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Introduction to Science Laboratory Safety

Everyone's talking about science safety, from science teacher organizations to the national standards. Here's what they're saying.

by [Kimberly S. Lightle](#), *ENC Instructional Resources*

With the increasing emphasis on inquiry-based teaching in all science classrooms, it is critical that science teachers become as knowledgeable as possible about laboratory safety issues. Ideas of safety have changed over the years--determining students' blood types, growing bacteria, and keeping huge chunks of sodium metal in the chemical storeroom have gone by the wayside. Boy, those were the days! There are still many exciting activities and investigations that students can do--they are just safer.

What do the standards say about safety? *The National Science Education Standards* (National Research Council, 1996) Science Education Program Standards (Chapter 7) describe the criteria for a high quality school science program. These standards focus on issues at the school and district levels that relate to opportunities for students to learn and opportunities for teachers to teach science. The last three standards in the chapter describe the conditions necessary to implement a comprehensive program that provides appropriate opportunities for all students to learn science.

There must be space for students to work together in groups, to engage safely in investigation with materials, and to display both work in progress and finished work. There also must be space for the safe and convenient storage of the materials needed for science. At the lower grade levels,

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schools do not need separate rooms for laboratories. In fact, it is an advantage in terms of long-term studies and making connections between school subject areas to have science as an integral part of the classroom environment. At the upper grade levels, laboratories become critical to provide the space, facilities, and equipment needed for inquiry and to ensure that the teacher and students can conduct investigations without risk. All spaces where students do inquiry must meet appropriate safety regulations. (Program Standard D, NSES, p. 218)

Professional organizations such as the National Science Teachers Association (NSTA) and the National Association of Biology Teachers (NABT) have also come out with position papers on safety in the science classroom (see below). Your state probably has an official document that describes what is allowed or required in the classroom-- check with your department chairperson or your state department of education.

For more science safety information, check out our list of [general resources](#), or see suggestions for creating a [safe life science classroom](#) or [chemistry laboratory](#).

Kimberly S. Lightle is ENC's associate director for Instructional Resources and director of the Learning Matrix and FEDRL, two of the National Science Digital Library (NSDL) initiatives at ENC. She is a former high school chemistry teacher. Email: klightle@enc.org.

Professional Organization Position Papers

- [NSTA Position Paper on Laboratory Science](#)
- [NSTA Position Paper on the Use of Animals in the Classroom](#)
- [NSTA Position Paper on Liability of Teachers for Laboratory Safety and Field Trips](#)
- [NSTA Position Paper on Safety and School Science Instruction](#)
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Covering Safety in the Science Classroom

Discussing safety in the science classroom doesn't have to be bland and boring. Here you'll find ideas for making the necessary learning both fun and informative, while satisfying your state's and school's requirements.

by [Amy L. Kovach](#), *ENC Instructional Resources*

Lessons on safety were always part of my opening unit of the school year because safety is one topic that plays a role in every laboratory and activity. Students need to understand and follow appropriate behavior, proper laboratory techniques, and suitable laboratory attire before they begin an activity or experiment. Likewise, before teachers begin a lab, they should understand the necessary techniques, the acceptable methods of materials disposal, and any liability issues.

The following are some of the ways my students and I explored our responsibilities in maintaining a safe science classroom.

Safety Contracts

Having a signed safety contract is an absolute must! It allows you to refer back to the contract to reinforce safety instructions before each new laboratory session. It provides evidence that both the students and their caregivers know what is expected of them in the classroom, if a violation occurs. It also prepares students for what to do, if an emergency arises.

First, pass out two copies of a safety contract (for contracts you can use in your classroom, see the resources below). As a class, discuss each point that is presented in the contract. Students sign both copies of the contract and then take them

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home to have them read and signed by their parents or guardians.

When students return the signed copies of the safety contract, place one copy in the student's laboratory folder. Place the other copy in your files. Some districts and states require that all students in middle and high school have signed safety contracts on file before they conduct any lab activity because of liability issues, which is a good policy for any science classroom.

Biological supply companies often provide safety contracts for purchase. Depending on your situation, however, you may wish to look for contracts that can be customized to the specific needs of your class or that can be downloaded for free from online sources.

Visuals

Posters are a great way to present visual reminders of proper safety procedures in the classroom (see the resource list below). Some posters contain amusing diagrams or cartoon images of animals or humans not following the established safety rules. Others show standard hazard symbols and laboratory techniques, such as how to heat a test tube. I placed the posters in my classroom so students would always be facing a poster when they looked up from their lab tables. I hung smaller, laminated posters from the ceiling that showed proper techniques, such as how to carry a microscope.

