

Safety in Outreach Settings

INSTRUCTION GUIDE

Disclaimer for *Safety in Outreach Settings* Resource

The American Chemical Society (“ACS”) is a federally chartered nonprofit organization with its principal office at 1155 Sixteenth St., NW, Washington, DC 20036.

ACS advocates for the safe practice of chemistry across all disciplines, at every age, and in every organization. We engage with like-minded professionals, participants, students, and entities to provide tools to foster a culture of safety in your classroom, campus, or lab.

Through the ACS Institute’s Center for Lab Safety, the *Safety in Outreach Settings* Resource (hereinafter ‘Resource’) seeks to facilitate hands-on activities or performing chemistry demonstrations in public outreach settings, which require special safety considerations beyond the established standard operating procedures of a chemistry lab.

All information contained within the Resource—the Instruction Guide, RAMP Worksheet, Outreach Safety FAQs, Outreach Hazard Guides, RAMPed-Up Activities and Demos, Conversation Checklist, and any other future materials associated with this Resource (hereinafter collectively ‘Outreach Safety Materials’)—is provided by ACS for information purposes only, and not as part of any legal obligation, whether express or implied by law, whether real or imaginary, between ACS and any person or entity unless specifically undertaken otherwise in writing by the Society. As the owner of all Outreach Safety Materials, ACS reserves the right to change, modify, add, or delete materials relating to this Resource at any time and from time to time without prior notice of any kind whatsoever.

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Further, you acknowledge and accept that every time chemistry is taken out of the lab, on the road, and into public spaces, there are inherent risks to be assumed that ACS cannot guarantee against or prevent. Your diligence in using the Outreach Safety Materials is critical to help you, your audience, your volunteers, and the staff at the facility hosting an event have a positive, safe experience with chemistry. In any event, you assume all risks associated with these Outreach Safety Materials and the associated chemistry activities, experiments, and demonstrations.

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Introduction

Facilitating hands-on activities or performing chemistry demos in public outreach settings requires special safety considerations beyond the established standard operating procedures of your lab. Settings such as science museums, children's museums, libraries, public parks, and schools are unlikely to have fume hoods, splash shields, eye protection, or even easy access to running water. Add the need to transport chemicals to and from the site, with the unknowns of bringing together groups of people, and the likelihood that someone will get hurt increases dramatically!

Safety in Outreach Settings will help you (1) identify and select low-risk activities for your outreach program, (2) recognize and eliminate high-risk activities and demos before they lead to accidents, and (3) make strategic changes to activities and demos to minimize the likelihood of injury and promote a culture of safety.

***Safety in Outreach Settings* consists of six parts:**

- Instruction Guide;
- RAMP Worksheet;
- Outreach Safety FAQs;
- Outreach Hazard Guides;
- RAMPed-Up Activities and Demos; and
- Conversation Checklist.

The central component of *Safety in Outreach Settings* is the RAMP Worksheet. This double-sided worksheet will guide your thinking and give you a place to document your conclusions as you consider the risks associated with offering an activity or demo in an outreach setting.

The image displays two overlapping versions of the RAMP Worksheet. The top worksheet is the 'Recognize the Risks' page, which includes sections for 'Recognize the Risks', 'Activity Name', 'Hazard', and 'Risk'. The bottom worksheet is the 'Required PPE' page, which includes sections for 'Required PPE', 'Hazard', 'PPE', and 'Required PPE'. Both worksheets feature tables for documenting activity details and safety requirements.

Each completed RAMP Worksheet will indicate:

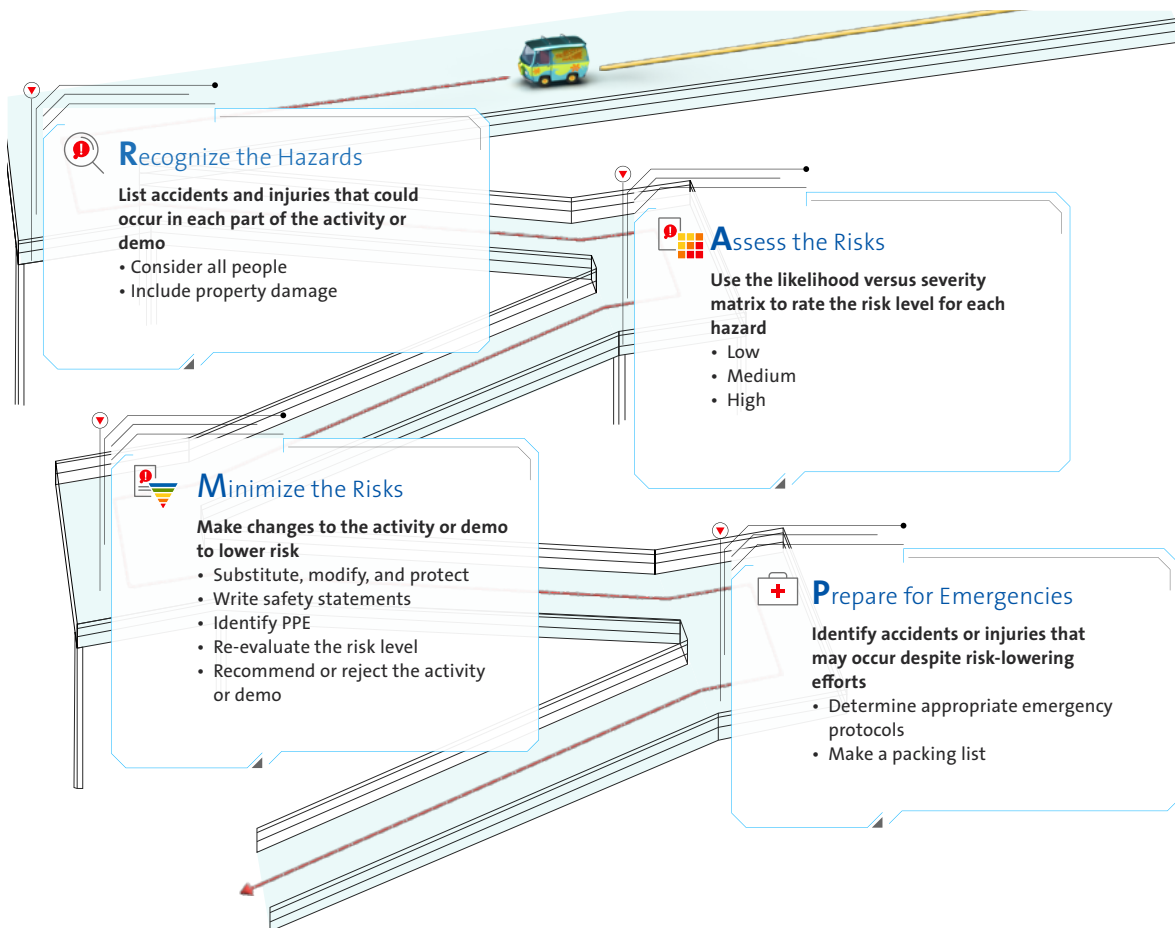
- whether or not to use the activity or demo in an outreach setting;
- whether participants will need to wear safety glasses, splash goggles, or other personal protective equipment (PPE);
- which changes must be made to the materials and procedures to minimize risks;
- which safety statements should be given to presenters, facilitators, and participants; and
- what to do if someone gets hurt.

