).
- Pour hot water not hotter than 49 °C (120 °F) into small containers for use by activity participants.
- Keep hot objects out of reach of children and other members of the public until the object has cooled completely.
- Use ovens or irons out of reach of children.

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Inhalation Hazards

Inhalation hazards are airborne substances such as gases, tiny droplets, or ultrafine particles that cause respiratory distress. Inhalation hazards include substances that may become airborne as they are shaken, sprayed, or poured, or evaporate. Examples of inhalation hazards include cornstarch, instant drink mix, theatrical fog, smoke from combustion reactions, perfume, and aerosols. Gases released into the air may displace oxygen, causing severe injury or even death.

Refer to the SDS for hazards, risks, and protocols for specific inhalation hazards such as vapors, dust, and particulates. In particular, Section 11 contains toxicological information,

Section 8 contains exposure controls and personal protections, and Section 4 includes symptoms of inhalation as well as first aid measures. For substances that are sold directly to the public, refer to the consumer warning labels or find the SDS for the product on the manufacturer's website. Some items do not come with SDSs or warning labels. Think critically about the hazards that these types of items may pose, particularly in an outreach setting. Some inhalation hazards, such as cornstarch, are also flammable. Be sure to consult the Outreach Hazard Guides for *Flammables and Ignition Sources*, *Allergens and Sensitizers*, *Cryogenics*, *Oxidizers*, and *Pressurized Containers* as appropriate, along with this one for inhalation hazards.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">• Pouring a powder from one container to another• Release of ultrafine particles into the air	<ul style="list-style-type: none">• Even if a substance is not listed as hazardous, inhaling particles can irritate the respiratory system.• Small particles can easily become airborne and persist in the air.• Larger airborne particles may irritate the nose, throat, and eyes.• Items such as cornstarch, sugar, or cocoa powder; aluminum, magnesium, or zinc; charcoal, cellulose, or soot; and various chemical dusts are combustible and, under certain conditions, explosive.	<p>Low Risk</p> <ul style="list-style-type: none">• Using a scoop to carefully transfer cornstarch from a box to a bowl <p>Medium Risk</p> <ul style="list-style-type: none">• Dumping cornstarch into a large bowl• Using theatrical fog in a well-ventilated space• Smelling the smoke from a combustion reaction <p>High Risk</p> <ul style="list-style-type: none">• Transporting dry ice in the trunk of a car with the windows of the passenger cabin partially open	<ul style="list-style-type: none">• Use only quantities that can be adequately handled by the ventilation system.• Do not pour a powder near an ignition source, flame, or source of static electricity.• Minimize the amount of dust released into the air by scooping rather than pouring powders and, in the case of spills, using a vacuum to collect dust rather than a broom.• Store, transport, and handle all particulate matter (PM) in small containers.• Wear splash goggles.• Use a high-efficiency particulate air (HEPA) filter to reduce the amount of PM in the air.• If there is even the slightest risk of explosion, use a safety shield to protect activity facilitators and participants from propelled container fragments or contents.	<ul style="list-style-type: none">• Prevent the further spread of dust and vapors by closing the door of the room where the incident occurred and increasing ventilation.• Use a fan to blow indoor air out.• Evacuate the room or building until the dust settles and is removed.• In case of fire, follow the fire emergency protocols of the host facility.
<ul style="list-style-type: none">• Smoke from combustion reactions• Smoke from fog machines• Volatile organic compounds (VOCs) and other aerosols• Invisible gases generated as part of a reaction	<ul style="list-style-type: none">• Small particles may lodge in people's lungs, causing short- and long-term negative health effects.• Exposure to theatrical fog irritates the eyes and the respiratory tract.• Breathing in small particles and aerosols can be dangerous for people with pre-existing heart or lung issues.• Inhalation of gases can cause damage to mucous membranes.	<ul style="list-style-type: none">• Placing dry ice into a pool and diving into the water• Inadvertently creating a cloud of cornstarch dust near a heat source	<ul style="list-style-type: none">• Keep participants out of the stream of smoke, whether from combustion or a fog machine.• Do not use substances with strong smells.• Do not use substances with known harmful VOCs, such as benzene, carbon tetrachloride, and formaldehyde.• Keep containers of VOCs tightly closed when not in use.• Use VOCs in a well-ventilated area.• Use only the specified fluid "fog juice" in a fog machine.• Do not do activities that could result in the release of harmful quantities of noxious gases into the local air supply.• If a chemical must be smelled, teach all involved the technique of wafting.	<ul style="list-style-type: none">• Use a fan to blow indoor air out.• Evacuate the room or building.



