Hello Everyone,

I would like to share with you the safety incidents reported to me recently, that occurred after the restart of research operations in FRNY. As we restarted research operations in our labs after a longer period of working from home on items not providing hands-on opportunities, it is critical that we think and check twice before we proceed with any hands-on task.

June 18, 2020: Broken toe by gas cylinder falling during transportation

Description: On June 18, 2020, around 4:30PM, three researchers from the same group transferred an empty nitrogen cylinder to the storage area outside FRNY and wanted to move full nitrogen cylinders into the lab. The researchers used three gas cylinder carts for this task, one of which was a three-wheel cart available in the FRNY receiving area, in front of FRNY G134. They loaded the carts with the full cylinders, secured them to the carts with the available chains and started to move the loaded carts toward the building by pulling the carts. When pulling the 3-wheel cart over the gap between the concrete pieces that make the sidewalk, the small wheel (which was the leading wheel because the cart was pulled) caught on this gap, lost its balance and fell. On this occasion no one was hurt; the researchers brought the cart with the gas cylinder in upright position and continued the trip after switching carts (a different researcher handled the 3-wheel cart after this near miss). Shortly thereafter, as the loaded cart was pulled, the small wheel of the 3-wheel cylinder cart caught again in the gap between the concrete slabs and fell again; the gas cylinder slid off the cart and rolled onto the researcher's foot.

Immediate Action: The other two researchers helped bring the cylinder cart and its load in upright position, helped bring the researcher and gas cylinder in the building and applied an ice pack to the injured researcher's foot before taking the researcher to IU Health Urgent Care for evaluation. An X-Ray revealed a fracture of the great toe on the researcher's left foot. The incident was reported next day and was investigated during the following days to determine the root cause of the safety incident and make pertinent recommendations to prevent future occurrences.

Results of investigation: Upon tanking to the researchers involved in the incident, and visiting the scene of the incident, it became apparent that:

- The researchers used the gas cylinder cart improperly (they pushed the cart instead of pulling it). Having only the small wheel in the front (instead of 2 big wheels if the trolley were used correctly), the cart lost its balance when it caught on the small gap in between concrete slabs, and fell.
- The 3-wheel design for the cart is not very safe and the cart is not as stable as the 4-wheel cart
- The near miss that happened minutes before the actual safety incident was ignored and instead of learning from it and replacing the 3-wheel cart with a more stable 4-wheel cart for the task, the same unstable cart was used again.
- The researchers lacked training on the proper use of gas cylinder carts
- Clear instructions on the correct use of cylinder carts need to be made available to all users.

Actions taken to prevent similar situations:

The ChE safety committee discussed this incident and the following actions were taken:

- The proper use of gas cylinder carts was communicated to the group:
  - ❖ Gas cylinder carts should be pushed, not pulled to allow for better control and to protect the user from incidents. Pulling a loaded trolley down the ramp can cause the loaded gas cylinder cart to gain momentum, which can cause it to fall on the user, leading to an injury.
  - ❖ Pulling the trolley will result in the trolley either being pulled with only one hand to be able to walk forward (which results in having a bigger force applied to the side where the cart is pulled, thus the cart is more likely to lose balance and fall), or the cart being pulled with two hands and the user walking backwards (facing the trolley), which is also unsafe.
- The 3-wheel gas cylinder cart was partially decommissioned (it is kept as a last resource and will be made available for use only when the 4-wheel carts are not available).

- Clear instructions on the proper use of gas cylinder carts were placed on each trolley. These instructions are clearly visible:
  - ❖ Inspect the cart for mechanical integrity. Don't use defective carts.
  - ❖ Use the chain to secure the gas cylinder to the cart.
  - ❖ Use two hands to PUSH the cart. Don't pull the cart.
  - ❖ Use appropriate PPE - safety glasses, sturdy closed toed shoes, long pants.
  - ❖ Report defective carts to Jason Davenport.
- The "Gas Cylinder Handling Procedures for FRNY Building" was updated to include recommendations on use of gas cylinder carts and some other edits/recommendations. This updated document is now available on our website, under the "Laboratory Safety Requirements" section. The attached version has the updates highlighted in yellow to allow for fast identification of the updates.
- The Gas Cylinder Transport Safety Video 2014 developed by ChESS was moved to the "Laboratory Safety Requirements" section of the ChE safety website (https://engineering.purdue.edu/ChE/aboutus/safety). I encourage everyone to view this video.