Use *Safety in Outreach Settings* every time you plan to take chemistry out of the lab, on the road, and into public spaces. Your diligence in using these and other safety resources referenced throughout this guide will ensure that you, your audience, your volunteers, and the staff at the facility hosting your event all have positive, safe experiences with chemistry!

What is RAMP?

Safety in Outreach Settings adapts RAMP, the risk management system used in academic labs, to public venues. Like a physical ramp, RAMP provides a pathway between where you are and where you want to be. Whether you intend to raise safety awareness, lower risk, or just take your outreach to the next level, RAMP is the process of information-gathering, critical thinking, decision-making, and creative problem-solving that can take you there!

RAMP is an acronym for the four phases of thinking and preparation required to manage the risks of doing chemistry.



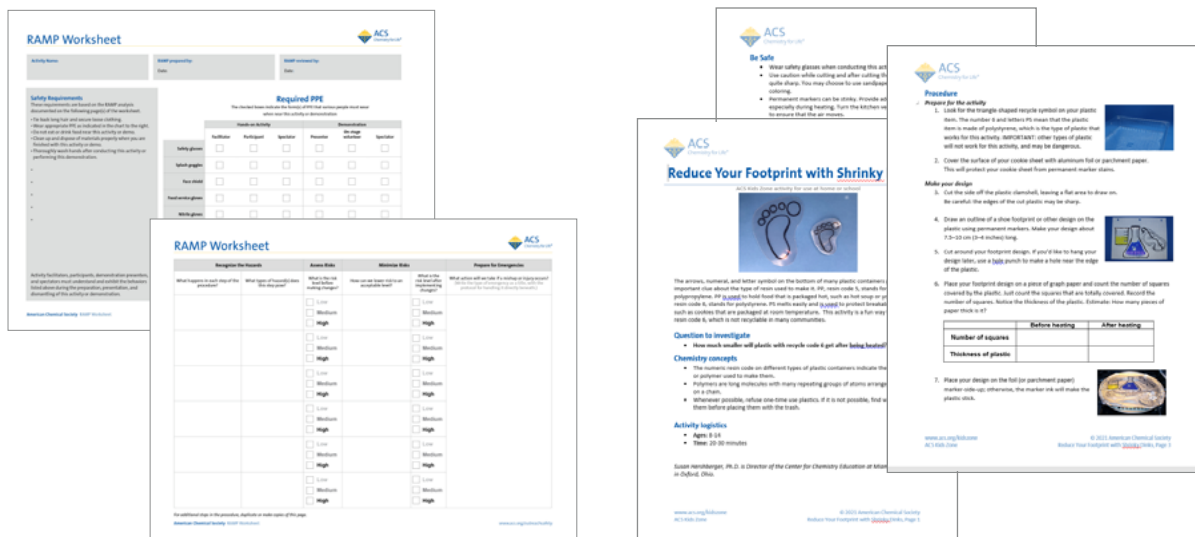
Additional chemical safety resources about RAMP:

- [RAMP Basics](#)
A framework for making chemical safety an integral part of chemistry education and practice.
- [Safer Experiments and Demonstrations](#)
A collection of articles, guidelines, and requirements that explain how to plan and conduct chemistry demos both on- and off-campus.
- [Foundations of Chemical Safety and Risk Management for Chemistry Students](#)
A free, on-demand, self-paced course that teaches the components and tools necessary to develop a strong culture of safety in academic chemistry labs.
 - Each of the 17 units in the course takes about 40–60 minutes to complete.
 - A certificate is awarded upon successful completion of the course.
- [ACS Center for Lab Safety](#)
Access to authoritative tools, education, training, and guidance to support the safe, ethical, responsible, and sustainable practice of doing chemistry.