Inhalation Hazards (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Minimize the amount of dust released into the air.
- Avoid strong smells. If a chemical must be smelled, use the wafting technique.
- Do not pour a powder near an ignition source, flame, or source of static electricity.
- Ensure that all demos are appropriate for the room being used and the available safety equipment.
- Keep all exit paths clear.
- Ensure adequate ventilation in the demo area, to ensure that participants and audience members will not be exposed to harmful quantities of toxic gases or chemical vapors.
- The use of a fume hood is required for any demo that uses or produces a substance with a threshold limit value (TLV) less than 50 ppm (check the SDSs for the TLVs of all chemicals).
- Provide safety shield protection whenever there is the slightest possibility that a container, its fragments, or the contents could be propelled with sufficient force to cause exposure and/or personal injury.

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Noise and Unexpected Loud Sounds

Noise and unexpected loud sounds such as unexpected pops and explosions, sounds resembling gunshots or destruction, and even loud music can be triggering to people. Many children and some adults are very sensitive to loud sounds. Because of this, avoid using loud or unexpected sounds in outreach settings. Practice conducting demos and

hands-on activities, to identify the type and timing of associated sounds. Find ways to soften or even eliminate loud sounds. Then consult with the host facility about the use and timing of these less intense sounds.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> Doing something that makes an unexpected loud sound 	<ul style="list-style-type: none"> People in a crowd could mistake the sound for a gunshot and panic. Children, especially those who are neuro-atypical, may experience fear or overstimulation. Continued loud sounds may damage a person's hearing. Vibrations from explosions can dislodge objects from surfaces, and they could fall onto an onlooker. 	<p>Low Risk</p> <ul style="list-style-type: none"> Piercing a balloon with a long skewer, removing it, and then, after a warning about the sound, popping the balloon with the sharp point of the skewer <p>Medium Risk</p> <ul style="list-style-type: none"> Viewing scheduled fireworks from a distance Holding a burning wooden splint near the mouth of a test tube containing hydrogen (makes a popping sound) <p>High Risk</p> <ul style="list-style-type: none"> Sitting directly in front of speakers during a loud musical performance 	<ul style="list-style-type: none"> Avoid loud sounds. Warn everyone within earshot of the impending sound so that they can mentally and physically prepare. Advise them to cover their ears. Be aware of participant behavior that could cause loud or unexpected sounds. 	<ul style="list-style-type: none"> Use a calm voice, and recognize that unexpected loud noises are unpleasant. Identify the source of the unexpected loud sound. Assure participants or the audience that this will not happen again. Focus participants on their breath, calm music, or something else that will not induce sensory overload.

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Keep microphones and volume controls out of reach of the public.
- Do not intentionally make unexpected loud sounds when interacting with the public, in particular children, teens, and sensitized individuals.
- Inform everyone in the vicinity of upcoming sudden sounds so that they can prepare both mentally and physically.

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Oxidizers, such as hydrogen peroxide, bleach (sodium hypochlorite), sulfuric acid, and oxygen, readily accept electrons, making them very reactive and in some cases combustible. Do not store or transport oxidizers near acids or bases.

