Exploring Safely

A Guide for Elementary Teachers

By Terry Kwan and Juliana Texley

NSTApress®
NATIONAL SCIENCE TEACHERS ASSOCIATION
Arlington, Virginia

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Exploring Safely: *A Guide for Elementary Teachers*
NSTA Stock Number: PB166X1
ISBN: 0-87355-200-8
Library of Congress Control Number: 2001098898
Printed in Canada by Webcom
Printed on recycled paper

NSTA Press
1840 Wilson Boulevard
Arlington, Virginia 22201-3000
www.nsta.org

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Preface

It has been many years since NSTA released a laboratory safety guide for teachers. In that time, many things have changed. We have more to teach—and the concepts are more complex. High-stakes tests have narrowed our focus and sharpened the scrutiny of our communities. Technology has permitted us to gather and transmit information with increasing speed; it has also allowed us to make lab experiences more like real-world science.

Social conditions have changed too. Today's teachers work with increasingly diverse student populations, including students with many special needs and sensitivities for whom they must design lab and field work. The public is more litigious, increasing teachers' concerns about liability. We also know more about potential hazards. We have access to new research and data about toxicity of materials and dangers in methods that were not apparent years ago.

But today's students need hands-on experience in science more than ever. They need to observe and investigate, practicing the skills that will enable them to make good decisions and to work in the complex world of the 21st century.

The good news is that we now have information about alternatives and options that we never had before. We can still provide the investigative and observational activities that are essential to helping students understand the content and the methods of science. We can still set the scene for the discrepant events that produce the "Aha!" so essential to engendering true understanding and love of the scientific endeavor. Teachers today can implement exciting curricula based on the National Science Education Standards in a safe learning environment if they have background knowledge and good sense. To do so requires planning and preparation, but it's well worth the effort.

This book is intended to offer positive options, even as it raises awareness of potential hazards. *Exploring Safely* is the elementary edition, followed by *Inquiring Safely* for middle school teachers, and *Investigating Safely* for high school teachers. While we've included many anecdotes—all true stories, except for the names—from the designated grade ranges, the general principles are the same.

This elementary volume is for both self-contained classroom teachers and science specialists. It also has many applications for administrators and central office personnel. Be sure to share it as needed, so that your entire school community will become more conscious of safety.

While the traditional safety manual tends to be a compilation of safety rules, regulations, and lists, this book takes another path. We offer a more narrative style, providing discussions of safety concepts in the context of commonplace situations in

real classrooms. We hope this approach makes these books enjoyable to read as well as to reference.

We also hope that the books are thought provoking. No single publication can cover every eventuality. We encourage you to make connections and generalize from the ideas presented. Our goal is to provide you, the teacher, with examples of safe practices and to help you become more alert to ways of ensuring safety when you teach science in your classroom and in field studies. Above all, we encourage you to use common sense.

We believe that creating a safe environment for teaching and learning science is a group endeavor, led by the teacher, but joined by the entire school community. As you read this book, we hope it helps you "see" your physical environment and your procedures through a safety-conscious lens. In so doing, you will be able to give your students habits of mind that will last a lifetime.

Special thanks to the contributors who reviewed and added to this document: Kenneth Roy, chair of NSTA's Science Safety Advisory Board; Bob Davis, chair of the Council of State Science Supervisors Writing Committee for Science and Safety; Eric Pyle, chair of NSTA's Special Education Advisory Board; Fran Hess; Judy Williams; Sandra West; Gloria Rudisch, M.D.; Tim Champion; Lance Rudiger; Janice Danielson; and Sue Senator. Their tireless work has helped us polish our view of the classroom and enrich our offerings to you, the teacher.

Author Biographies

Terry Kwan taught middle and high school science before becoming a science supervisor and independent contractor, collaborating with private and public institutions to develop science programs, train teachers, and design science facilities. She has been a school board member in Brookline, Massachusetts, since 1985 and a community representative to Institutional Biosafety Committees for the Harvard Medical School and the Dana Farber Cancer Institute.

