

Introducing Students to Lab Safety in Chemical Engineering: The Safety Scavenger Hunt

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Abstract

Faculty who teach laboratories or supervise undergraduate students in research projects understand the importance of adherence to safety guidelines in the laboratory. Safety training, however, often consists only of watching a few videos or relating safety rules with cautionary anecdotes. While these exercises provide valuable background and general guidelines for safe practices, each laboratory has particular hazards that must be addressed. The Chemical Engineering Department at Rowan University has developed an interactive exercise to introduce students to lab safety. Rather than deliver a lecture, we have devised a “safety scavenger hunt” to be completed in a laboratory period at the beginning of the semester. Safety violations, such as unlabeled containers or lack of personal protective equipment, are staged for this activity. Student teams compete against each other to identify these staged and other potential safety hazards associated with equipment, as well as the location of Materials Safety Data Sheets and safety and first aid equipment.

This activity serves as an introduction to safety for a course or curriculum, and sets the stage for developing a culture in which lab safety is observed at all times. At Rowan, throughout the courses for which this activity was designed, Junior/Senior Clinic (a research project course for undergraduates) and Unit Operations Laboratory, safe practices are tied to the students’ grades. In addition to requiring students to prepare HazOp reports for each laboratory experiment or project, random safety checks are performed throughout the semester. This paper provides details for delivering this introductory exercise, as well as student responses.

Introduction

Training students to practice safe behavior in the laboratory is essential to producing competent engineers. Creating students who instinctively and thoughtfully incorporate an awareness of safety in every experiment and process is an intensive effort; entire courses are devoted to chemical hygiene and accident prevention^{1,2}. Throughout the curriculum, developing safe habits in students in a wet or unit operations laboratory requires raising student awareness of obvious and hidden hazards, and motivating students to monitor their own and others’ safety. Rather than simply going through the motions of following lab safety rules set by the faculty and college safety officer, students must participate in observing and resolving safety violations in the lab.

While many excellent videos and virtual lab safety tools exist³, there is no substitute for honing students' observation skills through active learning.

The Scavenger Hunt

This activity can be accomplished in a 1-2 hour lab period and is designed to familiarize students with the location of personal protective and safety response equipment and materials, alert students to common housekeeping safety violations, and help students develop methods for avoiding and responding to safety issues. Before the class period, 10-20 examples of common hazards are placed throughout the lab. Setup requires less than an hour for 3 people. The staged hazards can include:

- unidentified liquid spills (we used water)
- improperly or unlabelled containers
- hot plate placed next to flammables cabinet
- liquids stored above eye level
- inspection tag removed from fire extinguisher
- access blocked to fire extinguishers and safety showers
- contents removed from first aid kit
- open containers of food placed in lab
- bottles of chemicals placed in "food grade storage" cabinet. (we re-labeled a non-food grade cabinet as food grade storage)
- metal stored with glass in drawers
- blocked aisles or exits
- inaccessible safety equipment
- faculty members without eye protection

Faculty members work with the safety officer to ensure these hazards are staged in a safe manner and removed immediately after the activity is completed.

Student teams draw a map of the laboratory, including the location of all emergency exits, PPE and safety response materials, and Materials Safety Data Sheets. As the teams tour the laboratory, they must note all potential and existing safety hazards on their laboratory sketch. Once their time of the lab is concluded, students work together to list possible consequences, suggest methods for avoiding the hazard, and develop response procedures.

After all groups have finished, student observations are compared with those of the faculty. Each safety violation is awarded a point value, and the team with the highest score wins safety glasses for the entire team. In addition each team turns in a laboratory map, hazard list, and response sheet, and faculty score this sheet.

Semester follow-up

In the courses for which this activity was designed, observing safe laboratory practices is a significant portion of the grade. In addition to the safety scavenger hunt, which initially raises student awareness, several other methods are used to maintain safety-consciousness.

- Points are deducted for unsafe practices (not wearing safety glasses, unlabeled containers, improper handling of equipment) at the discretion of the faculty and safety officer, and are deducted from the *entire* team's grade. Note that these penalties apply to safety violations detected by faculty and staff members.
- Points are awarded to student teams for noticing and fixing safety violations. Students may report incidents to the safety officer and/or faculty. The team that reported the issue (provided they did not cause it in the first place) is rewarded. However, the team that created the issue is *not* penalized for incidents or violations that are reported by another student. This approach has been successful in the Michigan Technological Institute's PAWS (Prevent Accidents with Safety)⁴.
- Points are awarded for completeness and accuracy of HAZOP component of written reports.

Results and Student Response

During the exercise, each team identified a least 23 distinct safety hazards in the allotted 15 minutes (the winning team found 44). Some safety issues that had not been staged, but were pre-existing, were among those identified. Students were also enthusiastic during the exercise. There was a spirit of friendly competition—students joked about fixing hazards just so other teams would not find them. Afterward, the chemical engineering technician led a discussion (with photos) of the various hazards and why each of them was of concern. Since the exercise was active and followed by a discussion rather than a lecture it is expected that students will retain more of the information.

REFERENCES

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BIOGRAPHICAL INFORMATION

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MARVIN L. HARRIS is the Chemical Process Engineering Technician for Rowan University Engineering. Prior to Rowan, he was a Senior Process Development Technician for Union Camp Research and Development Division (International Paper). Marvin specialized in paper machine start-ups, runnability surveys and mill production trials. He operated a 25 TPD ozone-bleaching pilot plant, 5000 GPD wastewater recycling pilot plant and has just recently installed and started-up a 25' - 6" glass distillation column for methanol-water separations. Marvin spent eight years on the UC R&D Safety Committee, when the Division received OSHA's VPP Star Status Award.