Refer to the SDS for hazard identification, proper procedures for handling each specific chemical, and information on what to do in an emergency involving the chemical. For substances that are sold directly to the public, refer to the consumer warning labels or find the SDS for the product on the manufacturer's website. Also consult the Outreach Hazard Guide for *Flammables and Ignition Sources*, if relevant.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">• Pour, scoop, or use a dropper to transfer an oxidizer from a source container.• Use a stirring rod or a spoon to mix substances.	<ul style="list-style-type: none">• Can irritate or even burn the eyes or skin• Can cause irritation to the respiratory tract or respiratory distress• May cause minor irritation to severe burns on contact	<p>Low Risk</p> <ul style="list-style-type: none">• Skin contact with 3% hydrogen peroxide, commonly (household concentration) <p>Medium Risk</p> <ul style="list-style-type: none">• Pouring 30% hydrogen peroxide solution into a tall graduated cylinder while wearing gloves, goggles, a lab coat, and closed-toe shoes	<ul style="list-style-type: none">• Wear eye protection, protective clothing, and gloves.• Avoid contact with eyes.• Provide adequate ventilation.• Provide small amounts of source solutions.	<ul style="list-style-type: none">• Immediately flush the eye with a steady stream of sterile saline solution or cold tap water for at least 5 minutes.• In cases of respiratory distress, move to fresh air.
<ul style="list-style-type: none">• Clean up a spill or dispose of oxidizers.• Transporting oxidizers		<p>High Risk</p> <ul style="list-style-type: none">• Conducting the exothermic potassium chlorate and gummy bear reaction while wearing a short-sleeved shirt and sandals and with bare hands	<ul style="list-style-type: none">• Use small quantities of reactants.• Place oxidizers and acids in separate bins or boxes when transporting.	<ul style="list-style-type: none">• Wipe up spills with paper towels, and place them with the solid trash.• Clean the area and the affected equipment with standard cleaning supplies.

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Do not grind strong oxidizers (such as potassium perchlorate) with a mortar and pestle.
- Store and transport strong oxidizers in a separate box from reducing agents (including items containing cellulose, such as paper towels, if they may become wet).
- Avoid touching your eyes.
- Ensure adequate ventilation.

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Pressurized Containers

Pressurized containers include carbonating cylinders, medical oxygen cylinders, cans of shaving cream, cans of hair mousse, cans of air freshener, and unopened bottles or cans of carbonated beverages. Keep in mind that some containers may become pressurized as a result of a chemical reaction or application of heat.

Refer to the SDS for hazard identification, proper procedures for handling each specific chemical, and information on what to do in an emergency involving chemicals stored in

pressurized containers. Some pressurized gases, such as tanks of helium for party balloons, carbon dioxide cartridges to make bubbly beverages, or supplemental oxygen for climbing at high elevations, are sold directly to the public. Refer to the consumer warning labels or find the SDS for the product on the manufacturer's website. Also consult the Outreach Hazard Guides for *Noise and Unexpected Loud Sounds*, for *Cryogenics*, and for *Flammables and Ignition Sources*, as applicable.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">• A lid or top pops off the top of a container.• Gas is generated in a balloon or other flexible container.	<ul style="list-style-type: none">• Someone (including both participants and those approaching the area) could get hit in the face, eye, or other body part, with the lid or, in the case of a ruptured container, with sharp pieces at high impact.• Reactants could splash into someone's eye or onto their skin, hair, or clothing.• Reactants could splash onto the table and floor around the activity area.• A tight-fitting lid could inadvertently be placed on a container where gas is being generated and rupture the container.• A balloon or flexible container could become a reactant-leaking projectile.	<p>Low Risk</p> <ul style="list-style-type: none">• Inflating a balloon with carbon dioxide released as popping candy dissolves in a bottle of soda <p>Medium Risk</p> <ul style="list-style-type: none">• One 18 cm self-inflating balloon ruptures and the contents shoot out.• Overfilling a helium balloon to the point that it pops loudly in a crowded area• The valve breaks on a pressurized gas cylinder, filling a large room with the gas contents. <p>High Risk</p> <ul style="list-style-type: none">• Leaving a pressurized container unattended• A glass or hard stopper is ejected and becomes a projectile.	<ul style="list-style-type: none">• Splash goggles that are ANSI Z87.1 certified will protect eyes from blunt impact and from splashes of reagents into the eyes.• Provide safety shield protection whenever there is even the slightest possibility that a container, its fragments, or the contents could be propelled with sufficient force to cause exposure and/or personal injury.• Never point a test tube or reaction vessel of any type toward another person.• Never generate gas in a container that someone could inadvertently seal.• Use plastic containers if chemically compatible.• Monitor participant behavior to prevent rupture of a container.• In the case of splashing, either use a tarp securely taped to the floor with gaffer tape or move the activity outside. Limit the range of projectiles by covering small containers with a tall clear plastic cup or other cover.	<ul style="list-style-type: none">• If someone is hit with a projectile, check to see what they were hit with, to identify the type of intervention required. Provide an instant cold pack or a piece of ice in a zip-top plastic bag wrapped in a paper towel, to minimize swelling. Provide a bandage for cuts.• Splashes onto skin: advise participants to go to the restroom and rinse the affected area under running water for several minutes.• Splashes onto clothing: provide paper towels to wipe the liquid.• Splashes into eyes: provide a sterile eyewash bottle and recommend that participants rinse the affected eye with the entire container. They may need to follow this with running water. Provide clean paper towels.• Follow the incident reporting policy of the host facility and, if applicable, of your organization.• Take extra precautions to ensure that the incident does not happen again.



