> system which has at least a skeletal outline of rigidity, in which there is a schedule of a kind, some sort of routine, something that can be counted upon, not only for the present but also far into the future. Perhaps one could express this more accurately by saying that the child needs an organized world rather than an unorganized or unstructured one.
>
> (Maslow, 1943, p. 377)

The focus of this chapter is on managing a classroom in ways that will lead to maximum science learning for all students. We don't ignore the traditional perception of classroom management because ensuring that students behave is clearly one aspect of safety. But keeping students under control is a limiting view of children and classrooms. We do not dispute the need for order. Maslow indicated that this is a defining aspect of safety. But we do not want to make classroom control the ultimate goal. Although it seems obvious, we don't hear this idea expressed often enough to convince us it is true: the purpose of school is student learning, and managing student behavior is a prerequisite for learning, not the goal. There are many varieties of safety that must be satisfied for learning to occur. Physical safety is one, and an orderly and predictable environment is another. In addition, we must attend to issues of emotional and intellectual safety such that students learn. Broadly speaking, the focus of this chapter is on creating a safe environment to support the science learning of all students—it's just that an overemphasis on behavioral control is insufficient to reach this goal.

An Environment of Physical Safety

We have deliberately avoided discussing laboratory safety until this point in this book because of the worry that such concerns could be used as an excuse to avoid hands-on activities. Aside from getting a paper cut or dropping a heavy text on one's foot, there are admittedly far fewer physical risks associated with teaching science from a book. We wanted to convince you of the power of direct experiences as part of teaching science to all students as well as encouraging you to accept your obligation to take the steps necessary for this to happen. In other words, over time you should become more fully prepared to incorporate direct experiences with scientific materials into your teaching. We anticipate that you are now prepared to learn about reducing the chances of one of your students being hurt by a piece of equipment.

We must be ready to accept the reality that children are accidentally bumped or bruised as part of everyday living. Heads might bonk together during group activities, a tooth might work itself loose, or someone might accidentally poke a hand with a pencil. Despite this inevitability, we should take steps to reduce the frequency and intensity of any harm that might befall our students. We organize our responsibilities regarding classroom safety into three categories: preventative, monitoring, and responsive. **Preventative safety** is a matter of being knowledgeable. For the teacher it means knowing which substances might be harmful, how equipment might be misused, and what steps to take to avoid situations in which an injury might occur. The preventative aspects of classroom safety also include students' knowledge. They too should fully appreciate the issue of touching their eyes during an activity, know that they might hurt themselves if they mistreat science equipment, and understand proper procedures to ensure their safety. If this knowledge is couched as part of the larger agenda of making sure everyone is safe, then compliance will not occur out of fear. We teachers are responsible for educating ourselves about safety issues and transmitting that knowledge to the students.

The next category of safety is making sure the knowledge is actually being applied. Safety goggles can be required equipment during a chemistry activity, but the difference between knowing this and using them is what makes all the difference. As with preventative safety, **monitoring safety** is a responsibility that is not exclusively the teacher's. Safety in the classroom is something everybody must work to achieve and sustain.

The final category of science classroom safety is **responding safety measures**, that is, responding in appropriate ways in the event something is broken, somebody is hurt, or some other problem arises despite knowing and monitoring. For example if a test tube or something else made of glass breaks, the inclination to pick up the pieces with one's fingers should be resisted. In addition, putting broken glass into the same trashcan as papers might cause an unsuspecting custodian to get cut. In science laboratories, there are special containers reserved for broken glass. In an elementary or middle school classroom, there is less need for such a container, but the lesson is the same. Broken glass should be disposed of in ways so no one can be accidentally cut. One possibility is to wrap the broken glass in a paper towel and put that inside a plastic cup—and perhaps the teacher will deliver the package to the school dumpster on his or her way to the parking lot at the end of the day.

Most school districts and all state offices of education publish science safety guidelines. These normally take the form of long lists of rules, warnings, prohibitions, and procedures. It is unfortunate that there is usually so much information and it is presented in such a technical way that it doesn't encourage us to read the material. To a certain extent, safety guidelines published by a school are for legal purposes and may sound more frightening than we might prefer. Because you are unlikely to consult your school's or state's safety guidelines on a regular basis, we urge you to locate a copy (often available online) and read it completely, even just once. As an aid for helping you to sort through the safety materials, we are going to describe several categories of safety issues as an advanced organizer for your official safety guidelines reading assignment.

Injuries: Bleeding and Burning

Perhaps the most frightful safety issue is the possibility of students being injured by a piece of equipment, drawing blood, or becoming burned. Let's return to our three types of safety knowledge. First, consider how to prevent situations that might lead to bleeding or burning. Working with sharp materials such as needles and knives are obvious dangers, but so too are toothpicks and scissors. Reminding students that these materials are potential sources of pokes and cuts is a wise strategy. Remind them that you are most worried about anyone being hurt and much less interested in trying to catch perpetrators. This is not an issue about intentional versus accidental harm. The goals are for no one to be hurt and for you not to worry about whose fault it might be if someone is hurt.

