Laboratory Safety Challenge

Teaching Safety To Students

Introduction

Getting students to comply with laboratory safety rules and teaching them proper lab technique are two of the most important responsibilities of every science teacher. How can you get your students to take ownership of the safety rules, to accept responsibility for lab safety for their own benefit? A great way to show students that the safety rules make a lot of sense is to role-play what happens when the rules are deliberately ignored or violated. The purpose of the laboratory safety challenge is to have students witness lab procedures gone awry, and then use their observations to derive a common-sense set of safety rules.

Concepts

- Laboratory safety

Preparation

Before class, plan your improper laboratory attire and prepare an "unsafe" demonstration to showcase improper lab techniques. (A safe "unsafe" demonstration that works well is the reaction of sodium bicarbonate with vinegar.) Use the suggestions provided below, along with your own ideas, to present an unforgettable safety lesson for your students. Be creative and add your own dramatic flair wherever possible!

Set up the demonstration table with the necessary materials and equipment for the activity—make sure the table looks cluttered and unorganized. Designate a student or another teacher to introduce the "guest" presenter (e.g., Ms. Cary Less) for the demonstration. The student should explain to the class that you (the teacher) are unavailable today and a guest presenter has been invited to fill in. The administration, however, has some questions about the safety practices of the guest presenter, and so would like the students to carefully evaluate the safety aspects of the presentation, paying special attention to lab attire and laboratory technique. The students should make a list of all safety concerns so that they can be reported to the proper authorities. Note in the summary shown below that the corresponding laboratory safety rules are included in parentheses next to the description of each safety "violation."

Procedure

Improper Lab Attire

- Goggles hanging loosely on forehead or around neck. (Wear safety eyewear at all times in the laboratory.)
- No lab coat—bring one in as you enter and set it down. (Wear a lab apron or lab coat to protect skin and clothing.)
- Long messy hair, not tied back—use a wild, out-of-control wig for dramatic flair. (Tie back long hair, especially when working with open flames.)
- Shorts and open-toed shoes or sandals. (Always wear long pants or dress and close-toed shoes to protect against spills.)
- Loose, billowing or baggy sleeves, and long, dangling necklaces and bracelets. (Do not wear clothing or jewelry that presents a safety hazard in the lab.)

Improper Lab Technique

The activity can be performed either as a silent demonstration (no talking, only acting) or as a walking monologue (read aloud the steps in the lab procedure and talk to yourself, perhaps muttering under your breath). *Example:* Let's see, the procedure says I need 25 grams of baking soda. Oops, it looks like I accidentally weighed 35 grams here. No problem—I'll just pour some back in the bottle. Hmmm, 28 grams? I'm sure that's close enough.

- Take a drink from a can of soda that is on the demonstration table. (No drinking in the lab.)
- Blow big bubbles of gum throughout the demonstration. (No eating or gum chewing in the lab.)
- Fumble around through the great clutter and jumble of chemical bottles on the table, looking for the right ones to

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use. (Keep work area neat and clean at all times.)

- Weigh out too much sodium bicarbonate into the beaker; pour the excess right back into the bottle. (To prevent contami nation, do not return unused chemicals to reagent bottles.)
- Add water to the beaker and, while stirring vigorously, spill the beaker of sodium bicarbonate solution all over a demon stration tray, and then blithely ignore the spill. (Clean up all spills immediately.)
- Weigh out another sample, adding the sodium bicarbonate directly to the balance pan. Then pick up the balance pan and pour the baking soda into the just used, "dirty" beaker. (Do not weigh directly on the balance pan.) Add water to the beaker and stir, splashing everywhere.
- Set up a Bunsen burner (don't actually hook it up to the gas); pretend to turn on the gas jet and *then* start looking for matches to light the burner. (Do not turn on the gas jet until you are immediately ready to light the burner.)
- Pretend to heat the beaker by holding it at the top rim with your fingers; say "ouch" as you nearly drop the beaker. (Use tongs or forceps or wear heat-protective gloves when handling hot glassware.)
- Set up a ring stand and place the beaker on wire gauze; put a thermometer in the beaker to measure temperature but then use it to stir the solution. (Do not use a thermometer as a stirring rod.)
- While pretending to wait for the solution to heat up, pull out a candy bar from your pocket and take a bite. (No eating in the lab.)
- Fumble through a purse and pull out a mirror and hair spray. Fix your hair (wig) by spraying it with hair spray. (Keep flammable and combustible materials away from open flames.)
- Pick up an unlabeled bottle of vinegar and try to determine what it is. (Always label all chemical bottles; do not use chemicals from unlabeled bottles.) Smell the vinegar by putting your nose directly over the mouth of the bottle. (Do not smell a chemical directly—use a wafting motion to direct the odors to your nose.)
- Measure some vinegar into a graduated cylinder by holding the cylinder at eye level near your face and messily pouring. (When transferring chemical reagents from one container to another, hold the containers away from your body or set glassware level on the table before pouring.)
- Add food coloring or dishwashing detergent, if desired, and then pour the sodium bicarbonate solution into the vinegar in the cylinder. The mixture will erupt out of the cylinder and overflow all over the table—act surprised. (Always practice a demonstration beforehand so you know what to expect.)
- After the demonstration, say thanks and walk out. (Clean and wipe up all work surfaces thoroughly after a demonstration or lab.)