Pressurized Containers (Continued)

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none">• Portable lecture bottles• Consumer-grade helium tank, N₂O cartridge, carbonating cylinder, scuba tank, or medical oxygen cylinder• Consumer products such as canned air, hair mousse, shaving cream, sprayable air freshener, and other cans that use pressurized gases to expel products from the containers	<ul style="list-style-type: none">• Never leave a pressurized container unattended. People may take it for huffing later. Inhaling any pressurized gas directly from the cylinder could cause light-headedness, dizziness, unconsciousness, or death. It could also cause an air embolism, resulting in seizures, or rupture a lung.		<ul style="list-style-type: none">• Ensure that all pressurized containers are properly labeled.• Transport and store pressurized containers upright in such a way that they will not tip over.• Use a lecture bottle gas cylinder stand or carrier to transport one or more lecture bottles.• Ensure that the cap is always on a lecture bottle when it is not in use.• Check the valves and regulators of lecture bottles and consumer-grade pressurized containers to ensure that they are not leaking, damaged, or corroded.• Minimize the amount of time the lecture bottles and consumer-grade pressurized containers are in a vehicle.• Avoid transporting pressurized containers in a hot vehicle.	<ul style="list-style-type: none">• If gas is leaking from a pressurized container, turn off the cylinder valve if it is safe to do so.• If you are unable to turn off the gas, evacuate the area and prevent others from entering until first responders arrive.• If someone may have huffed from the pressurized container, seek medical attention right away!

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- A test tube or reaction vessel of any type should never be pointed toward another person.
- Follow proper procedures for working with pressurized gases.
- Make arrangements to use a safety shield and/or eye protection for all individuals in the room for demos that launch projectiles or if there is even the slightest possibility of an unsafe explosion.
- Provide safety shield protection whenever there is even the slightest possibility that a container, its fragments, or the contents could be propelled with sufficient force to cause exposure and/or personal injury.
- All visitors in the vicinity must wear eye protection. Ensure that participants can enter and exit the space safely and that everyone can see what is happening as they approach the space.