Two near misses were also reported to me in the last two weeks:

1. **June 24, 2020: Spilled Nanoparticle Ink in Glovebox Antechamber**
   Description: When a researcher wanted to use the glovebox in a lab, he found that a vial in the antechamber had tipped over and appeared to have leaked. The vial contained nanoparticles dispersed in DMSO, and about 50 microliters had spilled in the antechamber.
   Immediate action taken: The researcher removed the leaking vial and placed it in a fume hood. He then cleaned the small spill using isopropyl alcohol and paper towel and disposed of the paper towels in the solid waste. The owner of the vial was contacted to let them know it had leaked.
   Recommendations: As the likely cause of the spill was the cap being loosened during the vortex mixing step of the experiment, it is recommended that a parafilm is placed around the vial cap to help ensure the cap does not come loose during this step. After removing the parafilm check that the vial caps seal properly before placing them in an antechamber because the vacuum purge cycles can tip vials.

2. **July 3, 2020: Waste container spill in glovebox**
   Description: During a nanoparticle wash cycle procedure involving frequent transfers of solvent (mainly isopropyl alcohol (IPA)) between centrifuge tubes and waste beakers inside a glove box, the researcher performing this procedure missed to re-cap the waste container before removing his arms from the glove box. When the researcher returned to the glovebox to continue the washing cycle, he accidentally knocked over the waste container, spilling about 1/3 of its contents.
   Action: The researcher cleaned up the spill with paper tissues (the spill was mostly IPA) and disposed the contaminated tissues as hazardous waste.
   Recommendations: This is a good reminder not to rush through the steps of a procedure and through experiments, and always check that containers (including waste containers) are sealed after use. When using a glove box, avoid leaving chemical containers and other items near the glove ports, as they can easily (and accidentally) be knocked over causing a spill.

Some lessons learned and *general* recommendations:

1. Never guess the proper use of instruments, apparatus and devices used. If you are unsure of the correct procedure for safe handling/use, ask for clarification.
2. Before using any device/tool (in this case gas cylinder cart) inspect it for mechanical integrity and review mentally the correct use. Never attempt to use defective/compromised (or unstable) devices.

3. Always use appropriate PPE for the task you perform. Make sure the PPE used provides adequate protection from hazards and the necessary dexterity to avoid safety incidents. In this case, steel toed shoes would have been ideal, this would have prevented the gas cylinder fall to result in a broken toe.
4. If you are not confident in handling heavy items on your own, ask for assistance.
5. Learn from near misses. If a near miss happens, stop and analyze the reason behind the near miss. Instead of ignoring a near miss, REPORT it and learn from it. Address the cause of the near miss and prevent similar situations from happening.
6. Never rush through experiments and through the different steps of a procedure. Always follow the standard operating procedures and pay close attention to details.
7. Ensure everyone in your group knows and follows the incident report protocol. The first bullet point under the "Workplace Injury Information" on ChE safety website (https://engineering.purdue.edu/ChE/aboutus/safety) has useful information on the proper safety incident/near miss reporting procedure.
8. Report any safety incidents or near misses to the group safety officer and to the safety committee chair, and discuss them in your group meetings. Sharing this type of information is key in increasing safety awareness.

Incidents and near misses are great tools to learn from previous situations/events. Please continue to report any safety incidents and near misses that occur in your work area; sharing them with everyone in our School will raise the safety awareness and prevent similar situations from happening.

Sincerely,

Gabriela
On behalf of the ChE Safety Committee