

Science Safety

in the
Community
College

By John Summers, Juliana Texley, and Terry Kwan

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Introduction

Community colleges form the backbone of our nation's system of higher education. More than 1,650 institutions across the nation serve a broad range of students, providing academic, social, career, and citizenship skills for a lifetime of learning.

Community college students are among the most diverse groups of learners in the country. They come from a wide variety of secondary institutions—or none at all, because GED (General Educational Development) diploma holders and home schoolers are as welcome as the local high school valedictorian. New Americans and grandparents sit next to precocious secondary students trying to get a jump on their college studies. Students ranging from those who have had the structured support of special education to those who have experienced no structure all meet in the community college classroom.

Engaging in real science isn't just an academic ideal: It is essential to the understanding of evidence-based reasoning. But the diversity among students in an introductory community college science course makes creating a safe laboratory environment a tremendous challenge. When everyone is invited to participate without prerequisites, nothing can be assumed. The community college instructor can never rely on a common foundation of understanding or skills. This includes laboratory skills and safety precautions. Teach the basics. Do not assume prior knowledge and experience.

Challenging? Of course. But when we teach adults the skills they need to inquire about real-world scientific issues in a safe environment, they gain attitudes they will carry with them to their homes, their families, their workplaces, and their neighborhoods.

We believe that every adult in this nation should be scientifically literate and that we would have a stronger nation because of it. That means there's no place where promoting scientific literacy is more important than in the introductory laboratory classes offered at a community college. We also believe that with background knowledge and good sense, every community college instructor, full time or adjunct, can implement a fully investigative laboratory science course in a safe learning environment. To do so requires planning and preparation, but it's well worth the effort. So it is with great enthusiasm that we offer this guide to safety in the community college.

This book is one in a series of four that offer positive options, even as instructors learn more about hazards: *Exploring Safely* is the elementary school guide, *Inquiring Safely* is the middle school volume, and *Investigating Safely* is the high school guide. In *Science Safety in the Community College*, most of the guidelines for programs, coursework, and student behaviors have been formulated with the introductory student in mind. As students progress through a college sequence, they increase their knowledge

and skills, and the standard of best practice changes as well. We expect instructors will use their experience, training, and judgment to decide what might be reasonable for more advanced students. However, the guidelines for facilities—particularly those regarding space, safety equipment, and ventilation—should be considered standard for all course work, whatever the level.

Although the traditional safety manual is often 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. As we did in the first three volumes, we've included many anecdotes that highlight and reinforce ideas. We have changed names and made other modifications to better illustrate some hazards, but all of the stories are based on actual events. We hope this approach makes the book enjoyable to read as well as valuable to reference.

Because we recognize that another way to use the book is to look for specific topics, we have included a detailed index. You will find that some of the same information is repeated in several sections. This is to minimize flipping back and forth among chapters. A glossary at the end of the book defines terms as we use them and includes definitions of acronyms.

We hope the books are thought provoking. No single publication can cover every possibility or all the specific policies and rules promulgated by federal, state, and local authorities. Each state's community college system is different, and the buildings in which the programs are housed differ widely. Our goal is to provide you, the instructor, with examples of safer practices and to help you become more alert to ways of ensuring safety when you teach science in your laboratories and in field studies. Above all, we encourage you to use common sense and stay up-to-date with policies and regulations.

We believe that creating a safe environment for laboratory instruction in the sciences is a group endeavor, led by the instructor but joined by the entire institution. We have included information we hope you will share with department chairs, facilities directors, administrators, and others so they fully understand the support they must provide to enable you to conduct a safe and effective program. As you read, we hope this book helps you "see" your physical environment and your procedures through a safety-conscious lens. That will help you give your students habits of mind to last a lifetime.

No safety book can be omniscient. No guide can prescribe every action or precaution that might be needed in a college classroom. Safety is more than a set of rules: It's a state of mind. Because no single volume can anticipate everything that could go wrong, we believe instructors and administrators must make awareness of safety issues a skill and a habit. So we hope that as we share these experiences with you, you'll hone your own safety skills and that sixth sense that creates a stimulating and safe classroom for all students.