Get Ready to RAMP

Prepare the RAMP Worksheet

Make a digital or hard copy of the double-sided RAMP Worksheet for each activity or demo you are considering for your outreach. If the activity or demo you are RAMPing up is available online, include a link on the RAMP Worksheet to the specific version you are considering. If you have a hard copy of the activity or demo, be sure to list the name of the activity or demo on the worksheet exactly as it appears on the hard copy, so that you can easily pair them up later.



Add your name to the cover page of the worksheet as the preparer, and appoint a reviewer. Even with the guides and examples that are part of *Safety in Outreach Settings*, risk management is subjective. Members of your outreach team will need to check in with one another frequently to develop group norms.

Gather support materials

In addition to the worksheet and activity write-up or video, be prepared to access the following:

- *Safety in Outreach Settings* support material at www.acs.org/outreachsafety;
- Safety Data Sheets (SDSs) and consumer warning labels for reagents, products, and byproducts;
- first aid information from your organization, the facility where you plan to do your outreach, SDSs, or another reliable source or a trusted medical professional; and
- if you are presenting demos, download the checklist [Safety Guidelines for Chemical Demonstrations](#).

Accessing these documents will help you gather accurate information and make informed decisions as you think through the RAMP risk management process.

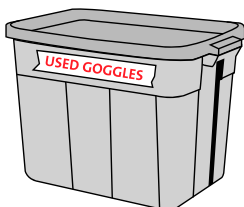
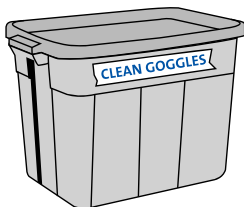
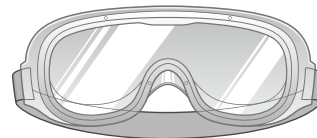


Outreach Safety FAQs

Read the Outreach Safety FAQs to find the answers to these frequently asked questions about outreach safety.

How do I know which form of PPE to use?

At a minimum, all facilitators and participants must wear properly fitting safety glasses when conducting chemistry activities. Find out when splash goggles and gloves are needed.



How can I clean eyewear adequately between users?

Review recommendations for cleaning safety glasses and splash goggles, along with tips for managing this task in various outreach settings.

Do I have to wear PPE when preparing household materials and equipment for hands-on activities?

Find out when PPE is necessary and when it is not while preparing and portioning outreach supplies.

What do I need to do to safely transport chemicals and supplies to and from an outreach site?

Find out how to prevent problems that may occur when transporting fragile items, flammable liquids, acids and bases, dry ice, and more.

Why shouldn't I dispose of used chemicals and disposable items at the outreach site?

Find out why leaving trash or pouring liquids down a sink at the site is a bad idea, and learn what to do with unused reagents, products of chemical reactions, and used paper towels.



Is it safe to send science souvenirs home with children?

You should include instructions and safety information for caregivers with certain science souvenirs. See which giveaways require this type of written information, and find out what to write.

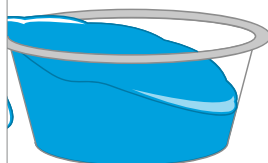
KIDS⁴ CHEMISTRY
MAKING SLIME

Prepare
Clean your work surface and wash your hands with soap and water both before and after making slime—before, keep your slime clean and after keep everything else clean. In addition to the bag of supplies for this activity, you will need one pair of scissors and a paper towel.

Procedure
This is a two-person activity! Both a student and adult must work together to make this slime. Please wait for the presenter to give the instructions before doing each step.

Instructions for students	Instructions for adults
1 Pour all of the blue liquid into the small beaker.	Hold the dropper bulb-side down. Use scissors to cut off the sealed tip.
2 Hold the beaker on a flat surface with one hand. Use a stirring rod to stir the liquid continuously with the other hand.	While your student is stirring, gradually add the entire contents of the dropper into the blue liquid.
3 Pull your stick up out of the beaker and pull the slime off the corner.	Dropper of the dropper with the household trash.
4 Press, squeeze, and stretch your slime. The more you play with it, the less sticky it will be.	Use a paper towel to wipe the stirring rod clean. Reuse it in future science experiments.

Design Slime, Participant Instructions © 2020 American Chemical Society



Column R: Recognize the Hazards

Purpose: Identify hazards from chemicals, equipment, and procedures with the potential to cause harm.

Left side: What happens in each step of the procedure?

Flip your worksheet to the side that looks like one big chart. This is where you will document most of your thinking throughout the RAMP risk management process. In the far left column, paraphrase each step of the procedure and write each phrase in its own row. Add just enough information to describe *what happens*. Also consider who will do each step of the procedure. If there is switching back and forth, for example between a facilitator and a participant or between a presenter and a volunteer from the audience, indicate who will do which step.

Do I have to paraphrase every single step in the procedure in a separate row?

- You may be able to bundle steps that are closely related. This works when the problems that may occur are similar. For example, pouring one solution into another and stirring to get them to mix quickly might be listed as two separate steps in the activity procedure but can be addressed in the same row on the worksheet.
- Other actions, such as labeling cups or waiting for one minute, may not require the careful attention of the RAMP process and could be skipped. However, when in doubt, include the action in the chart! For example, expecting six- and seven-year-olds to write their names on metallized polymer balloons with permanent markers introduces more risk than one might expect. Including this step in its own row means that later on in the RAMP process, you will be primed to identify strategies to prevent stray marks on the table, lessen the strong smell of the markers, and manage the group so that the caps are replaced on the markers and the markers are collected for reuse.