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Sharps

Sharps include scissors, safety scissors, hole punches, knives, staples, needles, safety pins, toothpicks, nails, sharpened pencils, wire cutters, and razor blades. Sharps may be created when an item such as a polystyrene test tube breaks or a lid made of polystyrene is cut. When considering the hazards of tools used for cutting, consider the hazards associated with both the tool and the item being cut.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> • Either the activity facilitator or a participant uses a sharp tool or device. • Examples of sharps include: <ul style="list-style-type: none"> ◦ medical devices such as a needle, syringe, EpiPen, lancet, scraper, scalpel, or knife; ◦ tools such as pliers, tin snips, wire cutters, pipe-cutting tools, awl, saw, utility knife, box cutter, wire, or scraper; ◦ household tools and devices such as scissors, razor blade, rotary cutter, tape dispenser cutting blade, food wrap container blade, can opener, opened can lid or edge, safety pin, paper edge, paper cutter, kitchen, craft, or garden knife, or hole punch; ◦ equipment with moving blades such as a drill, food processor, or blender; ◦ unintended sharps, such as sharpened pencils, paper clips, pipe cleaners, chipped or broken glass, or even safety scissors for use by children. 	<ul style="list-style-type: none"> • Someone could hurt themselves or others with the sharp tool or device, or with the object being cut. • If a sharp tool, sharp device, or sharp object is left unattended, someone could inadvertently touch it, misuse it, or intentionally injure themselves or others. 	<p>Low Risk</p> <ul style="list-style-type: none"> • Using scissors to cut lengths of string in an area that is inaccessible by the public • Taping boxes closed using a tape dispenser with a cutting blade • Using pliers to cut wire into usable lengths before transporting to an event <p>Medium Risk</p> <ul style="list-style-type: none"> • A child cuts themselves or someone else while using scissors • A pipe cleaner pokes or punctures the skin of a child making or wearing a beaded bracelet <p>High Risk</p> <ul style="list-style-type: none"> • Searching for a knife with an exposed blade in a box filled with other supplies • Placing an exposed syringe with a needle in the trash 	<ul style="list-style-type: none"> • Pre-cut as much as possible before your event, to avoid the need for cutting tools at your event. • If cutting on-site, use cutting tools or devices in a location inaccessible by the public. • Cut on a stable surface, such as a cutting board. • Close scissors, snips, or retractable knives immediately after use, and store them this way. • Pass tools like scissors to another person in the closed position, handle end first. • Share a knife or other sharp tool by placing it on the counter or table and inviting the other person to pick it up. • For devices and equipment, make sure that all guards and safety devices are in place and functioning properly. • Use plastic beakers, cylinders, stirring rods, pipets, bowls, or trays, rather than glass or ceramic, in outreach settings. 	<ul style="list-style-type: none"> • Follow the emergency medical protocol of the host facility or your organization. • In the case of children, offer the parent, guardian, or chaperone access to wound-care supplies, such as antibacterial ointment, gauze, clean paper towels, or bandages. • Cover the wound with a piece of sterile gauze, and apply pressure for a few minutes to stop bleeding. • If an arm or a leg is bleeding, elevate the wound above the heart while applying pressure. • Irrigate the wound with cool water, and pat dry with a piece of sterile gauze. • Seek emergency medical attention if the wound is deep, the edges of the wound are gaping, or the wound is bleeding heavily. • Cuts or scrapes involving the eye require the attention of a medical professional.



Sharps (Continued)

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Use caution when using objects, devices, or equipment with sharp edges.
- If cutting on-site, use cutting tools and devices in a location inaccessible by the public.
- Cut on a stable surface, such as a cutting board.
- If appropriate, use a mechanical device to hold an object stationary while cutting.
- Transport knives, blades, or other sharps in a puncture-resistant container.
- Close retractable knives immediately after use, and store them this way.
- When using equipment with moving blades, be sure to use all guards and safety devices properly.

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Spills and Splashes

Spills and splashes may occur when pouring, stirring, or dropping substances. Any liquid in an open container, or in a container that could easily become open, presents a spill or splash risk. Even a liquid such as water or saltwater could present a fall risk if it spills on the floor. Spilled solids such as sand, salt, cornstarch, or even gravel may cause injury if someone were to step, slip, and fall.

Refer to the SDS for hazard identification, proper procedures for handling each specific chemical, and information on what to do in an emergency involving the chemical. For substances that are sold directly to the public, refer to the consumer warning labels or find the SDS for the product on the manufacturer's website. Some items do not come with SDSs or warning labels. Think critically about the hazards that these types of items may pose, particularly in an outreach setting.

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> • Activity facilitator or participant pours, moves, or reaches over a container of liquid. • Participant uses a pipet to transfer liquid. • Participant stirs a liquid. • Facilitator or participant places a solid in a liquid-filled container. 	<ul style="list-style-type: none"> • Liquid could splash in an eye, onto skin, or into a pre-existing wound, causing irritation or injury. • If a liquid spills onto the floor, someone could slip, fall, and get hurt. Depending on the liquid, the floor may remain slippery even after the spill has been wiped up. 	<p>Low Risk</p> <ul style="list-style-type: none"> • Using a toothpick to drag drops of water on a plastic plate together to form one big drop • Using dropper bottles of water and saltwater to find the maximum number of drops of each that can be placed on the head of a penny <p>Medium Risk</p> <ul style="list-style-type: none"> • Squeezing an orange slice to release juice without wearing eye protection <p>High Risk</p> <ul style="list-style-type: none"> • Leaving a puddle of water on a floor in a busy hallway 	<ul style="list-style-type: none"> • Wear indirectly vented chemical splash goggles, because any foreign particle in the eye causes irritation and may cause injury. • If a substance is particularly irritating or corrosive, facilitators and participants may wear appropriate protective clothing. (Consider wearing two pairs of gloves, for extra protection.) • Provide appropriate personal protective equipment for audience members who are considered to be in the "danger zone" that would result from a splash or other means of contact. • All event locations where activities will be carried out should be equipped with a simple spill control kit, which includes paper towels and plastic garbage bags. It is also good practice to have signs and/or stanchions on hand in case larger spills occur, so that traffic can be rerouted safely. 	<ul style="list-style-type: none"> • If contact with eyes occurs, use a sterile eyewash to rinse eyes for several minutes. • If skin contact occurs, rinse the affected area under running water for several minutes. • Control the spread of liquid and absorb it with paper towels, vermiculite, dry sand, special absorbent material, cat litter, or spill pillows. • Collect and contain residues, and place them in a plastic bag or bucket. • Package the absorbed substance and material to transport back to your home, office, school, or lab for proper disposal. • Decontaminate the area and the affected equipment using standard cleaning supplies or according to the SDS. (Murphy's oil soap or oil-only sorbent pads are effective for cleaning oily spills.)