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Author Biographies

John Summers taught environmental sciences, biology, and chemistry for many years and continues to be involved in programs to support teaching and learning of the sciences at the precollege level. A presenter at numerous NSTA and American Association for the Advancement of Science (AAAS) conferences, he is also a faculty member for online teacher training at the undergraduate and graduate levels. He has served on panels to structure and review frameworks, assessments, and systemic initiatives in the state of Washington. His special interests include using science-oriented outdoor experiences to challenge and connect with at-risk students.

Juliana Texley has taught all the sciences, K to graduate school, for 30 years and spent 9 years as a school superintendent in Michigan. For 12 years she was editor of *The Science Teacher*, NSTA's journal for high school instructors, and served as an officer of the Association of Presidential Awardees in Science Teaching. She currently teaches college biology and technology and develops and teaches online courses for students and instructors.

Terry Kwan taught middle school science before becoming a science supervisor and teacher trainer. She is an independent contractor, collaborating with private and public institutions to develop science programs, train teachers, and design science facilities. She served 18 years as an elected school board member in Brookline, Massachusetts, and currently serves as a lay member of the National Institutes of Health Recombinant DNA Advisory Committee and a community representative to Institutional Biosafety Committees for the Harvard Medical School and the Dana-Farber Cancer Institute.



How can you and your students avoid searching hundreds of science websites to find the best information on a topic? SciLinks, created and maintained by the National Science Teachers Association (NSTA), has the answer.

In a SciLinked text, such as this one, you'll find a logo and keyword in the text near a concept your class is studying, a URL (www.scilinks.org), and a keyword code. Simply go to the SciLinks website—www.scilinks.org—type in the code, and receive an annotated listing of web pages that have been extensively reviewed by a team of science educators. SciLinks is your best source of pertinent, trustworthy internet links on subjects from astronomy to zoology.

Need more information? Take a tour—www.scilinks.org/tour.

Setting the Scene

Safer Science in a

Drive-Through Learning Community

More than 1,650 community colleges across the country provide convenient, close-to-home access to learning. But the convenience and broad appeal of community college courses also create challenges for the instructor. Many community college students are distracted by competing obligations—family, job, and other responsibilities may vie for time and attention. Because students don't have to pay high fees or move away from home, they may treat introductory courses like an academic smorgasbord. Some may come early, ready to enjoy a feast. Some may stop in to sample the menu, ready to drop a course at the first sign of challenge. Still others transfer in when a different course gets tough, hoping that a science course is more to their liking. The challenge is to keep every guest at the science banquet and enable each to develop a true appetite for science inquiry as a critical skill in comprehending the world. Along with the challenge, community college instructors may have a unique advantage. Unlike teachers of high school or four-year college students, community college instructors can count on a powerful characteristic in most of their students—motivation. Community college participation is almost always a voluntary act, motivated by the student's personal goals. It takes a special effort to drive to each class on time, prepared and ready to work. Though you may compete for their attention, your students want and need what you have to offer. You hold the keys to their future.

A Scientifically Literate Citizenry

The National Science Education Standards (NSES) (NRC 1996) leave no room for doubt—inquiry-based science is vital to producing scientifically literate adults. Although they were written primarily for K–12 programs, the critical thinking and analytic skills inherent in scientific literacy are as important to all adults as to professional scientists. The same skills and thought processes engendered by laboratory investigations are those your students will need in the workplace, in the home, and in the voting booth. This way of knowing is critical for successful citizens and to a functional society.

Even if you represent a student's one and only exposure to science, your role is vital. The introductory science course may be the last opportunity members of our increasingly diverse society have to learn how to gather, evaluate, and draw conclusions from empirical evidence. What they learn or do not learn can influence significantly the way they make decisions as citizens, employees, managers and leaders, parents, and voters.

Evaluating choices and accepting, rejecting, or modifying recommendations based on data occur regularly in adult life whether a student chooses a career in science and technology or not. An individual's ability to weigh options with scientific and logical rigor, to reject pseudo-science, or to accept scientific analyses may well be based on that person's experiences in the course you teach. Providing a program that demystifies science and puts it in a safe and understandable context may be even more important for students not planning to pursue careers in science and technology than for those who do.

Moving Up Safely

Developing a responsible and safe introductory community college laboratory science program is a challenge. The subject matter is complex, requiring cerebral, technical, and mechanical skills. The prior knowledge and experiences of students are diverse—they range from retired professionals returning for intellectual stimulation to high school dropouts who have discovered the need for education and just passed their General Educational Development exams.