Why is it important to consider who will do each step of a procedure?

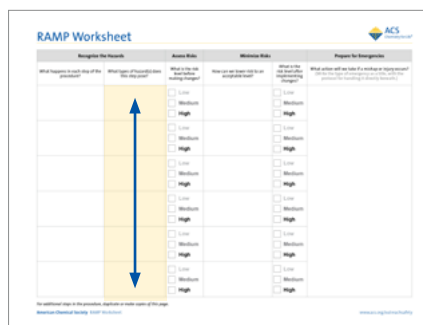
- Inviting a member of the audience to pour one solution into another introduces more risk than having a practiced member of your outreach team do the same thing. Considering who does each part of a demo or hands-on activity will help you properly assess and manage risk. If you plan to work with students, list their age range or categorize them as early elementary, elementary, middle school, or high school students. This will help you to think through safety considerations that are particular to the developmental levels of the participants.

Why do the RAMPed-Up Activities and Demos have extra actions that are not listed in the procedure?

- There are important actions that are taken for every hands-on activity and demo but are rarely listed in the steps of the procedure. These include preparation, transportation to and from the site, and proper disposal. Add these steps to your RAMP Worksheet to ensure that you are considering and minimizing the risks for every aspect associated with offering the particular activity or demo in an outreach setting.

Right side: What types of hazard(s) does this step pose?

Write a phrase or two beside each action listed on the left side of Column R to describe how participants or presenters might be hurt doing or watching this part of the activity or demo. Include the route of exposure, such as skin, eyes, inhalation, or ingestion, in your phrase about potential harm. Keep in mind that accidents, as well as inappropriate use of chemicals and supplies, may occur. Consider both as you identify hazards.



Consult the following sources to help you identify hazards that have the potential to cause harm.

- **Outreach Hazard Guides**

Check to see which outreach hazards are present in your activity or demo. Each of the 12 outreach hazard groupings is presented in the format of a RAMP Worksheet to guide you through each phase of the RAMP process.

- **Safety Data Sheets (SDSs)**

Refer to the SDSs and consumer warning labels for chemicals and other items used in the activity or demo. Do the same for the products and byproducts created. Keep in mind that the lack of an SDS or warning label does not mean that there are no risks associated with the substance or item.

- **Globally Harmonized System of Classification and Labelling of Chemicals (GHS)**

Look for the GHS pictograms on SDSs, on consumer warning labels, and on the applicable Outreach Hazard Guides, to identify harm that could result from exposure to the chemicals, equipment, and actions in your activity or demo.



Acids and Bases



Allergens and Sensitizers



Broken Glassware



Cryogenics



Flammables and Ignition Sources



Hot Surfaces and Liquids



Inhalation Hazards



Noise and Unexpected Loud Sounds



Oxidizers



Pressurized Containers



Sharps



Spills and Splashes

Outreach Hazard Guides

Consult the 12 Outreach Hazard Guides, along with the SDSs, consumer warning labels, and GHS pictograms, to recognize the hazards, assess the risks, minimize the risks, and prepare for emergencies. In some cases, you will need information from multiple hazard categories to recognize the hazards posed by a single chemical, piece of equipment, or item.

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.

Allergens and sensitizers vary from person to person. 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.

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.

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. Also consult the Outreach Hazard Guides for *Pressurized Containers* and for *Flammables and Ignition Sources*, if relevant.

Flammables and ignition sources include cornstarch, candles, paper towels, isopropyl alcohol; propellants in containers such as hair mousse, hair spray, or aerosol disinfectants; clothing, human hair, lighter fluid, propane, gasoline, and oxygen gas. Flammables must be kept away from heat sources and flames.

Hot surfaces and 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.

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. Consult the Outreach Hazard Guide for *Inhalation Hazards* when using cornstarch, instant drink mix, theatrical fog, smoke from combustion reactions, perfume, or aerosols. Gases released into the air may displace oxygen, causing severe injury or even death. Some inhalation hazards, such as cornstarch, are also flammable.

Noise and unexpected loud sounds such as unexpected pops and explosions, loud noises, 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.

Oxidizers, such as hydrogen peroxide, bleach (sodium hypochlorite), sulfuric acid, and oxygen, readily accept electrons, making them very reactive and in some cases combustible.

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.

Sharps include scissors, safety scissors, hole punches, knives, staples, needles, safety pins, toothpicks, nails, sharpened pencils, wire cutters, and razor blades.

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.

Column A: Assess the Risks of the Hazards

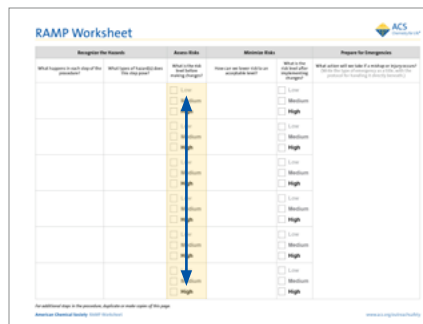
Purpose: Determine whether the risk posed by each hazard is low enough to warrant the use of the chemical, equipment, or procedure.

What is the risk level before making changes?

To determine the level of risk presented by each hazard, first refer to the applicable Outreach Hazard Guides, SDSs, and consumer warning labels to gather information. Then assess these risks as you mentally place each hazard in the Risk Assessment Matrix. Finally, record the risk level of *low*, *medium*, or *high* in Column A for each hazard.

Use this Risk Assessment Matrix as a reference to help you determine how to classify the level of risk presented by each hazard.