Juliana Texley has taught all the sciences, K to 12, for 25 years and spent 9 as a school superintendent. She was editor of the *Science Teacher* for 12 years and an officer of the Association of Presidential Awardees in Science Teaching. She currently teaches college biology and technology, and develops online curricula for students and teachers.

About the Cover Artist

Shennon Bersani used her daughter Kerrin as the model for this cover. Her continuous curiosity and love of nature made her the perfect choice. Other live models, the goldfish, where taken from Shennon's backyard pond — a haven for birds, butterflies, turtles, frogs, and a ribbon snake. Two colored-pencil illustrations were created, one of Kerrin with the background and one of the bowl of fish. Merging the two on the computer using Photoshop achieved the final image.

Exploring Safely brings you *sci*LINKS, a new project that blends the two main delivery systems for curriculum—books and telecommunications—into a dynamic new educational tool for children, their parents, and their teachers. *sci*LINKS links specific science content with instructionally rich Internet resources. *sci*LINKS represents an enormous opportunity to create new pathways for learners, new opportunities for professional growth among teachers, and new modes of engagement for parents.

In this *sci*LINKed text, you will find an icon near several of the concepts being discussed. Under it, you will find the *sci*LINKS URL (*www.scilinks.org*) and a code. Go to the *sci*LINKS website, sign in, type the code from your text, and you will receive a list of URLs that are selected by science educators. Sites are chosen for accurate and age-appropriate content and good pedagogy. The underlying database changes constantly, eliminating dead or revised sites or simply replacing them with better selections. The *sci*LINKS search team regularly reviews the materials to which this text points, so you can always count on good content being available.

The selection process involves four review stages:

1. First, a cadre of undergraduate science education majors searches the World Wide Web for interesting science resources. The undergraduates submit about 500 sites a week for consideration.

2. Next, packets of these web pages are organized and sent to teacher-webwatchers with expertise in given fields and grade levels. The teacher-webwatchers can also submit web pages that they have found on their own. The teachers pick the jewels from this selection and correlate them to the National Science Education Standards. These pages are submitted to the *sci*LINKS database.

3. Scientists review these correlated sites for accuracy.

4. NSTA staff approve the web pages and edit the information provided for accuracy and consistent style.

*sci*LINKS is a free service for textbook and supplemental resource users, but obviously someone must pay for it. Participating publishers pay a fee to NSTA for each book that contains *sci*LINKS. The program is also supported by a grant from the National Aeronautics and Space Administration (NASA).

Setting the Scene

Ms. J. has an average third grade—many students, much diversity. But their science skills shine even when she's not around. When the substitute is in, Tetsuko, who speaks only Japanese, takes responsibility for the aquarium. Maria, who is learning disabled, manages the seed experiment. Jean knows where to find the custodian when the class needs more soap for hygiene. Matt makes sure everything is in its place at the end of the day. Ms. J.'s class is a science team, learning together.

Share the Adventure *and* the Responsibility

Investigative science provides the opportunity for students to learn new skills. But it also means more work and responsibility for everyone. An active science program requires the distribution, use, and care of much more material and equipment than a textbook/workbook program. Classroom management is the first key to a safe learning environment—and to satisfaction for the teacher.

The first steps to hands-on science should be small ones. Practice the rules of investigation in short tasks before you try complex ones. At least some of your students may not have had the opportunity to experiment in class before and may perceive activity time as free time. Plan a five-minute investigation with a written response. If that is successful, try a ten-minute project with only a few pieces of equipment to manage. A rule of thumb in education is that children can't concentrate for more minutes than their age in years—about ten minutes for a fourth grader. But you can extend this by including time throughout the activity to respond, write, or assess.

If you try to do all the setup and cleanup yourself, you will find yourself with too little time and too much responsibility. Giving your students the skills to help maintain good organization will not only prevent accidents but will also teach them what they need to conduct their own research in the future. It can also improve class dynamics. Working with real objects and observing cause and effect firsthand often changes the playing field, creating new leaders in class work and challenging students who are great readers but who need help from others to complete an investigative laboratory task. Students who have trouble with reading or math skills may shine at managing materials or may display undiscovered observational and manipulative skills.