Objects that are sharp can cause bleeding, but so can equipment that suddenly becomes sharp during the course of the activity. In other words, when something breaks it can transform from being a nice glass container to become an assortment of flesh-tearing pieces. Thermometers are another example; typically, we do not think about thermometers as dangerous, especially because mercury thermometers are so rare in schools now. But a thermometer that snaps in two because of horseplay or by being dropped instantly becomes a cutting hazard.

Our first instinct when we hear something break might be to ask: "Who did that?" when a far better thing for a teacher to say is: "Did anybody get hurt?" Being disappointed that a piece of equipment was broken should not overshadow the importance of keeping everybody safe.

Students expect an adult to say something right after something breaks. The message you send in that moment can be profound! Imagine a situation where a jar of pond water slips from a child's hands and shatters on the classroom floor. Here's an appropriate response by a teacher:

Teacher: OK, did anybody get cut by glass?

Class: No.

Teacher: Good, let's make sure it stays that way. I need for you to not move. Instead, look around to make sure there isn't a piece of glass near you that somebody might accidentally step on. Don't move. Don't pick anything up. Just look.

Student: Here's a piece by this desk.

Teacher: OK, thank you. Terry, would you please get the dustpan and brush. And take that old coffee can with you. Walk carefully toward that group and have your classmates show you where they see pieces of glass.

Student: There's a big piece. And some more over here.

Student: What about the water?

Teacher: It is most important right now to find all the pieces of glass. Terry will need to sweep up all the pieces. Carefully put those in the coffee can. After that, then somebody can use some paper towels to clean the water so we don't have a slipping hazard. If your group is not anywhere near the broken glass, then you still have work to do. I'm glad everyone is safe. For Terry and others nearby, please do not touch the glass. Only use the dustpan and brush. I'll be over to check the area as soon as I finish helping this group I'm with right now. Everyone has a job to do. Get back to work.

Burns will occur only when there are hot materials present. The obvious preventative measure is to not allow anything very hot to come into the classroom. Safety guidelines published by states and equipment suppliers are usually very detailed regarding flames from candles and Bunsen burners. But in elementary and middle schools, our recommendation is simply to never have flames in the classroom. When a heat source is needed, you might consider using hot plates. Just recognize that this substitution is very much like having several glowing stovetops in your classroom. On those occasions when you do need very hot water, we have had good results by simply using an old coffeemaker. Again, the best safety guideline for avoiding burns is to avoid allowing hot objects into the classroom.

Even with prevention and monitoring, there may be unfortunate occasions when a student is injured. Except in extreme cases, the major concern is with infection. Unless you have training in first aid for very minor injuries, you should admit to your limitations and send a student to the school nurse. When we consider the issue of infections, we first think about the injured student's wound becoming infected. In addition, we must recognize the possibility of infections spreading from the injured student to others. Blood-borne diseases are not merely issues for adults as children may carry viruses and other infectious agents. Without being alarmist, we think it is best to exercise extreme care and caution whenever blood is involved. Checking in advance with the policies for your school and district is a good step toward prevention. Minor scrapes and cuts can be treated in the classroom with an adhesive bandage. This should be accompanied by notifying those who should know what happened. At the very least, this includes the student's family and the administrators in the building. Of course, this doesn't apply solely to science injuries—it represents professional good sense in the gym, on the playground, or at the bus stop.

> **For Reflection and Discussion**
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> In the event of a minor accident in a classroom such as something being broken, how would a calm and concerned response influence the environment compared to an angry and accusatory reaction? How might this shape subsequent safety issues in this classroom?

Trips, Slips, and Falls

So far, we have considered injuries resulting from students coming into contact with sharp objects. In this section, we discuss injuries that might occur as students move through the classroom. Although we're tempted to use this as an opportunity to invoke the physics of falling (gravity, friction, and acceleration), that would make light of a serious issue. We are concerned about keeping our students safe while they are in our care. Part of the solution is avoiding situations where movement is hampered to a point where people might trip or where the conditions could cause them to slip. Even when people lose their balance but don't actually fall, trips and slips can still cause injuries because of the sudden and wrenching movements and the strain put on muscles and bones.

