

# Safety Precautions

## General Demonstration Safety Precautions

- Always practice a demonstration before presenting it at an event. Never present a demonstration that you haven't seen before until after you have practiced it.
- All Science Theatre presenters must wear jeans or khakis, closed toe shoes, and a Science Theatre shirt or similar.
- Follow all safety precautions required for a demonstration, and use appropriate safety gear for the demonstration.

## Fire Demonstration Safety Precautions

Some of our demonstrations use fire. Please take the following precautions if you are performing a demonstration involving fire:

- Tie back long hair and do not wear loose clothing.
- All presenters must wear safety glasses or goggles while the demonstration is being performed. Presenters not involved in the demonstration should stay at least six feet away from the demonstration.
- If a blast shield is used, the audience must be at least six feet away. If a blast shield is not used, the audience must be at least 15 feet away. A small blast shield is required for fire demonstrations that sit on a table.
- Fire demonstrations are never to be aimed towards the audience or demonstrators.
- Keep fire away from flammable items such as hair, clothing, and combustible powders and liquids (CPLs).
- Keep containers of CPLs closed until just before they are needed so that fumes or powders do not ignite.
  - CPLs should be measured out with ignition sources turned off and at least six feet away.
  - After they are measured out, close the container and remove it from the demonstration area before turning on the ignition source.
  - If possible, pre-measure the amount needed for the demonstration so the bulk container does not need to be brought.
  - Any spilled CPL should be taken care of immediately using a proper spill agent. Ignition sources should be turned off/extinguished if they are on/lit, and should not be turned on/lit until after the spill is taken care of.
- When using any device that produces fire or heat, with the exception of candle lighters and matches, wear heat-resistant gloves.

- When handling any object that is currently being or has recently been heated, wear heat-resistant gloves.
- Always have a fire extinguisher within easy access. Make sure you know how to operate it.
- Most fire demonstrations give off smoke. Be aware of smoke detectors, and read the safety precautions for Flying Particles.

## Cryogen Demonstration Safety Precautions

- A Cryogen is a solid, liquid or gas that has been cooled far below the freezing point of water. Cryogenics can cause frostbite within seconds, making them a safety hazard.
- The cryogenic materials used in our demonstrations are dry ice, Liquid Nitrogen, and objects that have been cooled by the dry ice or liquid nitrogen.
- The audience should be at least ten feet away from a Liquid Nitrogen presentation.
- **Required Safety Gear:** A small blast shield, safety goggles, cryogen-safe gloves.
- **Recommended Safety Gear:** A lab coat.
- **Required Dress:** Closed toe shoes, jeans, t-shirt.

### Cryogen Storage and Containment

#### Liquid Nitrogen

- Liquid Nitrogen must be kept in a cryogen approved container. Do not overfill the container, and keep a loose-fitting lid on the container at all times when not in use. Store and use Liquid Nitrogen in a well ventilated area.
- When carrying Liquid Nitrogen, wear safety goggles and the cryogen gloves. When transporting it, keep the container upright at all times, and buckle it into a seat to prevent it from tipping or spilling.
- During a performance, safety goggles are required at all times, and the blast shield should be in front of the container at all times. Wear the cryogen gloves whenever you are using the Liquid Nitrogen during the performance.
- If spilled, Liquid Nitrogen will vaporize quickly. However, due to the Leidenfrost effect it will roll along smooth surfaces easily, making it possible for a spill to travel rather far. To prevent a spill from traveling, keep a blast shield in front of the Liquid Nitrogen container throughout the duration of a presentation.
  - If Liquid Nitrogen is spilled and is rolling slowly across the floor, create a barrier around the spill to contain it as it vaporizes.
  - If Liquid Nitrogen is spilled and is rolling in the direction of the audience, ask the members of the audience that are not wearing closed toe shoes to lift their feet off the floor. If they are all wearing closed toe shoes, then alert them that their feet are safe, but to not touch it with their hands.
- If you spill Liquid Nitrogen on your skin, keep the exposed area angled to let it roll off of your skin. You will have a few seconds to react due to the Leidenfrost effect, so a quick response will help you avoid injury.
- If frostbite does occur, run the affected area under warm water for 3-5 minutes to rewarm the skin. Treat the affected area with an antibacterial ointment and bandage it.

- If it is spilled on your clothing, pull the clothing away from your skin and allow it to vaporize. If the spill soaked a large area of your clothing, you should remove that article of clothing promptly to avoid frostbite.