Discussion

The laboratory safety challenge is a great way to introduce or reinforce the topic of lab safety with your students. Rather than having students read aloud from a long list of prescribed safety rules, this activity allows students to generate their own list of common-sense safety rules. Have students write down a list of what is "wrong" with the lab attire as well as the "mistakes" in laboratory technique as you perform the demonstration. Afterwards, the students can get into small groups and combine their lists to generate a consensus or classroom set. The rules obtained in this manner should be augmented, of course, by a comprehensive review of all the rules in the *Flinn Scientific Student Safety Contract* and a discussion of their importance and relevance. The use of a little reverse psychology in the laboratory safety challenge may help students perceive the safety rules in a new light, to realize that the rules have been developed for their own benefit and to protect the students from harm.

Discussion Questions

1. A good tactic to improve safety is to focus on specific problem areas rather than always looking at the broad picture. What is the most frequently misunderstood or overlooked rule in the student safety contract? Discuss simple, practical steps that would be easy to implement to overcome any "problem" rules.
2. What is the department policy for handling safety violations? Does the administration fully support the department safety policy?

Tips

- This unusual activity is a popular workshop presentation for us at science teacher conferences.
- This demonstration is meant to be a fun and engaging way to help students generate their own list of laboratory safety rules. Do not actually use any harmful chemicals or hazardous laboratory techniques. Choose a demonstration with an extremely safe procedure.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, chemical reactions
Content Standard F: Science in Personal and Social Perspectives, personal and community health

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Laboratory Safety Challenge* activity, presented by Sue Bober and Irene Cesa, is available in *Teaching Safety To Students*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Laboratory Safety Challenge* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP4236	Contract, Student Safety Policy
AP4238	Safety Exam
AP8730	Liability Reduction Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

Flinn Scientific's Student Safety Contract

PURPOSE

Science is a hands-on laboratory class. You will be doing many laboratory activities which require the use of hazardous chemicals. Safety in the science classroom is the #1 priority for students, teachers, and parents. To ensure a safe science classroom, a list of rules has been developed and provided to you in this student safety contract. These rules must be followed at all times. Two copies of the contract are provided. One copy must be signed by both you and a parent or guardian before you can participate in the laboratory. The second copy is to be kept in your science notebook as a constant reminder of the safety rules.

GENERAL RULES

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
3. Never work alone. No student may work in the laboratory without an instructor present.
4. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
8. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.
9. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Bring only your laboratory instructions, worksheets, and/or reports to the work area. Other materials (books, purses, backpacks, etc.) should be stored in the classroom area.
10. Keep aisles clear. Push your chair under the desk when not in use.
11. Know the locations and operating procedures of all safety equipment including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Know where the fire alarm and the exits are located.
12. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
13. Be alert and proceed with caution at all times in the laboratory. Notify the instructor immediately of any unsafe conditions you observe.
14. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink. Check the label of all waste containers twice before adding your chemical waste to the container.
15. Labels and equipment instructions must be read carefully before use. Set up and use the prescribed apparatus as directed in the laboratory instructions or by your instructor.
16. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. Wash your hands with soap and water after performing all experiments. Clean all work surfaces and apparatus at the end of the experiment. Return all equipment clean and in working order to the proper storage area.
17. Experiments must be personally monitored at all times. You will be assigned a laboratory station at which to work. Do not wander around the room, distract other students, or interfere with the laboratory experiments of others.
18. Students are never permitted in the science storage rooms or preparation areas unless given specific permission by their instructor.
19. Know what to do if there is a fire drill during a laboratory period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
20. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly.
21. When using knives and other sharp instruments, always carry with tips and points pointing down and away. Always cut away from your body. Never try to catch falling sharp instruments. Grasp sharp instruments only by the handles.
22. If you have a medical condition (e.g., allergies, pregnancy, etc.), check with your physician prior to working in lab.

CLOTHING

23. Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. There will be no exceptions to this rule!
24. Contact lenses should not be worn in the laboratory unless you have permission from your instructor.
25. Dress properly during a laboratory activity. Long hair, dangling jewelry, and loose or baggy clothing are a hazard in the laboratory. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed.
26. Lab aprons have been provided for your use and should be worn during laboratory activities.