For most instructors, what can be controlled is limited. The course outline, the prerequisite requirements for students, and the physical facilities often are prescribed institutionally or by groups of instructors. In larger community colleges, the responsibilities for parallel sections may be shared by full-time and adjunct instructors. They must share facilities, equipment, and supplies even though they rarely meet. Although community college students may receive information through course catalogs, they make decisions regarding registration and attendance with much less guidance, structure, and support than afforded to secondary students.

These circumstances make it all the more important that you, your colleagues, and administrators have structured guidance to ensure that laboratory investigations have been selected and designed with safe practice in mind and conducted in facilities that are appropriate. We hope this book provides some of that guidance and that, more important, it reminds all involved that specific attention must be paid to safety for all laboratory science instruction.

Using This Book

After you read this overview chapter, the way you use this book will depend upon your experience, your training, and your assignment. You'll find the book includes a

lot more than just a list of safety rules. There are tips for teaching, management, and even your own mental health. You may wish to skip right to your own discipline (in Chapters 5 through 8) or use the index to find best practice on a specific topic, such as Standard (Universal) Precautions, contact lenses, or internet safety. Or you may want to use the book as a refresher for your own professional development, reading it from start to finish.

If you choose the latter course, you'll find some repetition. Some ideas deserve to be repeated. Some appear more than once to accommodate those who read only a part of the book, including administrators, support staff, and disciplinary specialists. Other ideas may seem obvious to full-time veteran faculty but may surprise adjuncts who come to teaching from business or industry.

No matter how you choose to read this book, you are likely to find something that makes you uncomfortable—a treasured demonstration or customary practice that isn't considered safe. You're not alone. We've had the same experience in writing and working with instructors while developing the book. Change is never easy. You'll likely find some precautions that you just don't believe; your experience and training may have convinced you that they are not only safe but also essential to your goals as an instructor. That may be true and may be appropriate in your program. But it's also possible that thus far you've just been lucky. So we invite each of you, our peers, to consider seriously the precautions we've included and to use good judgment in adapting them to your assignment and your institution.

You're likely to find differences between this book and the traditional safety manual. Our recommendations are based not only on physical dangers but also on developmental and experiential appropriateness. In many cases, we don't discuss just *how* to make an investigation safe, but also *why* it should or should not be done at a given instructional level. This may be a new perspective for many veteran instructors, but we have found that laboratory accidents can frequently be traced to assuming that students bring knowledge or experiences that the instructor or former students have had, but which the current population has not had. In this day of butane lighters and piezoelectric sparkers, you may be quite surprised at how many students don't know the difference between a safety match and an ordinary friction match. You may be quite familiar with sterile technique, but your students may not have studied—or may have totally forgotten—germ theory.

Chapters in Brief

The low cost and convenience of community colleges are two factors that draw the diverse population who attend. Among the things students are looking for at a community college are a slow transition to college work, remediation, and “cover” to stay at home or in the country. What is almost always a common factor is the proximity of the college to the students' residence or workplace. Unlike high school classes, which are frequently leveled by interest and ability, or four-year college and graduate courses

in which students are sorted by majors and prerequisites, the community college class is likely to have students with a plethora of interests, prior experiences, and goals. In Chapter 2, “Communities of Learners,” we look at ways to accommodate diverse needs and goals—not only to make your program safer but also to help everyone involved achieve the goals that brought them to the community college campus.

Many of our college buildings are aging. In some institutions, increases in enrollment have forced administrators to use stopgap scheduling or emergency housing. National studies have found a significant increase in the number of buildings in serious need of repair, while shortfalls in state budgets have left publicly supported colleges with few extra dollars for renovation or expansion. Facilities are vital to safe science, as you will see in Chapter 3, “Where Science Happens,” which discusses space and equipment, and Chapter 4, “Finders Keepers,” which discusses storage.

Meanwhile, the body of content knowledge in each discipline of science constantly changes. What was yesterday’s best practice can be today’s unacceptable risk. Chapters 5 through 8 summarize many of the most common cautions in the science disciplines for instructors in life, Earth, and physical science classrooms. In Chapter 9, we’ve included tips for field studies and exploring “The Great Outdoors.”