Assessing the level of risk from hazards is a subjective exercise. Individuals tend to have different tolerances for risk. Along with doing your research, communicate with members of your outreach team, in particular those with knowledge of chemical safety and those with experience working with children. Also, consider the organization(s) you represent when you share chemistry out in the community, including the host facility. How much risk is each organization willing to accept?



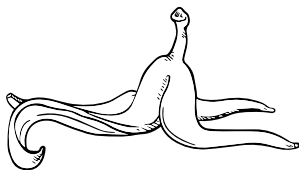
Risk Assessment Matrix				
		Likelihood		
		Happens Rarely or Never	Happens Occasionally	Happens Frequently
Severity	Minor or no Injury	Low Risk	Low Risk	Medium Risk
	Injury Requiring First Aid	Low Risk	Medium Risk	High Risk
	Severe Injury Requiring Professional Medical Attention	Medium Risk	High Risk	High Risk

What's the difference between *hazard* and *risk*?

Hazard

A hazard is the name for any source of potential injury, damage, or harm.

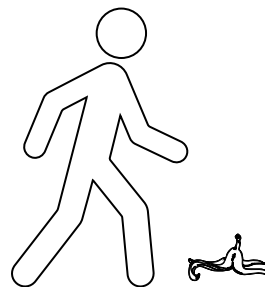
Hazards are intrinsic properties of chemicals, equipment, and environmental conditions.



A banana peel on a sidewalk is a hazard.

Risk

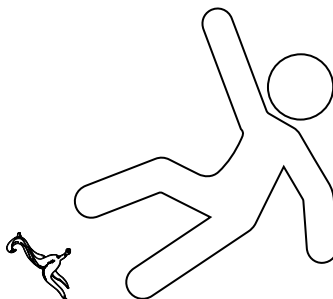
A hazard becomes a risk the moment a person is exposed to the hazard.



A banana peel on a sidewalk becomes a risk the moment a person approaches it.

Level of risk

The level of risk presented by a hazard is a function of (1) the likelihood of an injury occurring and (2) the severity of the injury.



The likelihood that one person walking on the sidewalk will step on the banana peel, slip, and fall may be low, provided that the person is alert and is watching their step.

- If the person is texting or chatting with a friend while walking, the chance of slipping on the banana peel and falling increases.
- The more people who walk on the sidewalk where the banana peel is, the greater the chance that someone will step on it, slip, and fall.
- Falling onto the sidewalk may result in an injury as severe as an open wound requiring stitches, a broken bone, or even a head injury, although such injuries are not common.

Therefore, putting a banana peel on a frequently used sidewalk creates a high risk!

Column M: Minimize the Risks of the Hazards

Purpose: Plan and implement strategies to minimize risks, and determine whether the level of risk is acceptable.

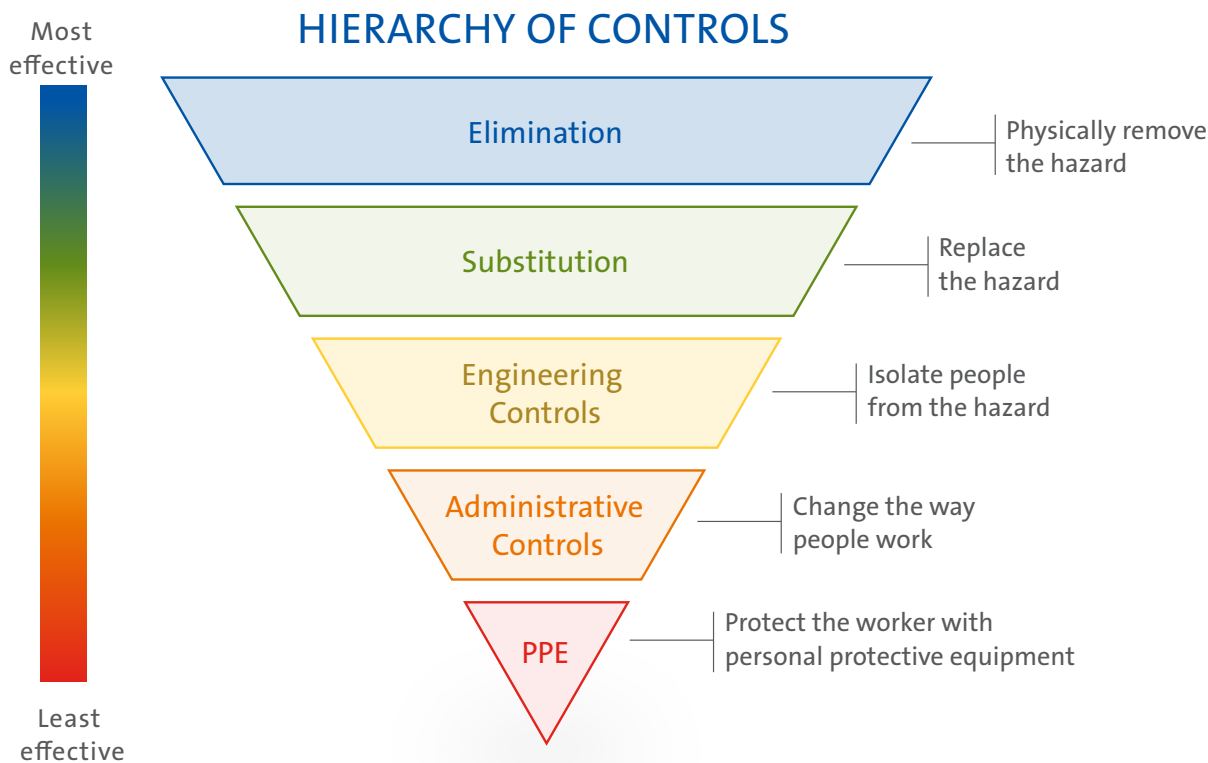
Left side: How can we lower risk to an acceptable level?