ACCIDENTS AND INJURIES

27. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.
28. If you or your lab partner are hurt, immediately yell out "Code one, Code one" to get the instructor's attention.
29. If a chemical splashes in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.
30. When mercury thermometers are broken, mercury must not be touched. Notify the instructor immediately.

HANDLING CHEMICALS

31. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for smelling chemical fumes will be demonstrated to you.
32. Check the label on chemical bottles twice before removing any of the contents. Take only as much chemical as you need.
33. Never return unused chemicals to their original containers.

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34. Never use mouth suction to fill a pipet. Use a rubber bulb or pipet pump.
35. When transferring reagents from one container to another, hold the containers away from your body.
36. Acids must be handled with extreme care. You will be shown the proper method for diluting strong acids. Always add acid to water, swirl or stir the solution and be careful of the heat produced, particularly with sulfuric acid.
37. Handle flammable hazardous liquids over a pan to contain spills. Never dispense flammable liquids anywhere near an open flame or source of heat.
38. Never remove chemicals or other materials from the laboratory area.
39. Take great care when transporting acids and other chemicals from one part of the laboratory to another. Hold them securely and walk carefully.

HANDLING GLASSWARE AND EQUIPMENT

40. Carry glass tubing, especially long pieces, in a vertical position to minimize the likelihood of breakage and injury.
41. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
42. Inserting and removing glass tubing from rubber stoppers can be dangerous. Always lubricate glassware (tubing, thistle tubes, thermometers, etc.) before attempting to insert it in a stopper. Always protect your hands with towels or cotton gloves when inserting glass tubing into, or removing it from, a rubber stopper. If a piece of glassware becomes "frozen" in a stopper, take it to your instructor for removal.
43. Fill wash bottles only with distilled water and use only as intended, e.g., rinsing glassware and equipment, or adding water to a container.
44. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
45. Examine glassware before each use. Never use chipped or cracked glassware. Never use dirty glassware.
46. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.
47. If you do not understand how to use a piece of equipment, ask the instructor for help.
48. Do not immerse hot glassware in cold water; it may shatter.

HEATING SUBSTANCES

49. Exercise extreme caution when using a gas burner. Take care that hair, clothing and hands are a safe distance from the flame at all times. Do not put any substance into the flame unless specifically instructed to do so. Never reach over an exposed flame. Light gas (or alcohol) burners only as instructed by the teacher.
50. Never leave a lit burner unattended. Never leave anything that is being heated or is visibly reacting unattended. Always turn the burner or hot plate off when not in use.
51. You will be instructed in the proper method of heating and boiling liquids in test tubes. Do not point the open end of a test tube being heated at yourself or anyone else.
52. Heated metals and glass remain very hot for a long time. They should be set aside to cool and picked up with caution. Use tongs or heat-protective gloves if necessary.
53. Never look into a container that is being heated.
54. Do not place hot apparatus directly on the laboratory desk. Always use an insulating pad. Allow plenty of time for hot apparatus to cool before touching it.
55. When bending glass, allow time for the glass to cool before further handling. Hot and cold glass have the same visual appearance. Determine if an object is hot by bringing the back of your hand close to it prior to grasping it.

QUESTIONS

56. Do you wear contact lenses?
    ☐ YES ☐ NO
57. Are you color blind?
    ☐ YES ☐ NO
58. Do you have allergies?
    ☐ YES ☐ NO

    If so, list specific allergies _____

    _____

    _____

AGREEMENT

I, _____ , _____ (student's name) have read and agree to follow all of the safety rules set forth in this contract. I realize that I must obey these rules to ensure my own safety, and that of my fellow students and instructors. I will cooperate to the fullest extent with my instructor and fellow students to maintain a safe lab environment. I will also closely follow the oral and written instructions provided by the instructor. I am aware that any violation of this safety contract that results in unsafe conduct in the laboratory or misbehavior on my part, may result in being removed from the laboratory, detention, receiving a failing grade, and/or dismissal from the course.

_____
Student Signature

_____
Date

Dear Parent or Guardian:

We feel that you should be informed regarding the school's effort to create and maintain a safe science classroom/laboratory environment.

With the cooperation of the instructors, parents, and students, a safety instruction program can eliminate, prevent, and correct possible hazards.

You should be aware of the safety instructions your son/daughter will receive before engaging in any laboratory work. Please read the list of safety rules above. No student will be permitted to perform laboratory activities unless this contract is signed by both the student and parent/guardian and is on file with the teacher.

Your signature on this contract indicates that you have read this Student Safety Contract, are aware of the measures taken to ensure the safety of your son/daughter in the science laboratory, and will instruct your son/daughter to uphold his/her agreement to follow these rules and procedures in the laboratory.

_____
Parent/Guardian Signature

_____
Date