

## Chemistry Lab Safety Guidelines for Student & Supervising Adult

### Safety measures to follow *before* starting a lab.

**Before you begin *any* lab, *always* follow the preparation guidelines below.**

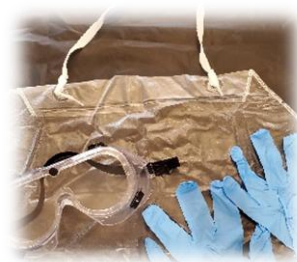
#### Preparing your work area

- **It is never safe to conduct labs alone! Always have a supervising adult nearby to monitor and respond to any emergencies that might arise.** Keep a supervising adult present during labs as some labs include substances that can be harmful (e.g., toxic, corrosive, irritants, flammable) or involve fragile equipment that could break (e.g., glassware). If a child or pet enters your work area, this supervising adult will need to remove them immediately.
- When you are conducting a lab, your full attention should be on following safety guidelines, following lab instructions, and being aware of your surroundings. Be alert, not distracted or tired. Ensure that distractions are minimized. Everyone can be distracted and this is extremely dangerous in a lab.
- Remove children and pets from your work area. Children and pets can distract you but also endanger themselves by touching/tasting/smelling/spilling chemicals, causing fires, or breaking fragile lab equipment such as glassware. This can happen in an instant and the consequences can be deadly. For your own safety and that of your household, ensure children and pets are removed from your work area.
- Cover your work surface with a thick plastic/vinyl mat or runner to prevent leaving chemical residues that could damage your work surface or cause harm to someone who used that work surface after you. This removable work surface cover should only be used for chemistry and should be clearly labeled "LAB ONLY." Avoid having your work area be atop unfinished wood or other porous surface that could absorb harmful chemicals, leaving chemical residues others or food could come in contact with.
- Open windows and vents to provide adequate ventilation.
- Your work space should be clean and tidy. Clear the counter or tabletop of any other materials. Clear away any items that could be contaminated or ruined by an accidental spill.
- If using a burner or stove, be extra careful to remove ANY clutter from your work area and ensure your burner or stove is NOT near/under cabinetry or other household furniture that could catch fire.
- Remove all food and drink items from your work area. Any food-related items that are used in lab for testing or analysis are considered lab chemicals thereafter and should remain with lab stock. Do not return any chemicals used in the lab to kitchen or other food prep area (e.g., baking soda used for a lab should not be used for making cookies after). See chemical storage guidelines further below.
- To avoid the chance of electrical shock, ensure any electrical appliances are used away from sinks/taps and dry any spilled water or other liquid before plugging in these appliances. Do not use any electrical equipment with damaged/frayed/loose electrical cords. Completely dry your hands before touching electrical outlets, plugs, or switches.
- Keep flame sources, sparks, and heat away from flammable substances to avoid fires.
- Check glassware and equipment before using and do not use if damaged. Check that any glassware or other labware you are going to use is clean. In the clean-up section further below, I will describe how to clean glassware at the close of every lab so that it is clean for the next lab you do.
- Keep a full box of baking soda (also called sodium bicarbonate or  $\text{NaHCO}_3$ ) near you during labs in the case you spill acid and need to neutralize it. Keep a full bottle of distilled white vinegar 5% in the case you spill base and need to neutralize and dilute it. Instructions for how to do this are under the acid/base section.
- In case of emergency, know where the nearest phone, fire extinguisher, and first aid kit are. Also know where the nearest shower and sink are in the case of a chemical spill to your skin or eyes.
- In addition to knowing emergency # (e.g., 911), make a list of other emergency numbers and contacts and post near your work area.



#### Preparing yourself

- Wear chemical-splash goggles, nitrile gloves, and lab apron.
- Wear close-toed shoes and long pants.
- Do not wear loose, baggy, or bulky clothing. Remove jewelry.
- Tie loose or long hair back.
- It is strongly recommended that you remove contact lenses (and wear prescription glasses as needed) because if you get any chemicals in your eyes, these chemicals could get "stuck" behind these lenses, making it difficult to



wash your eyes out. Regardless of whether you do or don't wear contact lenses, you will still need to wear goggles over your contact lenses or prescription glasses.

- Where provided, read chemical bottle labels and review safety data sheet (or SDS) for each chemical prior to use. The SDS will discuss any specific hazards and handling instructions for that chemical. Keep the SDS for each chemical where you can easily review them during the lab.
- Read all lab instructions before starting the lab to know proper lab procedures, safety guidelines, and waste disposal. Keep these lab instructions where you can easily review them during the lab.