Videos are another way to reinforce safety instructions (see suggested videos in the resource list below). I had students watch a video that took a humorous approach to science safety with the actors conducting inappropriate laboratory activities and showing the consequences. The slapstick comedy kept everyone entertained. After showing actors slipping on wet floors and such, the video ended with a discussion of what should have been done to keep the laboratory a safe place.

Activities

There were a few fun activities that I had students do to become familiar with the room and the points of the safety contract. Students diagrammed the classroom as if they were looking down at it from an aerial view. They had to include where specific potential hazards, proper equipment, and safety devices were located. They had to diagram electrical outlets, laboratory desks, and the fire extinguisher.

Another activity had students identify proper and improper laboratory behavior and techniques

while using their safety contract as a reference. Students were given a cartoon of kids in a biology lab. Some of the kids in the cartoon were acting appropriately, while others were acting inappropriately. Students had to circle the appropriate techniques and cross out the inappropriate techniques on the cartoon. Then students wrote how the cartoon kids could improve their improper behavior or techniques. For instance, one boy in the cartoon was running with a beaker full of fluid that was sloshing over the edge. Suggestions that students came up with included the boy should be walking not running and the boy should be wearing gloves because the fluid is not identified. I discussed their answers as a class.

It is important to stress that students remain calm in an emergency, immediately inform a teacher about the situation, and know how to use emergency equipment and contact the nurse. It is also important for you and the students to know the school's policy on who can provide first aid for others. As an activity to reinforce this information, I asked students to divide into groups of three or four for role-playing. Each group randomly selected scenarios from pre-made cards. They then had to create and act out a brief skit to demonstrate the situation. The class had to try to guess what the situation was, and if the students who were acting it out followed the guidelines of the safety contract. Scenarios included electrical shock, fire, proper laboratory attire, a poisoning, cut wound during a dissection, and cleanliness in the lab.

One year, a very creative and theatrical bunch happened to select the explosion card. One student decided to play the role of a high school biology student, while the other two students played either his bad conscience or his good conscience. His consciences gave him advice on what he should do with bottles of chemicals that they placed on the table. The high school student decided to listen to the bad conscience and mix the chemicals. All three then shouted a thunderous "ka-boom" timed perfectly with the student throwing a cup that contained bits of paper into the air. As the paper bits floated down to the lab desk, the student walked around woozily. One of the group members worked to comfort the student, while the other walked calmly over to me to inform me of the situation.

Assessing the Students' Learning

At the end of the unit, I gave students a quiz. Some parts of the quiz consisted of multiple choice and short answer questions about safety. Another part consisted of hazards and safe practices that were set up at stations around the room, as they might be experienced in real life. In the stations, students had to describe the

situation and then identify it as a hazard or a proper laboratory technique. For instance, because I was in a biology classroom, I always had one station with a microscope that had a frayed cord.

The opening unit on safety usually took about one week. However, students were reminded about specific safety contract points throughout the year as they applied to each lab activity. It is also important to remember that enforcement of the safety contract was necessary. If a violation of the contract did occur, I first gave a warning. Rules that were typically violated included pulling long hair back, cleaning the laboratory desks after use, and making sure goggles remain on throughout the laboratory. A second offense resulted in a student not being able to complete the laboratory, with a phone call to the parent or guardian referencing the safety contract.

The safety unit was a way to prevent potential safety problems before they occurred, along with a way to be prepared if an emergency did arise. Safety cannot be stressed enough in any science classroom; even though it can be a tough sell at times, it is time well spent.

Amy Kovach is the senior science abstractor at ENC. She is a former high school biology teacher and has a current interest in entomology. Email: akovach@enc.org.

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Related Resources

Flinn laboratory techniques guide



Date: 2002 **Grade**
(s): 9 - 12 **Cost:** \$12.25
ENC#: 032188

Safety is the number one priority in science classrooms, but students don't always remember proper safety techniques. These reference guides, which are designed to fit in students' binders, provide easy access to visual and print instructions for typical laboratory techniques. (For more details, see [ENC Record](#).)

Safety Contracts

Flinn Scientific's middle school science safety contract

Date: 2004 **Grade**





(s): 5 - 8 Cost: \$4.80 ENC#: 032559

Agreeing to following safe procedures in a science laboratory can never start too early. This safety contract is designed to cover proper behavior with simplified rules for middle school students. (For more details, see [ENC Record](#).)