The 21st century has brought new technology as well as new concerns. After covering traditional safety categories, we added Chapter 10, “The Kitchen Sink,” which discusses items that fit nowhere else, such as internet use, allergies, and Standard (Universal) Precautions.

Today’s society is quite litigious, and many people place blame on instructors for factors well beyond the instructors’ control. So finally, in Chapter 11, we share tips on how professionals can “Live Long and Prosper” by protecting themselves as well as their students.

Keeping Up

What do those degrees on your wall mean? A prescribed sequence of courses? A statement of competency? A ticket to a job? Since your last formal course work, a great deal could have changed, both in your science discipline and in teaching techniques. An important step to safer college science is to keep on learning.

It’s not just the content of science that changes but also the standards for safe investigation. To structure a safe college science program, you must stay current with both research findings and regulations. Which chemicals now require special handling or are banned outright? What cultures and culturing practices previously thought harmless are associated with serious infectious disease? What are the latest requirements for protective gear? Best practice is constantly changing. You must remain up-to-date and so must your course outlines. That’s especially challenging for a faculty that is partly or predominantly adjunct.

Students change too. Their interests and developmental levels are affected by previous school experiences and by their experiences outside school. Demonstrations once considered motivational—such as explosions—are now considered dangerously tempting to students who have been bombarded by media violence. It's not enough to simply evaluate the content of an inquiry; you must also consider the context in which today's students will receive it.

The information that qualified you for your degree and the course outlines and lab assignments you first used may quickly become outdated. You can't depend even on a book like this one for your entire safety knowledge base. Each disciplinary expert should assume responsibility for keeping up-to-date in his or her area. To help you do that, internet links and references accompany each chapter. We've also included information that leads you to online course work and mentoring by professional associations. We hope you'll join us as lifelong learners in the important endeavor of ensuring safety in science investigations.

It May Take a Village

Some battles have to be fought by the department rather than by individual instructors. For instance, although science instructors may be knowledgeable in multiple science disciplines, it's usually unwise to assign someone to instruct in more than two distinctly different laboratory courses in any single term. The challenge of keeping up with rapidly changing standards and best practice is just too great.

Late registration is another issue. Instructors often begin the semester with a course overview and a review of basic safety procedures. The first lecture session is the opportunity to make sure students understand the syllabus, and the first laboratory session usually is used to introduce students to laboratory facilities and general expectations for lab work. If a student registers late and shows up after these presentations, you are still responsible for ensuring the student receives the same introductory instruction—especially as it relates to safe laboratory practice.

It may be hard to convince college registrars to turn down the prospective revenue of a late registrant. But it is essential that everyone understand and work to mitigate the risks. It may be that the department needs to create a separate laboratory introduction session or exercise that must be successfully completed by all students. This might be incorporated in a web-based tutorial on an online learning platform, such as Blackboard or WebCT, that can record and document successful completion by each individual. It must be thorough, and documentation of successful completion must be non-negotiable.

Safe, well-organized, clean laboratory space is also a condition that can be achieved only if all instructors participate. Community college laboratories are likely shared by multiple instructors and often have no individual clearly responsible. Safety equipment

SAFETY IN THE SYLLABUS

Consider where these key ideas might be built into your course syllabus:

- ▶ Clearly describe your goals and expectations. Specify not only content, but also laboratory skills, practices, attitudes, and conduct.
- ▶ Make students responsible for regular on-time attendance and for making up all instruction missed because of lateness or absence.
- ▶ Establish that students who miss preparatory and safety instructions will not be permitted to participate in laboratory work until all preparatory and safety work is made up.
- ▶ Identify all the ways you will be offering safety and lab practice guidelines: orally, in writing, on a web learning platform, or some other format.
- ▶ Provide specific options for students with disabilities, those with limited English proficiency, and those with limited access to technology.
- ▶ Include specific steps you will take to measure student understanding of safety issues and laboratory practices prior to activities where such knowledge is necessary. Do not depend solely on distribution of handouts and head nods to indicate understanding of critical safety issues, especially for students with disabilities or limited English proficiency.
- ▶ Insist on students' presence from beginning to end. Make it clear that critical instruction will begin at the start of class, and that latecomers may be excluded.
- ▶ Set standards for how quickly—or slowly—you expect work to be done. Avoid using a system where students can race through a laboratory exercise and leave early. This rewards speed and often engenders carelessness.
- ▶ Clarify how a student can make up laboratory work—if at all.
- ▶ Incorporate a rubric for safety, cleanliness, and organization in the grading scale.
- ▶ Affirm that each student is responsible for being an active participant in the education process and ensuring safe, appropriate laboratory practices at all times.