### Safety measures to follow *during* a lab.

***During a lab, make sure you are following the guidelines below.***

#### General Rules

- Make sure you have already followed the prior guidelines to prepare yourself (safety attire!) and your work area (safe work space!). **Again, it is never safe to conduct labs alone! Always have a supervising adult nearby to monitor and respond to any emergencies that might arise.** Keep a supervising adult present during labs as some labs include substances that can be harmful (e.g., toxic, corrosive, irritants, flammable) or involve fragile equipment that could break (e.g., glassware). If a child or pet enters your work area, this supervising adult will need to remove them immediately.
- Anyone near the lab should be dressed for the lab by wearing goggles, nitrile gloves, and lab apron.
- Remain alert, aware of your surroundings, and focused during labs. Avoid distractions, horseplay, or jokes at all costs. When you aren't alert and focused, you can easily have an accident leading to chemical spills, chemical contact with your eyes/skin, a fire, or other highly dangerous scenario.
- Follow the lab instructions carefully and do not deviate from these instructions or attempt to shorten them.
- Assume any chemical is potentially dangerous and handle it accordingly.
- Handle equipment gently and carefully. It is very easy to break glassware such as beakers, flasks, or test tubes or other fragile equipment such as a glass thermometer.
- Do not touch your eyes, mouth, nose, general face and body area with your gloves as they may have chemicals on them that could be hazardous. Avoid adjusting your goggles with chemical-contaminated gloves which can easily lead to chemicals in your eyes.
- Do not smell chemicals directly. If directed to smell a chemical, use your hand to waft the smell towards you.
- Do not use lab equipment as a food or drink receptacle. This is very dangerous as a beaker of acid looks exactly the same as a beaker of water.
- Do not taste any chemicals used or made in the lab to avoid poisoning.
- Do not eat, drink, or chew gum during the lab.

#### Heating substances

- **Always have a clear area both around and above your work area when using a burner/stove and rest any portable burner/stove on a non-flammable surface (e.g., tile countertop). Be *absolutely sure* that your work area is clear of clutter and that your burner/stove is not near/underneath cabinetry or other house fixtures or furniture that could easily catch fire.**
- If using a gas burner/stove, avoid gas leaks by always turning off the gas if the flame goes out and when you are finished with using burner/stove.
- Do not leave any lit burner/stove unattended.
- If using alcohol burner, follow the instructions provided with the **Home Science Tools** alcohol burner to assemble, ignite, and snuff out. Use only the denatured ethyl alcohol fuel source you ordered for this class in alcohol burner.
- For alcohol burner, see photo of suggested setup. Place your alcohol burner setup on a metal roasting dish or baking tray that can collect fuel if a spill occurs. Always place a 5" wire gauze with ceramic center directly under an alcohol burner as it gets very hot and could damage your work surface. Only fill burner canister  $\frac{3}{4}$  full (~50 mL) to minimize fuel contents in case of spill. After filling burner canister, immediately close denatured ethyl alcohol bottle and remove from work area.
- **Be very careful not to knock over your alcohol burner! The hot denatured ethyl alcohol fuel can spill on your work surface and instantly ignite, leading to a fire.**



- Point the open end of a test tube away from your face or that of others when heating.
- Do not put your face directly over a test tube, beaker, or other container being heated.
- Use test tube tongs to handle hot test tubes and use heat resistant hot mitts to handle larger hot glassware (e.g., beakers or flasks) or equipment.
- Allow hot items to cool down on the ceramic center of wire gauze before handling – not on lab surface directly.
- Careful! Hot substances/equipment will appear the same as cool substances/equipment. Move your hand beside the item to detect if the item is still hot before handling.
- Do not transfer hot glassware directly to cold water as this can cause glass to shatter.
- A microwave should only be used if directions call for this. Only use dishes that are labeled microwave-safe by manufacturer (e.g., typically ceramic or glassware – not plastic or metal). Do not use lab glassware in microwave. Only heat materials that are food safe.



#### Avoiding Contamination

- Work on a plastic/vinyl mat or runner. The clean-up section will describe how to wipe down work surfaces after the lab.
- Use a clean and dry spatula/scoop to take out any chemicals from a chemical stock bottle.
- Do not return unused chemicals to their stock bottle.
- Label chemicals and equipment used for labs as “LAB ONLY” so they do not get mixed up with kitchen supplies.
- Some labs will need to sit overnight. Be sure to place them in a safe place and label them so they do not get mixed up or accidentally thrown away.