Safety Contract **Date:** 2003 **Grade(s):** 5 to 12

Cost: Free

www.evsc.k12.in.us/curriculum/science/contract.htm

You can never have too many versions of a safety contract. This version, from Evansville Vanderburgh Schools, in Evansville, Indiana, presents the expected laboratory behaviors in a list and has a place for the student's and parent's or guardian's signatures.

Flinn Scientific's student safety contract



Date: 2004 **Grade**

(s): 5 - 12 Cost: \$4.95 ENC#: 032558

A safety contract is a MUST for any science class. This version lists the safety rules that students should follow and provides a section for parents or guardians to acknowledge they are aware of students' responsibilities. (For more details, see [ENC Record](#).)

Safety Visuals

Lab safety simplified



Date: 2002 **Grade**

(s): 6 - 12 Cost: \$35.80

ENC#: 031840

Who doesn't love to watch a choreographed science safety video? This one incorporates the proper and improper procedures, behavior, and attire to maintain a safe science classroom. (For more details, see [ENC Record](#).)

Science laboratory safety



Date: 1998 **Grade**

(s): K - 12 Cost: \$79.00

ENC#: 017179

Looking for a video about the dos and don'ts of laboratory safety? This video presents them with students acting out situations. (For more details, see [ENC Record](#).)

No horseplay in lab!



Date: 2005 **Grade**

(s): 5 - 12 Cost: \$4.05 ENC#: 032574

Amusing safety posters are fantastic reminders to kids about proper science laboratory procedures. This poster does a great job of playing on the phrase "horseplay" by the showing the unsafe situations caused in the laboratory by the antics of a cartoon

horse that does not follow the rules. (For more details, see [ENC Record](#).)

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General Science Safety Resources

Looking for some resources that will answer your safety questions and concerns? Check out the resources described below that support a safe science classroom.

by [Amy L. Kovach](#), *ENC Instructional Resources*

Safety Resources for Any Grade Level

Flinn Scientific

 **ENC Digital Dozen Site****Date:** 2004 **Grade****(s):** 9 - 12 **Cost:** Free **ENC#:** 014317<http://www.flinnsci.com/>

This web site offers resources for biology, chemistry, Earth science, and physics laboratories. Be sure to check out the top-notch section on safety (see www.flinnsci.com/Sections/Safety/safety.asp). It includes tips for safely storing and handling chemicals, guidelines for eye protection, and frequently asked safety questions. (For more details, see [ENC Record](#).)

Flinn Scientific Chemical & Biological Catalog Reference Manual

Date: 2005 **Grade(s):** 8-12 **Cost:** Free

This print catalog includes such practical information as advice for setting up and organizing chemicals and equipment, safety tips, chemical disposal procedures, solution preparation recipes, lab techniques, and more. Request your free copy at www.flinnsci.com/catalog_request.asp.

Flinn Scientific safety seminar : practical solutions to laboratory safety problems
Date: 2000 **Grade**

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**(s): 9 - 12 Cost: \$19.95****ENC#: 025846**

This science safety training kit, including a video workshop, user's guide, and generic chemical hygiene plan, is a resource that no school should be without! Teachers and administrators are presented with solutions to real problems, such as how to take a chemical inventory, chemical disposal procedures, teacher liability, and class size. (For more details, see [ENC Record.](#))

Science education safety : key issues in school laboratory safety

Date: 2001 Grade**(s): K - 12 Cost: Free ENC#: 020712**
<http://csss.enc.org/safety>

This web site, developed by the Council of State Science Supervisors (CSSS) for grades K-12, is intended to help teachers implement safe practices in the inquiry-based classroom. Instructor responsibilities and legal issues are discussed as well as chemical labeling and storage, required protective equipment, and guidelines for handling student accidents. Specifications for the physical layout and design of laboratory spaces are also provided. Information is displayed in PDF format as a booklet for secondary school teachers and as a flip chart for elementary school teachers, which CSSS encourages readers to download, copy, and distribute. General safety checklists and links to other web sites offer further safety recommendations. (For more details, see [ENC Record.](#))

Safety Resources for Elementary School

Elementary science safety manual for grades K-8

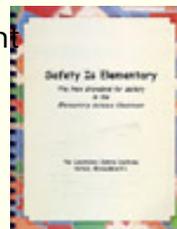
**Date: 1999 Grade****(s): K - 8 Cost: \$17.99 ENC#: 021146**

Most elementary classrooms are not equipped with typical laboratory and safety equipment such as lab benches, sinks, an eye-wash, or a fire extinguisher. This manual explains how to keep younger students safe when conducting typical hands-on labs in and out of the classroom. (For more details, see [ENC Record.](#))

Safety is elementary : the new standard for safety in the elementary science classroom

**Date: 2000 Grade****(s): K - 6 Cost: Out of Print****ENC#: 017989**

This alphabetical reference guide is just what you need to help prevent and deal with safety problems as they arise. There is information about



selecting and using eye protection, handling animals in the classroom, preventing accidents on field trips, and safely operating tools and equipment in the classroom. The guide also includes general first aid instructions and tips on fire prevention and control. (For more details, see [ENC Record](#).)