## Dry Ice

- Keep dry ice in a thick-walled insulated container with a loose fitting lid. Store and use dry ice in a well ventilated area.
- Spilled dry ice should be kept away from people and sensitive materials. Use a cryogen glove or similar to collect any large pieces.
- If dry ice comes in contact with bare skin, it can cause near-instant frostbite. Always use cryogen gloves when handling dry ice.

## Solid Cryogenics

- Solid cryogenics consists of the objects that are cooled by the Liquid Nitrogen or dry ice, such as the racquetballs, bananas and pennies we use in some of our demonstrations.
- Solid cryogenics should only be handled while wearing cryogen gloves or with cryogen-safe utensils, such as the tongs we have with the demonstration.
- Solid cryogenics can cause near-instant frostbite if they come in contact with skin. Avoid touching any solid cryogenics with your bare hands.
- If a solid cryogen is spilled, alert the audience that they should not touch the object. Pick up the object while wearing cryogen gloves.

# Dry Chemical Demonstration Safety

A dry chemical is a chemical substance that is not suspended in a liquid, most commonly water. Dry chemicals are most commonly found in powder form. If you are dealing with chemicals in a liquid form, please see Liquid Chemical Safety.

- When handling dry chemicals, safety goggles and rubber gloves must be worn at all times.
  - It is highly recommended that a lab coat is also worn while handling dry chemicals.
- Be aware of the properties of the chemicals used in a demonstration, as well as any safety hazards they might pose.
- Do not use any chemicals that you have not been trained on the use of, or are unfamiliar with.
- See Fire Demonstration Safety for additional guidance if the chemical is used to create a flame.
- See Flying Particles Safety for additional guidance if the chemical creates flying particles, including smoke/fumes.
- Dry chemicals should be kept in sealed containers at all times

- The containers should not be opened until they are needed, and should be closed immediately after use
- If a dry chemical is spilled:
  - Scoop up as much as possible of the spilled chemical and place it in a plastic bag or other non-reactive, sealable container.
  - Wet a paper towel and wipe down the area.
  - Place the paper towel along with the rest of the spilled chemical in the plastic bag or other container.

## Liquid Chemical Demonstration Safety

A wet chemical is a chemical substance in the liquid phase, also known as wet chemistry. If you are dealing with chemicals in a powder form, please see Dry Chemical Safety.

- **Required Safety Gear:** A small blast shield, safety goggles, rubber gloves
- **Recommended Safety Gear:** A lab coat
- **Required Dress:** Closed toe shoes, jeans, t-shirt.
- Properly label all chemicals and date when they were opened
  - Make sure to dispose of the chemicals before the expiration date and dispose of accordingly to the label's directions
- When dealing with volatile substances, make sure to do so underneath a fume hood or an area with appropriate ventilation
- If a flammable liquid is used in a demonstration, make sure to cap all reagent bottles after dispensing the appropriate quantities and be aware of heat sources and flammable vapors. Never repeat a demonstration using flammable liquids until all containers and surfaces are cool to the touch.
- Any volunteers must also wear approved safety gear

## Flying Particle Demonstration Safety

Some of our demonstrations release particles or debris during the performance. Please take the following precautions if you are performing a demonstration which releases particles:

- Use a blast shield, if possible. It will help protect the audience from any debris.
- Have a designated "Blast Radius" for the demonstration. If you have a blast shield, the minimum radius is six feet. If you do not, the minimum radius is fifteen feet.
- All presenters and volunteers must wear safety glasses or safety goggles when the demonstration is being performed. Presenters not involved in the demonstration should stay outside of the blast radius.
- It is recommended to wear a lab coat and long pants (jeans or khakies). These articles of clothing will prevent flying particles from coming in direct contact with the skin.
- If the demonstration fires particles in only one direction, it should be aimed away from the audience and other demonstrations.

- If the debris released from the demonstration is considered hazardous (sharp edges, extremely cold or hot, etc.), Wear appropriate gloves to collect the pieces. If needed, sweep the presentation area after the show is completed.
- Unless otherwise noted in a demonstration write-up, dispose of any debris in a trash can or receptacle.

If a demonstration gives off smoke, dust or any similar micro-particles, then please use the following safety precautions:

- Only perform a demonstration which gives off micro-particles in a well ventilated area.
- Notify the contact for the event prior to the event that the demonstration gives off smoke. They may need to move your presentation to a new room, or ask for a different demonstration to replace it.
- Be aware of any smoke alarms in the room, if any, and avoid using the demonstration near one.
- Do not let anyone from the audience to come close to a demonstration that is still giving off debris.
- If possible, collect any settled micro-particles with a wet paper towel or cloth. Unless otherwise noted in a demonstration write-up, dispose of any debris in a trash can or receptacle.

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