The science activity lesson provides an ideal opportunity to teach kids to take responsibility for their actions and their equipment. And for young children, figuring out how many items are needed, counting them as they are distributed, and recounting as they put them away are also ways to practice math skills. If you use a task board for student jobs, be sure to include science supply and equipment jobs. Older students can create diagrams of supply cabinets to make it easy for anyone to understand the system.

Cleanliness and Order—Foundations of Safe Practice

Most kids have seen the movie *The Nutty Professor*. However, the stereotype of the frizzy-haired scientist in the messy lab isn't one we want to perpetuate. Neatness and organization are essential to science. Everything in a science classroom should have a specific place. Safety equipment should be located where it can be quickly and easily grabbed for emergency use. Equipment and furniture should never obstruct escape routes.

The less "stuff" on the work surface, the less likely things will spill or get spilled upon. If a science experiment is to be conducted at a particular table or at student desks, then the surface should be cleared of everything except the equipment and supplies needed for the activity. In particular, food and food containers should not be anywhere near the spaces intended for science experiments. (See Chapter 10.) The less clutter around the work area, the lower the trip/fall hazard. Where to put the backpacks, extra notebooks, and other clutter? Certainly not on the floor next to the work area! In a spill or fire, an escaping student might trip and fall. Try the hall or put a sign on your door reminding students, "No books today."

What students should NOT do:

- Work in a chemical storage room or with stock bottles of chemicals
- Handle new or exotic organisms
- Go on errands without staff supervision
- Transport heavy equipment (such as televisions on carts)
- Use strong cleaning compounds or disinfectants

Extra clothing also can pose safety hazards. Those coats and hats can absorb chemicals or catch fire. If items are hung over the backs of students' chairs, the extra weight can cause them to tip over when students stand up or push their chairs away from their tables. Be sure there is a place to hang or store those jackets, caps, and other items that students wear to school but don't need during class time. (See Chapter 10, **Dress of the Day.**)

The Best-Laid Plans

Lesson plans often have great continuity but fall short in the real world. Every day there is someone absent in almost every classroom. That means that your safety precautions must consider the consequences of both teacher and student absences.

Remember that you are responsible for the program offered by your substitute. Because the substitute is unlikely to have your knowledge of the subject matter or the same level of classroom control, it is usually not a good idea to have them conduct complex activities or those with potential hazards. (If you direct them to do so, you could be liable. See Chapter 11.) Many teachers have a special substitute folder for one-day unexpected absences containing safe activities that would fit almost any part of the year. Make sure your substitute has a list of special needs students and the accommodations they require. If you will be absent for an extended period, take time to speak to your substitutes and ensure that they have the competencies to carry out your plans.

When students are absent, they often miss safety directions, so it is important to have a written version and to begin every class with a short review. Be sure that all your safety lessons and directions are included in your lesson plan book. Try to avoid having students out seeing the counselor, special education consultant, or speech therapist during direction time. A student who reenters the room in the middle of a science experience can be a real hazard to the rest of the group.

Students who are absent often need access to the supplies the next day. To save your sanity, you may want to organize these supplies in labeled boxes containing all the supplies for a particular unit. Place a laminated card with the relevant safety rules in the box with the supplies. While clear or translucent containers are ideal, shoeboxes and the ten-ream copy-paper cartons may also serve you well. Create outside labels that show not only the title of the activity, but also a list of the items inside. (See Chapter 4 for storage tips.) Many teachers find that assigning students homework buddies or makeup-work buddies works well.

Following any science activity, the work surface should be washed and dried completely before going on to the next activity. This is a great habit to instill—even if sometimes it doesn't seem necessary. Students can help here, but use only mild dish detergent. You will need a Material Safety Data Sheet (MSDS) for that product. (See Chapter 4.) Don't allow students to leave to see special personnel in the middle of the lab without their own, personal cleanup time.

In a heterogeneous classroom, with many absentees and special needs students, these guidelines may seem daunting. The key—teach responsibility along with science. Every student should feel responsible for every other member of his or her science team every day.