An outreach setting is no place for high-risk activities and demos, no matter how much people may enjoy them, how memorable they may be, or how frequently they are shared on social media. However, before abandoning popular chemistry experiences, consider ways to minimize the risks of each of the hazards listed in your RAMP Worksheet. Even medium and low risks can be minimized.

Look at Column M of the applicable Outreach Hazard Guides for ideas and inspiration. Ideally, activities or demos for which all hazards are low-risk are the best choice for use in outreach. Activities or demos that include one or more high-risk hazards present more risk than you, the organization(s) you represent when conducting outreach, and your host facility are probably willing to tolerate.

Throughout phase M of the RAMP risk management process, you will use established strategies, adapted from the [National Institute for Occupational Safety and Health's Hierarchy of Controls](#), to limit exposure to occupational hazards and protect people. By the end of this phase, Column M on your RAMP Worksheet will contain either (1) a clear list of changes to embed in your new, lower-risk activity or demo or (2) a strong case why the activity or demo should not be part of your outreach program. Both provide valuable insight and information.

The screenshot shows a 'RAMP Worksheet' with columns for 'Recognize the Hazards', 'Assess Risks', 'Minimize Risks', and 'Prepare for Emergencies'. The 'Assess Risks' column contains a grid of risk levels (Low, Medium, High) for various hazards. A blue double-headed arrow is drawn vertically through the 'Minimize Risks' column, indicating the goal of reducing risk levels.



Hierarchy of Controls from the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention

Strategies to minimize risks

To better understand the strategies used within the Hierarchy of Controls in the context of public outreach, imagine that you would like to advertise an upcoming physical comedy performance called “Giving Them the Slip”. Your team wants to build excitement and awareness by using images of banana peels on all of the signage for the performance and placing actual banana peels on sidewalks throughout an outdoor public space. Periodically, an actor will fake a slip on a banana peel and dramatically fall. Another actor will comedically react and try to help the person up, while also faking a slip and fall. As part of the physical comedy routine, the two actors will tell everyone in the vicinity about the upcoming performance. The banana peels on sidewalks will indicate the places for the actors to perform the sketch and will spark curiosity and engagement among members of the public.

Using the Hierarchy of Controls within the context of the slippery banana peel promotion

Elimination—Physically remove the hazard

Do not place banana peels on sidewalks!
Perform the physical comedy routine without a banana peel as a location marker.

Substitution—Replace the hazard

Make chalk drawings of banana peels on sidewalks throughout the public space to mark the locations for the actors to perform their comedy routine.

Engineering Controls—Isolate people from the hazard

Use stanchions to demarcate an area that is in view of but not in the path of the public, to conduct the comedy routine.
This will both protect the actors and cue the public not to walk in the space.

Administrative Controls—Change the way people work

Before the actors perform their physical comedy routine, let the public know that a short performance is about to begin, and instead of using stanchions, verbally warn the public not to walk through the performance area.

PPE—Protect the worker with personal protective equipment

Have the actors wear gloves, elbow pads, kneepads, and bicycle helmets when performing the physical comedy routine.

Like in the banana peel scenario, when evaluating hands-on activities and demos for outreach, you must consider potential injuries to members of the public as well as to the performers. You must also recognize the purpose for each hazard (e.g., the reason for the banana peels) as you apply the strategies and devise ways to minimize risks. Refer to the applicable Outreach Hazard Guides for ideas and inspiration, brainstorm ideas with colleagues, and record the best modifications on your RAMP Worksheet.

Hierarchy of Controls	Strategies To Protect Outreach Presenters and Participants while Conducting or Viewing Chemistry Activities and Demos
Elimination	<p>Substitute</p> <p>The most effective way to lower risk from a hazard is to eliminate the hazard from your activity or demo. If this is not possible or would defeat the purpose of the activity or demo, try replacing the hazard with a lower-risk alternative.</p>
Substitution	<ul style="list-style-type: none"> • Replace glassware with plastic cups, beakers, and dishes. • Replace a reactant with a lower-risk alternative. • Lower the concentration of a corrosive solution.
Engineering Controls	<p>Modify</p> <p>Be resourceful and creative as you think of ways to separate people from each hazard. Also, consider ways to cue or alert people to hazards as part of the activity or demo.</p> <ul style="list-style-type: none"> • Implement good lab practices, such as labeling chemicals. • Minimize the quantities of reactants used in the procedure by pre-making solutions and bringing only what you need. • Use equipment with built-in safeguards.
Administrative Controls	<ul style="list-style-type: none"> ◦ Put solutions in labeled dropper bottles to prevent spills. ◦ Place chemicals that participants will use in small, labeled containers with lids, rather than sharing access to a larger source container. ◦ Use trays or secondary containers to contain accidental spills. • Increase ventilation to protect against odors and the buildup of harmful gases. • Warn participants of any loud noises before they occur. • Clean and disinfect surfaces and shared equipment. • Tape down electrical cords. • After the event, remove all event materials and wipe down the work areas to protect people, such as custodial workers. • Label solutions, products, and byproducts with specific descriptive names, such as “used vinegar”, to transport back to your lab, office, or home.
PPE	<p>Protect</p> <p>Determine the appropriate personal protective equipment (PPE) needed for each hazard. Incorporate the wearing of PPE into the dialogue of the activity or demo procedure, or require that it is worn throughout the entire activity or set of activities. Be sure to protect all people involved in the preparation, the program, and the post-event cleanup!</p> <ul style="list-style-type: none"> • Require participants and activity facilitators to wear safety glasses when doing science as well as when within the vicinity of someone else doing science. • If using glass, heat, dust, pressurized containers, or liquids that might splash, require all participants, presenters, and observers to wear splash goggles. • Use gloves suitable for the chemicals you are using. • Use a splash shield as needed to protect the audience.