may be missing, outdated, or untested; hazardous materials may accumulate; and valuable or potentially dangerous equipment or materials may be left unsecured. Common expectations are needed so that instructors who may never meet each other can expect that certain minimal standards are applied.

You *can* fight city hall—or the dean’s office—if you act collectively. It’s easiest if everyone is on the same team. If your department head or administration is unaware of ever-changing regulations, safety risks associated with late enrollees, minimal standards for laboratory facilities and equipment, and the need for regular, licensed hazardous waste removal, you may need to tell them. If all else fails, share some of the guidance and legal precedents that we’ve included in this book.

Planning for the Safe Classroom

The paragraph describing a course in the college guide is usually written by committee. This is not always true for advanced courses, but it’s important that all students in a college get the same basic knowledge and skills in their introductory science experiences. That means that an individual instructor may not have much influence on the profile of a specific course. But what if the activities that a committee—or your predecessor—has chosen don’t seem safe? No matter what the history or how great the institutional pressure, it is important to remember that the students and sequence assigned under your name are your responsibility. In case of an accident, saying “It was always done that way” just won’t fly.

Because each member of a department may have a unique schedule and because meeting time may be scarce, many schools have established online discussion forums for their faculty. These opportunities for almost real-time shoptalk are invaluable. Even if you are assigned only one course on an occasional basis, make sure you participate all year long. Your input—and the choices you make—may depend upon every member of the faculty having the same current knowledge of risks and responsibilities.

The Syllabus Is the Thing

Many schools make syllabus preparation easy by offering templates so they can be quickly prepared. You may be provided with older course outlines that have been used for decades and be tempted to merely tweak the details. Or, you may be given a course syllabus prepared more recently by someone else. In today’s litigious society, we strongly recommend that you consider the syllabus you hand out to your students as a written contract between you and your students and that you incorporate language that clearly sets out your expectations and student responsibilities—even if that means providing an addendum to the existing document. Think of the syllabus as written evidence that you have provided a well-thought-out description for the conduct of the course and the conduct of your students.

Dampening the Swinging Door

A problem for some community college students is consistent and on-time attendance.

Emphasize your expectations for consistent attendance in a number of ways:

- ▶ Begin classes with a short activity that requires a specific product or outcome. Assign a small percentage of the course grade for these activities. (This is a great way to review safety.)
- ▶ Provide examples of appropriate and inappropriate reasons for absence. While you should be supportive of major life events, emphasize your high expectations for regular class attendance.
- ▶ Make it clear in the syllabus that failure to be present for the safety instructions will result in exclusion from the laboratories.
- ▶ Set firm rules for cell phone use. Under ordinary circumstances, cell phones should be turned off before a student enters the lab. For the rare instance when there must be instant contact with a student, silent paging should be in use.
- ▶ Assign responsibility and credit for group interaction. Make members of a group responsible for instructing and reinforcing procedures to all members.

The Best-Laid Plans

You will lower your stress and your liability, whether you are an experienced full-time instructor or an adjunct, if you establish the discipline of preparing complete and detailed written plans. As you'll see in Chapter 11, these plans not only create peace of mind but also provide valuable documentation in case a problem occurs. But recognize that detailed lesson plans can look great on paper and fall short in practice. The best format is one that is convenient for you to prepare and easy for you to follow. You may want to make columns in a plan book to list materials to prepare, time requirements, chemical allocations, and safety reminders.

An important planning principle is that old lesson plans should not be reused without examination and evaluation. Even with revisions, do not keep a plan beyond a set time—say, two or three years. When that time has elapsed, develop something new to ensure that your material is current and your teaching is fresh and enthusiastic.