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The Teachable Moment

Many books begin with a general chapter on safety. While this may be prudent, it doesn't mean much to students when it is abstract. Like everything else we do, safety lessons are best remembered when they are associated with real experiences. Though you may want to review and to post some general safety rules (e.g., hand washing rules and use of safety glasses) right from the start, the best time to give specific safety instruction is in conjunction with a lesson or activity where the safety procedure is needed. And even though the procedure is one you may have reviewed a number of times, do it again every time the activity you have planned requires the precaution.

Following the introduction of a new safety procedure, you might schedule a writing activity in which your students write a story involving the new procedure or an art activity that has students creating the signs and posters to remind themselves of the new safety idea. This provides for good, authentic assessment. Give students the challenge of placing the safety reminder signs and stories near the place where activities call for the reminders. For example, put hand washing signs near live animal cages, and safety–glass reminders near centers where chemicals are to be used. You'll also know they've mastered safety concepts when they can share them with visitors, new students, and returning absentees.

Homework Happens

Many of the safe practices that you promote in science activities can be extended easily to things that take place in students' homes. Reading labels carefully, the safe handling of sharp instruments and glassware, hand washing and cleanup—all have practical applications in the typical kitchen or bathroom. When you give instructions to keep students safe during field studies, these rules will probably keep kids safe when traveling with their parents. So take the opportunity and invite your students to think of how a rule you have just taught them would apply equally well to a situation at home. Help children to think safety wherever they are and whatever they are doing. Encourage them to work with parents to create a child-safe home, especially if younger siblings are present. Every new application of the ideas you present will help reinforce them and make safety a habit rather than an add-on.

You are responsible—and can be held liable—for assignments you give as homework. Consider these carefully. Don't ask students to explore chemicals in their home cabinets without their parents or to test soils in unknown neighborhoods unless you are sure they are safe. But at the same time, don't hesitate to develop safe home assignments for students to share with parents. Many teachers have created portable science kits (backpacks or boxes) that students can check out with such things as plastic thermometers or thermistors, measuring tools, binoculars and star charts, or leaf presses. Parents appreciate these opportunities for interaction, and once families have explored together, they are likely to continue.

Use your newsletter to communicate what you are doing and what your safety precautions are. If your school has an Internet site or a homework hotline, make sure that safety concepts are included. Many teachers also develop a safety contract with their students and have parents read it aloud and review it at home early in the year. It's a good idea to update and repeat the contract process each quarter.

SAFETY CONTRACT

I am learning to be a good scientist. I know that I must be organized, neat, and well behaved to learn science best. I promise to

- Prepare for activities: I will listen to directions and make sure I understand them before I start
- Care for equipment: I will handle objects carefully and put them away when I am done
- Follow directions: I will do each step in order and I will not try unknown things
- Observe carefully: I will be as quiet and calm as possible so that I can learn more
- Keep careful records: I will write down my observations
- Clean up afterwards: I will wash my hands and my workspace
- Follow all safety rules

I will share good science safety with students and family so that I can be a good investigator.

(Signed) _____

Student Parent

There's the Bell

When planning science activities, make sure that you account for setup and cleanup time within the lesson. Distributing materials at the beginning of the class, collecting materials at the end, and cleaning up the work space and used equipment takes time to do properly. It's important that your students see this as part of their responsibility and that these tasks are an integral part of the entire science activity, so make sure that you schedule enough time for these housekeeping tasks.

A Typical Lesson

- Overview and safety tips (5 minutes)
- Distribution of supplies (5 minutes)
- Activity period (10 minutes)
- Assessment break (5 minutes)
- Activity continues (10 minutes)
- Cleanup (10 minutes)
- Equipment check (5 minutes)

Total——(50 minutes)

If you have set a specific time to do a science activity, make sure that no one begins before everything is properly distributed and that everyone has stopped the activity when it is time to clean up. If students are doing their science activity in a center, make sure they know that cleaning up and preparing the center for the next student is very much a part of the activity. You may want to post a picture of the center's materials so students know what to leave there and in what condition. You won't have time to check every center just before dismissal.