Protect people, property, and the environment

The Hierarchy of Controls is designed to protect people—workers in industrial settings as well as students and scientists working in chemistry labs. These strategies are also useful when applied to protecting people who are doing or watching chemistry in outreach settings. Remember to protect *all* people associated with your outreach event. Consider audience members, participants conducting hands-on activities, parents and guardians, younger siblings, activity facilitators, demo presenters, spectators watching a demo show, members of the audience invited onstage, volunteers, teachers, and staff at the host facility, including custodial workers.

Also, consider ways to protect the facility. Chemistry can be messy, and when you do outreach you are essentially a guest in someone else's house—*their house, their rules*. Follow their rules, anticipate their concerns, and clean up after yourself.

Here are some strategies to increase the likelihood that the facility staff will invite you back for another event in the future.

- Provide coverings for the tables and tarps for the floor.
- If an activity will be messy or smelly, consider moving it outdoors.
- Use a spill tray to contain possible spills.
- Take all used solutions and solids out of the building with you. This way you can ensure that everything is disposed of properly.
- Use baking soda, citric acid, and an indicator to neutralize acids and bases before transporting them back to your lab, office, or home. This will make the solutions safer to transport and will ensure that when you do pour them down a drain, they do not damage the plumbing. You may want to incorporate neutralizing solutions into the procedures of activities and demos so that this practice is a learning opportunity for the public.
- Use small quantities of substances.
- Collect, clean, and reuse items such as cups and dishes.
- Place clean materials, which cannot be reused but can be recycled in your area, in a recycling bin at your lab, office, or home.
- Dispose of solids and liquids back at your lab, office, or home according to local regulations.
- Refer to the responses to the following Outreach Safety FAQs for additional guidance.
 - What do I need to do to safely transport chemicals and supplies to and from an outreach site?
 - Why shouldn't I dispose of used chemicals and disposable items at the outreach site?

Right side: What is the risk level after implementing changes?

Once you have identified and recorded the changes to your activity or demo, you must ask yourself the most important question of all: Is the modified activity or demo suitable for use in an outreach setting?

Return to the Risk Assessment Matrix to help you make this determination. As you follow the steps below, keep in mind that if someone is injured, you must be prepared to defend why you tolerated the level of risk you accepted by offering the activity or demo at your event. Record the appropriate risk level in the right side of Column M for each hazard.

Is the risk level low enough yet?

Look at the right side of Column M. With the modifications in place, is the level of risk presented by the activity or demo you are analyzing at an acceptably low level?

- **One or more hazards at a high risk level**
If the risk for one or more hazards remains at a high level or even at the borderline between medium and high, do not present the activity or perform the demo in an outreach setting.

The image shows a 'RAMP Worksheet' with a Risk Assessment Matrix. The matrix is organized into four columns: 'Recognize the Hazards', 'Assess the Risk', 'Mitigate the Risk', and 'Reassess the Risk'. Each row represents a hazard. The 'Assess the Risk' column contains a vertical scale with arrows pointing up and down, labeled 'High', 'Medium', and 'Low'. The 'Reassess the Risk' column is currently empty. The worksheet also includes a header with the ACS logo and a footer with the text '© 2012 American Chemical Society'.

- **All low-risk hazards**

If all hazards are low-risk, provided you and your outreach team implement the changes you identified, the activity or demo is a strong candidate for use in an outreach setting.

- **Low-risk hazards plus one or more at a medium risk level**

Carefully consider whether the benefit of the activity is worth the risk. It might be.

- Ask yourself these questions about each of the medium-risk hazards to help you make an informed decision:
 - › Will the activity help you accomplish your goals for the outreach event to a significant degree?
 - › If someone were injured, would all stakeholders agree that the benefits from offering the activity or demo outweighed the risk?
- Consider your responses to these questions:
 - › If the answer to both questions is yes for all medium-risk hazards, take the precautions you identified when minimizing the hazards and offer the activity or demo at your event.
 - › If you cannot honestly answer yes to both questions, do not present the activity or perform the demo in your outreach program. You must be able to defend the level of risk tolerated for each hands-on activity or demo you offer at your event.

Complete the cover page

After thinking through ways to minimize risks, you are ready to return to the cover page of the RAMP Worksheet.

First, determine whether or not this activity or demo is suitable for use in the planned outreach setting with the intended audience. Check the appropriate box in the lower right corner of the worksheet cover page.

I recommend use of this activity or demo if the risk-lowering measures identified in this document are implemented.

Do not use this activity or demo in an outreach setting.

If the answer is *no*, you can stop there. The other side of the RAMP Worksheet provides the justification for why the activity or demo is not suitable for use in outreach.

If the answer is *yes*, return to Column M on the RAMP Worksheet. Draw a star next to the changes in Column M that you will embed within the materials list and into the steps of the written procedure.