Exploring safely : a guide for elementary teachers



Date: 2002 **Grade**

(s): K - 5 **Cost:** \$22.95 **ENC#:** 026704

This book provides practical information and advice for safely teaching inquiry-based lessons in an elementary school science laboratory. The book discusses safety concepts in the context of real classrooms, providing positive options to eliminate potential hazards. Topics include making safety automatic to students, accommodating children with special needs, and equipping the classroom and students for safe activities. Safety guidelines are drawn from the American Chemical Society. (For more details, see [ENC Record](#).)

Safety Resources for Middle School

Flinn Science Catalog Reference Manual: Middle School

Date: 2005 **Grade(s):** 6-8 **Cost:** Free

This version of the Flinn catalog contains the same practical information as the high school version (above), but it is tailored to the middle school curriculum. Request your free copy at www.flinnsci.com/ms_form_news.asp.

Inquiring safely : a guide for middle school teachers



Date: 2003 **Grade**

(s): 6 - 8 **Cost:** \$22.95 **ENC#:** 027398

Get acquainted with general safety rules and ways to promote safety in the middle school classroom. You'll learn how science laboratories should be equipped and what specific precautions you should take in each of the traditional science disciplines: life science, chemistry, Earth and space science, and physical science. Consider the pros and cons of keeping live organisms in the classroom; evaluate the potential hazards of field trips and of having students perform science activities at home. Teacher vignettes, chapter summaries, and additional references make this a valuable resource. (For more details, see [ENC Record](#).)

Safety in the middle school science classroom



Date: 2004 **Grade**

(s): 6 - 8 **Cost:** \$14.95 **ENC#:** 029997

Everyone can use a little reminder about science safety. This flip chart is intended for display in the classroom. It highlights science safety practices and suggests

ways teachers can provide a safe environment for their students. Topics include what to do in case of an accident, essential eye protection, and tips for field trips. The chart concludes with a safety checklist that serves as a quick reference for basic safety practices. (For more details, see [ENC Record](#).)

Amy Kovach is the senior science abstractor at ENC. She is a former high school biology teacher and has a current interest in entomology. Email: akovach@enc.org.

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Handling and Organizing Chemicals

Need a little help coming up with a plan to organize that chemical storeroom? You've come to the right place.

by [Kimberly S. Lightle](#), *ENC Instructional Resources*

When I started teaching chemistry back in the 80s, I inherited a chemical storeroom from a teacher who had been hoarding enough chemicals and equipment to launch a rocket to the moon. The chemicals were haphazardly stacked and grouped, many of the jars and cans were so corroded that I couldn't determine what was inside them, and--to top it all off--the whole closet smelled really bad. It was truly amazing that the storeroom hadn't exploded or caught on fire. My principal, who was also new, realized the severity of the problem and supported me in the cleanup process. It took a while, but eventually we had a storeroom that the Occupational Safety and Health Administration could be proud of.

The importance of keeping a chemical storeroom organized cannot be stressed enough. If you have chemicals that are past their prime, contact your state department of education. Many states have hazardous disposal pick up plans available to schools for free or low cost. Many online and real resources will help you keep chemicals and equipment organized and safe. The ones highlighted here include information on how to organize and dispose of chemicals in a safe manner, as well as how to be safe while you and your students are using them in the classroom.

Chemical safety for teachers and their supervisors

Date: 2001 Grade

(s): 7 - 12 Cost: Free ENC#: 024995

This short pamphlet is great for

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chemistry teachers! It promotes proper chemical safety habits, discusses what the warning terms on chemical labels mean, and explains how to read Material Safety Data Sheets (MSDSs). (For more details, see [ENC Record](#).)

Flinn combined MSDS/Chemventory



Date: 2003 **Grade**
(s): K - 12 **Cost:** \$199.95
ENC#: 032729

Similar to the Flinn MSDS library, this software package goes a step further. The information can be personalized for the school's chemical storage area, so the entire inventory can be known and monitored. (For more details, see [ENC Record](#).)

Flinn MSDS library



Date: 2003 **Grade**
(s): K - 12 **Cost:** \$150.00
ENC#: 032730

You know you need to have MSDS on file for each chemical, but you don't. This is a convenient way to print and view over 1,000 MSDS or to create your own with just the click of a button. (For more details, see [ENC Record](#).)