Make Every Minute Count

If you've had a strong background in teaching strategies, you may be familiar with the research on how the brain stores information. If you've come to education from research or industry, this may surprise you—students don't concentrate much longer in minutes than their age in years, and that linear progression levels off at the age of 20. College students' attention, regardless of age, begins to wander if you try to talk for more than 20 minutes without a break or change in activity.

Using 20-minute elements is key to planning a college science block—especially for courses that meet for several hours once or twice a week. Attention span is also a factor to consider in safety instruction. Plan your sessions as a series of short, varying activities that each last no more than 20 minutes. Combine didactic instruction with debate and discussions, large-group instruction with study group or laboratory group work, safety instruction

with actual use of equipment. This approach will make your class more interesting, more effective, and safer.

You'll find some specific ideas for session elements in this book in sections called "The Savvy Science Instructor" at the end of each chapter. You can find many more ideas in the National Science Teacher Association's (NSTA) journals available online at www.nsta.org.

Never Assume

Some students walk into your classroom with cell phones and iPods but have never seen or used a manual can opener or tuned a radio without a scan button. Others may bring years of life experience to their college science course but seek a quiet corner in the back of the room, intimidated by the energy of the younger students and hesitant to apply highly developed life skills in the academic environment. Learning-disabled students, often supported by special education programs through most of their prior education, may be working without this support for the first time. English language learner (ELL) students may nod frequently, leading you to believe they understand all of your instructions, but those nods may reflect their respect for your position or their desire to be cooperative rather than true comprehension. The first safety guideline for instructors in an intro course is "never assume." Special steps may be necessary to ensure everyone has really grasped the critical information you are trying to convey.

As you introduce your students to college science, try to see your program through the widely differing experiences—or lack of experience—of all your students. Think of your laboratory facility as an entirely new venue and laboratory investigation as an entirely new experience. Do not assume that a student has experienced previously any skill or procedure—not even how to safely handle matches.

LABORATORY ASSISTANTS

One of the luxuries of most colleges is the help that instructors get from paid or credited laboratory assistants. Most lab assistants are supervised by a coordinator and specially trained in safety. Their access to chemicals and other potentially dangerous supplies is often controlled by strict institutional policies.

But no matter how well trained your laboratory assistant and no matter how well supervised, the ultimate responsibility for safety in your laboratory rests with you, your actions, and your instructions. There are many tips

(cont. on next page)

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for lab management in the chapters that follow. But in general, when you work with laboratory assistants:

- ▶ Know and test your laboratory activities thoroughly. Make sure you have tried every part of every lab in advance and are aware of necessary precautions.
- ▶ Check all institution, local, state, and federal regulations that might apply.
- ▶ Ensure that you and your laboratory assistants model appropriate safety precautions, including use of eye protection and other safety gear.
- ▶ If your assistant has the authority to decant and dispense individual quantities of chemicals for labs, check out the chemicals that have been dispensed. Make sure that all reagents are fully and correctly labeled, that quantities are appropriate and correct, and that all stock bottles have been correctly re-secured.
- ▶ Personally check and test all equipment you will be using or needing (including all safety equipment) before the laboratory activity begins.
- ▶ Ensure that you have the MSDS (see Chapter 4 for MSDS details) on hand for all materials to be used.

Mix or Match: Safety Is Still a Must

In some college programs, each lecture (or content) section is matched with a required laboratory component. In others, the laboratories are sequenced independent of the lectures. When the two sections are matched and taught by the same instructor, there are many opportunities to reinforce key ideas and to build the rapport that supports responsible conduct.

When labs are scheduled as independent units, the basic rule of “never assume” becomes even more important. Students who come into these sections may seem knowledgeable but lack important concepts that would enable them to recognize and avoid dangers. The independent laboratory almost always needs its own built-in series of direct instruction sessions to make sure everyone is thoroughly informed.

The Teachable Moment

Instructors commonly begin laboratory science courses with a tour of the facilities to familiarize students with the location and function of safety and emergency equipment such as fire extinguishers, the safety shower, the fume hood, and the eyewash, followed

by a review of general safety rules, such as when protective equipment must be used. They often then give a safety test and keep the results as a record of the session. There's nothing wrong with this practice, but it may be insufficient to ensure safe practice by students. Safety instruction that is abstract and isolated from the activities to which the instruction applies is easily forgotten and will need reinforcement.