Spills and Splashes (Continued)

Describe Each Step in the Procedure	Recognize the Hazards	Assess Risks	Minimize Risks	Prepare for Emergencies
<ul style="list-style-type: none"> Facilitator or participant uses a volatile or flammable substance. Facilitator or participant uses a mercury or alcohol thermometer. 	<ul style="list-style-type: none"> Vapor could enter the respiratory tract or eye, causing irritation or injury. Flammable liquid may be absorbed by hair or clothing, increasing fire risk for the participant. Glass thermometers may shatter, injuring eyes and/or skin. <ul style="list-style-type: none"> Exposure to mercury vapor poses a chronic health risk. Alcohol is both volatile and flammable. 		<ul style="list-style-type: none"> Prevent the spread of dust and vapors by closing the door to the room and increasing ventilation. 	<ul style="list-style-type: none"> Extinguish sources of ignition for volatile liquid spills. Increase ventilation. Collect volatile substances in a plastic bag. Seal the bag. If the volatile substance might react with or dissolve a plastic bag, place it in another suitable container. Once back at your home, office, or lab, dispose of absorbed materials according to the SDS and local ordinances.
<ul style="list-style-type: none"> Facilitator or participant pours or uses a scoop to transfer a powder from one container to another. 	<ul style="list-style-type: none"> Spilled powders may also cause the floor to be slippery. Fine airborne powders may enter the eyes or the respiratory tract. Airborne powders may be more flammable than larger particles of the substance. 		<ul style="list-style-type: none"> Keep a spill kit nearby to contain, absorb, and neutralize any spilled chemicals. Provide safety shield protection whenever there is even the slightest possibility that a container, its fragments, or the contents could be propelled with sufficient force to cause exposure and/or personal injury. 	<ul style="list-style-type: none"> Prevent the further spread of dust and vapors by closing the door of the room where the incident occurred and increasing ventilation. Use a fan to blow indoor air out. Evacuate the room or building until the dust settles and is removed. In case of fire, follow the fire emergency protocols of the host facility.

General safety requirements

- Wear appropriate PPE (safety glasses, at a minimum), including during preparation and cleanup.
- Tie back long hair and secure loose clothing.
- Do not eat or drink food or liquids when conducting this activity.
- Be sure to clean up and dispose of materials properly when you have finished with an activity.
- Thoroughly wash your hands after conducting the activity.

Activity-specific safety requirements

- Do not bring or use mercury thermometers with K–12 students.
 - Mercury is a serious chronic health hazard. Although it is not readily absorbed through the skin, its greatest health hazard is due to inhalation of its vapors, usually as a result of a spill. Mercury compounds (e.g., alkyl mercury) are extremely toxic and must be handled with extreme caution.

This document provides general examples to help you as you conduct your RAMP analysis. The hazards, risk assessments, strategies to minimize risks, and emergency protocols do not address all situations and may not be correct or complete. They are intended only to assist your thinking and information-gathering process. Refer to the disclaimer in the *Safety in Outreach Settings* Instruction Guide for a full description of limitations of this document and the other outreach safety resources. Send questions or comments to outreach@acs.org.