Some of the items listed in Column M are better written as safety requirements or cautions that must be given to the facilitators and presenters supervising each activity or demo. You will do this in the box titled “Safety Requirements” on the left side of the cover page. The *general safety requirements* listed are the five things that facilitators and presenters must adhere to as well as communicate to participants every time they conduct hands-on chemistry activities or demos. Add *activity-specific safety requirements*, such as “Provide adequate ventilation”, or warnings such as “Edges of cut plastic may be sharp”. Activity facilitators and demo presenters must follow all of these recommendations and ensure that all participants or members of the audience adhere to these as well.

In the chart titled “Required PPE”, use the checkboxes to indicate the PPE that must be worn by each type of participant within the vicinity of this particular activity or demo.

Column P: Prepare for Emergencies

Purpose: Identify possible emergencies, and develop protocols in the event of an accident.

What action will we take if a mishap or injury occurs?

Despite your best efforts to minimize risks, accidents may happen and people may be injured. Column P in the RAMP process will help you prepare so that you are ready when the inevitable happens. Look to the SDSs and the applicable Outreach Hazard Guides to help you identify possible accidents and emergencies associated with your hands-on activity or demo as well as the recommended emergency protocol. The chart below lists some samples. Check with your institution and with the host facility to determine how best to prepare for each type of emergency.

Type of Emergency	Action You Will Take if This Happens
Chemicals are splashed in the eye	Use sterile eyewash bottles to rinse eyes with water for several minutes.
Substance is swallowed or ingested	Follow the specific SDS recommendations and call Poison Control at 1-800-222-1222.
Skin contact with a chemical causes irritation	Rinse affected area with water for several minutes.
A substance or item catches on fire	Use an ABC fire extinguisher and the PASS method to put the fire out: <ul style="list-style-type: none"> • Pull the pin. Hold the extinguisher with the nozzle pointing away from you, and release the locking mechanism. • Aim low. Point the extinguisher at the base of the fire. • Squeeze the lever slowly and evenly. • Sweep the nozzle from side to side.
Solid or liquid spills	Clean the area with paper towels, and place them in a pre-designated bag or receptacle that you will take off-site with you.
Broken glass	Avoid the use of glass in outreach. If you must use glass, bring a broom, dustpan, and container that you can label and seal to contain the broken glass.
Cuts or bruises	Instruct the injured person to wash the wound with soap and water. Give the person sterile gauze, a self-adhesive bandage, or a cold pack.
Children are separated from their responsible adult	Follow the protocol of your host facility.

Assemble a list of needed items to handle emergencies

The final part of preparing for emergencies is to make a packing list of items needed to handle mishaps and injuries. For example, you may want to bring sterile eyewash bottles, paper towels, a spill kit, and a first aid kit. If you did not substitute glassware with plastic, be sure to bring a brush and dustpan along with a suitable labeled container for the collected broken glass. Carefully look through the emergency protocol and identify the items that you will assemble, pack, and keep handy during your outreach event. Order the necessary supplies so that they are available when it is time to pack for your outreach event.

Communicate with staff at the host facility

Schedule a meeting with staff at the host facility to discuss their ability to provide access to water, adequate ventilation, stanchions, or safety features you identified during your RAMP analysis. If the facility is unable to provide these or suitable alternatives, select different activities and demos, which the facility can accommodate,

for your program. Share the emergency protocols you are planning, so that together you can determine the best way to handle accidents and emergencies.

Refer to the Conversation Checklist document for the complete list of topics to discuss with the host facility to ensure you are on the same page when it comes to safety.

During your event, children and their responsible adults will look to activity facilitators and event organizers for leadership to handle incidents and prevent them from happening again. Find out how to get in contact with facility staff when these issues arise. The facility probably has its own emergency protocols in place, such as administering first aid or filling out accident reports, which should be done by trained staff rather than by volunteers. Be sure to communicate these procedures on the day of the event to all of the facilitators, presenters, and volunteers.

Conclusion

Once you have completed the RAMP risk management process for every activity and demo you plan to use in outreach, implement your recommendations. Make the changes to the materials and procedures, add the safety statements, and connect the new documents to their corresponding RAMP Worksheets. Share these pairs of documents with the facilitators, presenters, volunteers, and facility staff so that they are aware of the steps taken to minimize risks and are prepared to properly handle emergencies. On the day of your event, bring at least one copy of the activity write-ups paired with their RAMP worksheets for quick reference.

Groups that do chemistry outreach often have their own set of favorite activities or demos that they offer multiple times a year or every year. If it has been a while since you have presented a particular activity, conduct another RAMP analysis before confirming that the activity or demo will be part of the outreach event. Make new solutions and test the activities or demos again, even if you have assurances that the activity will work as planned. As you test, think about how to minimize risks further. Sometimes, minor changes in a piece of equipment or substance will present unexpected hazards or risks. Be prepared by running through the entire activity or demo exactly as it will be presented to the public. If there are any changes, whether small or significant to the activity or demo, go through the entire RAMP process and complete a new RAMP Worksheet for each activity or demo you plan to offer.

By using RAMP as you plan each activity and demo, you will advance the state of the art of your outreach. Children and their families will see that chemists care about safety. The facility that hosts your event will be inclined to host future events with you and your organization. Moreover, you and everyone associated with your chemistry outreach will have a positive experience learning and sharing chemistry together!

Safety in Outreach Settings was developed by a joint task force consisting of members from the ACS Committee on Community Activities, the ACS Society Committee on Education, and the ACS Committee on Chemical Safety. This document is maintained and updated by the Tools & Training Subcommittee of the ACS Committee on Community Activities.