Flinn Scientific chemical storage pattern



Date: 2001 **Grade**
(s): K - 12 **Cost:** \$4.05 **ENC#:** 032577

This poster assigns organic and inorganic compounds to the codes where they should be stored in the chemical supply area. It's a great reminder to hang in the area for quick reference. (For more details, see [ENC Record](#).)

Kimberly S. Lightle is ENC's associate director for Instructional Resources and director of the Learning Matrix and FEDRL, two of the National Science Digital Library (NSDL) initiatives at ENC. She is a former high school chemistry teacher. Email: klightle@enc.org.

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Safety in the Life Science Classroom

Often, discussions of safety in the science classroom focus on the chemistry laboratory. The life science classroom, however, presents its own unique challenges. Below, you'll find advice on disposing of dissection specimens, keeping live organisms in the classroom, and performing experiments.

by [Amy L. Kovach](#), *ENC Instructional Resources*

Because of the topics that are covered in life science courses, teachers can be faced with challenges of handling preserved or living materials. For instance, how should animals or plants be disposed of following dissection? What kinds of live animals or plants should be allowed in the classroom? And what are special precautions that should be taken with human or bacterial laboratories?

Dissection disposal presents potential hazards both for the environment and for classroom safety. If you choose to perform dissections on animals, most modern specimens are preserved in nonformaldehyde or limited formaldehyde solution following an initial fixation of the organism with formaldehyde. If the dissection is scheduled to take place over more than one day, return the organisms to the sealed container in which they came so any volatiles do not permeate the room. At the completion of the dissection, animals that have been preserved with formaldehyde should be rinsed with a steady stream of tap water for a period of 8 to 12 hours before they are placed in the garbage.

Animals that have not been preserved with a formaldehyde solution can be placed directly into the garbage for disposal. Plant specimens can also be placed directly into the garbage. However, special care should be taken with non-native

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plants to limit the potential of their reproductive structures escaping the classroom through tears in a garbage bag or down a drain and becoming established in the ecosystem as undesirable weeds.

When it comes to allowing living specimens into the classroom, all state and federal regulations about collection and release of the organisms must be followed. Teachers should also ensure they can provide the appropriate amount of space and nutritional requirements for the health of the organism prior to allowing the organisms into the classroom.

Human bodily fluids should not be used in school laboratories because these fluids can contain pathogens and must be treated with precaution. It is suggested that professionally prepared slides of cells and tissues or simulated materials be used instead. However, some states still permit students to examine their own cheek cells if done following specific protocol (see the resource link below). Students should not culture human bacteria that can be found in their mouths, on drinking fountains, on door knobs, or anywhere else because of the risk of concentrating a highly pathogenic form. If you want your students to perform bacterial or DNA labs, materials should be purchased from a biological supply company.

Amy Kovach is the senior science abstractor at ENC. She is a former high school biology teacher and has a current interest in entomology. Email: akovach@enc.org.

Resources

State Science Education Coordination Committee. (2004). *Utah Guidelines for Responsible Use of Animals in the Classroom*. Retrieved from: www.usoe.k12.ut.us/curr/Science/pdf/UseOfAnimalsInClassroom.pdf.

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Safe Science Facilities

Is your classroom or science lab a safe place for students? The following resources provide guidelines for classroom and lab layout, information about federal safety mandates, and lists of necessary lab safety equipment.

Follow this link for excerpts from [Science & Safety: Making the Connection](#) (PDF format), published by the Council of State Science Supervisors. High school and middle school teachers will find resources on laboratory layout, chemical and equipment storage, federal safety mandates, and guidelines in case of accidents. (High School Science Laboratory Facilities - pp. 8,9,11,12,13)

Follow this link for excerpts from [Science and Safety: It's Elementary](#) (PDF format), published by the Council of State Science Supervisors. Even though the elementary science classroom doesn't present the same hazards as secondary school laboratories, elementary teachers should know about protective equipment as well as guidelines for the physical layout of the classroom or science resource room. (Elementary School Science Laboratory Facilities - pp. 14,15,16,17)

Laboratory safety inspection kit

Date: 1999 **Grade****(s):** 5 - 12 **Cost:** \$39.95**ENC#:** 032560

So, you want to make sure your science room is safe, but not sure how? This kit provides simple questions in table format to identify existing safety problems and provide the correct procedure to change them. It is definitely one of those kits where you will say to yourself, "If I only would have had this sooner!" or "Why didn't I think of that?" (For more details, see [ENC Record](#).)

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