You should present general safety procedures—such as using eye protection, decontamination, and hand washing—at the beginning of the course. You also should repeat specific safety instruction in conjunction with the lesson or activity for which the safety procedure is needed. Even if you have reviewed the procedure a number of times, go over it *again* each time your planned activity requires the precaution. Keep a dated record of the specific instruction given to students who were absent or who later transferred into your course. Ensure that every student has received introductory safety lessons as well as the safety instructions associated with each investigation, and document the fact in a plan book or calendar.

Say It Again, Sam

With a revolving door on their lab courses and a diverse student body, community college instructors must be especially vigilant that each student has received all necessary safety instruction. Providing students with a written version of your instructions and safety directions and repeating them at the beginning of each relevant activity is important. When students are absent, they may miss safety directions. Keep an explicit record of what safety instruction has been given, when, and to which students. Keep this checklist as evidence that you gave proper and appropriate safety information to each student. Some instructors prepare and maintain a spreadsheet identifying students and safety issues. When a safety item has been presented, the appropriate square can be dated, providing a dated record of each student's safety preparation.

Some community colleges have open-enrollment policies that permit enrollment by students with only minimal English fluency. Depending upon institutional policy and your own good judgment, you may also need to offer safety instructions in other languages. Instructions may have to be tailored to students with specific learning challenges. You will also need to include appropriate methods of assessing comprehension. For more on this issue, see Chapter 2.

Out-of-Class Assignments

You are responsible and can be held liable for your out-of-class assignments. This includes independent study work and projects. Consider assignments carefully to avoid placing students in hazardous situations. Long work hours and family responsibilities may force students to squeeze homework into spare moments in random places, so consider your students' schedules and other obligations when assigning homework.

Try to structure assignments that have practical application and that can incorporate students' work, home, and other everyday experiences. For example, when instructing in microbiology, ask students to relate concepts to regulations and practices at their food-handling jobs or to propose appropriate hygiene practices in changing diapers. In chemistry classes, have students relate chemical characteristics with home or workplace chemical handling and hazardous waste practices. When introducing the concepts of variables and controls, ask students to apply these concepts to news reports regarding drug safety and FDA recommendations.

A Reputation for Excellence— Instructor as Model

Your classroom should be a professional place where everyone is expected to work seriously and dress appropriately. This is both for safety and for career preparation.

Model appropriate dress in your own attire—nothing baggy, torn, or hanging. Lab coats may be part of the caricature of the mad scientist, but they are also part of safe science, especially when you might be working with biological materials, stains, or toxins. Always use the appropriate eye protection during your own demonstrations and whenever you require your students to wear eye protection.

No food or drink in the lab applies to instructors as well as students—and no coffee or snacks, even in the back room if that back room is used for preps. Chemical and specimen-storage refrigerators must have prominent signage indicating “no edible food storage” and must never be used for lunches or other items meant to be eaten.

The physical environment also can contribute to or distract from the quality of instruction. Classroom clutter that cannot be distinguished from a midden both detracts from the seriousness of your endeavor and poses unnecessary safety hazards—fire, tripping, and undetected theft of valuable or hazardous materials.

Set High Expectations

As any veteran instructor knows, high achievement is the reward for setting high expectations for students. This is as true for safety 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 can become habit.

College science offers a rich curricular framework within which to build a safe environment for investigation. Safe work habits developed in the college laboratory should engender safe practices used at home and at work. With help from peers, friends, and the wider scientific community, the future begins here.

THE SAVVY SCIENCE INSTRUCTOR

Your students may appear to be more sophisticated and mature than they actually are. Mr. H emphasizes simple, small-scale, and authentic experiences and never misses the opportunity to show his freshmen the application of science to everyday experiences. He directs his students' attention to phenomena they might never admit they don't understand:

- ▶ Boiling point? Challenge students to heat pure water in an open container to above 100°C. Many believe they can.
- ▶ Sublimation? Observe snow piles disappearing without creating a flood.
- ▶ Water pressure? Explain how a toilet works.
- ▶ Biochemistry? Find DNA oozing out of bananas and onions.
- ▶ Radioactivity? Start with smoke detectors in homes and radon in basements.

For Mr. H's students, the world just becomes curiouiser and curiouiser.

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