Image by Kristin Marais.



#### Using acids / bases

- In the case of an acid spill, notify your supervising adult immediately. Then, pour a generous amount of the baking soda on the spill. Allow the acid and baking soda to bubble/fizz. Continue adding baking soda until the bubbling/fizzing has stopped, indicating the acid is neutralized. Mop up with paper towel and dispose of in outside trash can. Clean surface with soap and water.
- In the case of a base spill, notify your supervising adult immediately. Then, pour a generous amount of distilled white vinegar 5% onto the base spill. Allow the base and vinegar to mix (you likely won't see anything and thus can't tell when this is neutralized). The purpose of the vinegar is to both dilute the base but also provide some level of neutralization, even if you can't tell when it's neutralized. Mop up with paper towel and dispose of in outside trash can. Clean surface with soap and water.
  - This class will use sodium hydroxide pellets to make a base solution. A single pellet left on a surface will immediately absorb water from the surrounding air and form a clear, liquid, pool. This is NOT water! Be careful as this is highly concentrated base solution that can literally dissolve your skin. Add a generous amount of distilled white vinegar 5% to both neutralize and dilute the base. Mop up with paper towel and dispose of in outside trash can. Clean surface with soap and water.
- To prepare an acid or base solution, always add the more concentrated acid or base to water. This is because when an acid or base is dissolved in water, a lot of heat can be given off. By adding the acid or base to water, the heat given off can be absorbed by the surrounding water. Do not add water to an acid or base as the heat released can lead to flash boiling and thus dangerous splashing of acid or base that could cause serious harm if it came in contact with your skin, eyes, or other body area. As you add acid or base to water, do so slowly to avoid splashing and gently swirl to disperse the heat produced.

### Responding to Accidents

- Tell your supervising adult immediately if you have an accident which could include chemical contact with skin/eyes, spills, cuts, burns, or other incident.
- If you accidentally spill any chemicals, notify your supervising adult immediately.
  - For most chemicals, you can use paper towel to mop up. Then wash surface afterwards with soap and water. Dispose of paper towel in outside trash can. However, review lab instructions and SDS (safety data sheet if provided) before cleaning up.
  - Acid or base spills will require that you neutralize them first – see acids and bases section for details.
- If you accidentally get any chemicals in your eyes or notice any eye irritation, notify your supervising adult immediately, and immediately wash your eyes at the sink by splashing lukewarm water continuously for 20 minutes. Then, remove contact lenses if present and easy to remove. Continue rinsing. Seek medical and/or emergency attention as needed.
- If you accidentally get any chemicals on your skin or notice any skin irritation, notify your supervising adult immediately, remove any clothing items that may have chemicals on it, and begin rinsing the skin under tap water or in the shower for at least 20 minutes or until irritation subsides. Seek medical and/or emergency attention as needed.
- If you accidentally ingest any chemicals, notify your supervising adult immediately. Seek medical and/or emergency attention as needed.
- If you accidentally get burned, notify your supervising adult immediately and begin running cold water over the burn for several minutes or until burning sensation begins to subside. Seek medical and/or emergency attention as needed.
- In the case of broken glass, carefully use a broom and dust pan to sweep up larger glass pieces and then vacuum to ensure all glass pieces are gone. Do not pick up broken glass with your hands.
- If you do spill water or other liquid around electrical appliances, notify your supervising adult immediately to turn off these appliances and then dry the wet area before turning appliances back on.
- If a fire starts, notify your supervising adult immediately. Call 911 as needed.
- **Note that if you accidentally knock over a hot alcohol burner, the hot denatured ethyl alcohol inside will spill and can immediately ignite, leading to a fire on your work surface that can quickly spread to any flammable surfaces or materials nearby or above. This is why it is imperative you ONLY use burner in areas clear of clutter and away from any cabinetry or other furniture or fixtures that could catch light. Do not use water to put this fire out. If fire happens, step back, and call 911. ONLY if supervising adult feels it is safe to do so, should the adult consider covering the fire with a large metal lid or using a dry chemical fire extinguisher marked ABC.**