Climbing the Walls

Every elementary teacher knows that a pleasant, informative classroom is one key to achievement. Many teachers are true artists when it comes to bulletin and trim boards and wall and ceiling enhancement. Even the students who "stare at the walls" learn in most classrooms.

You can put your talent for room enhancement to good use by keeping safety in mind. First, don't clutter. Paper is combustible. Mobiles and paper chains are fire hazards. Clutter makes kids trip and fall. Easily distracted students become more so in messy environments. And perhaps most importantly, clutter doesn't create a good impression of an orderly work—and learning—place.

Be rigorous about throwing things out. Don't fall into the pack-rat syndrome. You probably only need one good copy of that favorite lesson (on CD–ROM if possible). You can always get more coffee stirrers and straws—six won't help much anyway. (See Chapter 4 for storage tips.)

Use your board space to emphasize continuing themes and ongoing safety rules. Make a feature out of the classroom escape route and the eyewash station. Allow students to develop posters reminding one another of hand washing (Germs!) and proper disposal and recycling.

A Reputation for Excellence

Science is exciting, and for that reason the good science teacher can become something of a local hero in an elementary school. That's especially true if you create a science space: a classroom with mini-museums, displays, and interactive bulletin boards. But becoming the local gathering place has its own complications. The rules for safety must be so clear that even the casual visitor will learn them quickly.

One way to make sure that happens is to make your students all docents in your classroom. Give them a sense of ownership and encourage them to explain the rules—and why they are necessary—when someone comes in. You may want to set up a few test runs with some invited guests (the lunch mom or the custodian) so that you can test the students for both hospitality and safety consciousness.

Another easy way for students to share is via the computer. Very young students have enjoyed producing PowerPoint slides of their experiments, which can be scrolled in the media center or at parent night. Middle and elementary students have created great web pages for their school sites. Video clips of students pointing out safety hazards can be added to the web page. These are ways to share science without constant traffic in the room.

Remember, it is far better to have a reputation for inquiry than for chaos. If people who enter your room find they are challenged to think, you'll be the real local hero.

Setting High Expectations

As any veteran teacher knows, high achievement is the satisfying reward for setting high expectations for our students. This is as true for the use of safe procedures as for any other expectation. The more you make students responsible for using and enforcing safe laboratory and fieldwork procedures, the more easily safe practice becomes habit. Once you have established a classroom climate that is based on the expectation that students be as vigilant as you are in spotting safety hazards and eliminating them, you might find that fewer rules work better than rules for every step and procedure. The ultimate safety rule should be: Don't do anything that you know or think might be unsafe to yourself or to others.

With an inquiry-based science program, you are likely to encourage students to experiment, observe, and explore on their own, in addition to following your step-by-step instructions. However exploratory, the work must be done in a safe manner. There can be no experimentation with safety rules. When it comes to safety instructions and safe procedures, you need to be explicit and exacting. While safe practices support inquiry-based science, it is totally inappropriate to let students learn by trial and error when it comes to matters of safety. If you catch your students quoting you— you've succeeded.

Topic: safety in the classroom
Go to: *www.scilinks.org*
Code: SEL01

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THE SAVVY SCIENCE TEACHER

Mr. Hernando's class is about to receive Lucia and Freya, a pair of gerbils, to care for and observe. In preparation for the animals' arrival, the class reads a trade book about gerbils in their natural habitat. When the cage and animals arrive, Mr. Hernando shows the children how to observe Lucia and Freya without disturbing them and how to clean and fill the water bottle hanging outside the cage. Immediately after the demonstration, Mr. Hernando goes to the sink and washes his hands, explaining why it is important to do. He also introduces a new center activity where students can use a variety of paper and markers to create illustrations of the new animals or hand washing posters to be hung next to the cage.

Connections

- American Chemical Society. 2001. *Safety in the Elementary (K–6) Science Classroom* (2nd ed.). Washington, D.C. American Chemical Society.
- NSTA Press. 1993. *Safety in the Elementary Classroom.* Arlington, Va.: NSTA Press.