### **Safety measures to follow for disposal of chemicals and clean-up of work area.**

**After a lab, make sure you are following the guidelines below.**

#### Disposal

- Follow lab instructions for disposal. Do not just randomly pour chemicals down the drain or into the trash.
  - To protect private septic systems (if you have one), don't pour any chemicals down the drain.
  - To protect rain water, don't pour any chemicals down storm drains or into rivers, creeks, or streams.
  - For acids and bases, follow lab instructions which will prompt you to dilute the acid/base and then neutralize that diluted acid/base before disposing of. See acid/base section.
  - While the lab instructions are designed to minimize waste and dispose of waste properly, you should still consult with your local Solid Waste and Wastewater Treatment department to ensure you are following city/state protocols in your area. In step with this, obtain two clean, dry 1-gallon plastic containers with securely-fitting lids and label these containers "Hazardous Waste: Liquid" and "Hazardous Waste: Solid" respectively. Store these hazardous waste containers in a cool, dry, climate-controlled, well-ventilated area that is inaccessible to children, pets, or anyone else that could be harmed by using chemicals incorrectly. Throughout the course, follow lab instruction prompts for when to add chemicals to these containers and keep a list of what was added and in what concentration. After the course, this can be delivered to your local hazardous waste site.

#### Clean-up

- Put all chemicals away in their designated place. See next storage section for more instructions.
- Clean any glassware and equipment at the close of the lab. Use a bathroom sink to wash by hand rather than kitchen sink/dishwater to avoid contaminating food preparation surfaces. Use a small drop of liquid dish detergent and scrub with test tube brush or designated sponge for chemistry. Rinse generously with tap water. Follow with a final rinse of distilled water to ensure that the glassware isn't left with water spots or any other type of residue from tap water.
- Wipe your plastic/vinyl mat or runner used as your work surface with a wet paper towel and then put away to ensure someone else does not work on this surface for food preparation or any other activity.



- Thoroughly wipe all counter areas down with soap and water.
- Use soap and water to thoroughly wash your hands when you are completely finished with the lab and clean-up.

#### Safety measures to follow for proper storage of chemicals.

**For all types of chemicals in this class, follow this general rule:**

**Store chemicals in a cool, dry, climate-controlled, well-ventilated area that is away from incompatible substances and inaccessible to children, pets, or others that could be harmed by using chemicals incorrectly. Do not store in kitchen.**

**Then, follow these additional rules below:**

##### Acids:

- Best: Within locked, non-metallic cabinet and separated from bases. Acids give off vapors that can rust surrounding metals.
- Acceptable: Within a plastic / wood tub or cabinet and separated from bases in a locked storage room.
- For this class, we will use the acid "1.0 M HCl" or "1.0 molar hydrochloric acid" that comes in a plastic 100-mL bottle from *Home Science Tools*.

##### Bases:

- Best: Within locked, non-metallic cabinet and separated from acids. Bases if they were to give off a vapor can rust surrounding metals.
- Acceptable: Within a plastic / wood tub or cabinet and separated from acids in a locked storage room.
- For this class, we will use the base "NaOH (s)" or "sodium hydroxide solid" that comes in a 30-g bottle from *Home Science Tools*. We will use this solid to create sodium hydroxide solutions between 0.5 – 1.0 M solutions.

##### Organic Solvents:

- Best: Within locked, flammables cabinet and separated from flame sources. Organic solvents are flammable so it's imperative to keep them away from any spark / flame source such as a stove, lighter, smoking, etc.
- Acceptable: In an area separated from flame sources in a locked storage room.
- For this class, we are using the organic solvent "denatured ethyl alcohol" that should be ordered from *Home Science Tools* to provide fuel for alcohol burners. If you opt to use a propane or natural gas stove for chemistry rather than purchase an alcohol burner, then you will not need to purchase this fuel.

##### Other Chemicals

- Best: Within locked chemicals cabinet, inaccessible to children, pets, or anyone else that could be harmed by incorrect use of chemicals and in an area that is cool, dry, climate-controlled, and well-ventilated.
- Acceptable: Inaccessible to children, pets, or anyone else that could be harmed by incorrect use of chemicals and in an area that is cool, dry, climate-controlled, well-ventilated, and can be locked.
- For this class, all other chemicals aside from acids, bases, and organic solvents in your materials list can be stored in this "other chemicals" area.

Nitrates: (we will not use nitrates)

Portions of this safety guidelines document were generally informed by: Swan, Christina H., and Mayes, John D. Chemistry Experiments for High School at Home. Austin, TX: Novare Science & Math, 2014.