An example of exercising prevention and monitoring is to create pathways through the classroom that are free of potential tripping hazards. Tables, desks, and chairs should be arranged so there are obvious paths for walking. Although not really a safety issue, easy access to such items as the pencil sharpener, recycle bin, computers, and bookshelves should be taken into consideration as part of the physical arrangements of the classroom. Imagine the flow of traffic through the classroom, and pay attention to tripping hazards. One important issue is the stowing of book bags and backpacks. Although the idea of having these items close to their owners may be appealing, such items have a tendency to migrate from underneath desks and chairs to find their way into walking paths. Furthermore, for students who are already dealing with physical challenges and rely on crutches or wheelchairs to move around, the need for clear aisles becomes even more necessary. In general, if students can be trained to monitor the preservation of clear passageways, they will help prevent tripping accidents.

When hands-on activities are about to get underway, the teacher should alert students to the potential for the equipment they are using to become a tripping hazard. For example, this might simply take the form of a reminder not to allow meter sticks to block the aisles. When the equipment being used requires electricity, such as with microscopes, then being aware of the presence of the cords may necessitate reminding the students that they exist. Again the emphasis is not on students somehow misbehaving but rather on their remaining conscious of potential problems—in this case a tripping hazard.

Slips occur when the surface someone is walking on is other than as expected. The causes for slips within a classroom are almost always spills and not only of liquids. Paper and sand can also change the floor's surface so it becomes slippery. It doesn't really matter that trips are falls forward and slips are falls backward. The effects are the same, even if the causes differ. If we apply our previous guideline of prevention and monitoring, then we may be fortunate enough to never need to worry about having to respond to a classroom situation where someone trips or falls.

Evacuation Procedures

Classrooms should be safe spaces. You want students to feel comfortable as they enter your classroom. Ideally, this sense of reassurance would extend throughout the entire school. However, there can be times when remaining in a classroom is incredibly unsafe, the most notable case being a fire. Although not necessarily a science education issue, it is important within the context of safety concerns to give evacuation procedures due consideration. In addition, depending on the location of your school, you also should learn the school-wide routines for evacuation in response to earthquakes or tornadoes.

Fire drills are routine American schools, but this tradition has a tragic origin. In 1908, the heating system in an elementary school in Collinwood, Ohio, caused a fire. The panic among those in the building, combined with the fact that the doors opened inward rather than out, contributed to the deaths of nearly 200 children and teachers. This is something to keep in mind whenever a fire drill interrupts the school day. Fire drills are intended to make the evacuation of a building automatic in the unfortunate event that an actual fire occurs. Rehearsing the evacuation of your classroom is a serious event and a lifesaving precaution.

There are two key aspects of evacuation: emptying the school and then accounting for every person. Standard operating procedure is that when the fire alarm signal is heard, students immediately move toward the exits and the teacher grabs the attendance book. Once everyone is assembled at the designated location, at a safe distance from the building, the teacher must take attendance to ensure everyone is present. As a student, you may have participated in more than a dozen fire drills over the years. But in your role as teacher, the significance of a fire drill is much more serious. Obviously preventing fires from occurring within your classroom is smart, which is why we suggest never allowing flames to become a part of your science teaching, even for a demonstration. But knowledge about evacuation is not solely yours. You must share this knowledge with your students, and the fire drills are a way to rehearse those understandings.

Returning to the notion of culture, there is an aspect of this related to safety protocols. If you teach in a school similar to the type in which you were educated, you may not be fully aware of the traditions, such as fire drills, that you have come to accept as part of what it means to go to school. For something as serious as physical safety, teachers shouldn't leave the knowledge about such cultural practices to chance. As teachers, we must formally explain the safety processes from the outset of the school year and remember to incorporate them into whatever orientations are provided to students who are added throughout the year. We want to illustrate the importance of this in the following excerpt. In this story, Luis describes his experience as a recent Mexican immigrant attending school in California. In addition to empathizing with his confusion, we trust you will recognize the implications for you as a teacher who will be responsible for children like Luis.

> A day came when I finally built up the courage to tell the teacher I had to go to the bathroom. I didn't quite say all the words, but she got the message and promptly excused me so I didn't do it while I was trying to explain. I ran to the bathroom and peed. … But suddenly several bells went on and off. I hesitantly stepped out of the bathroom and saw throngs of children leave their classes. I had no idea what was happening. I went to my classroom and it stood empty. Nobody. I didn't know what to do. I thought everyone had gone home. I didn't bother to look at the playground where the whole school had been assembled for the fire drill. I just went home. It got to be a regular thing for a while, me coming home early until I learned the ins and outs of school life.
>
> (Rodriguez, 2004, pp. 25–26)

Biological Safety: Allergies and Organisms

It is quite natural in science classrooms to have living things as part of the learning environment: seeds sprouting in cups, guppies swimming in an aquarium, and maybe an occasional critter sneaking in from the outdoors. In this section, we want to raise your level of awareness regarding biological issues. Teachers must be sensitive to the health of their students. For example, allergies are proving to be a condition we may not have given sufficient attention to in the past. More and more children are being diagnosed with asthma for reasons that are not completely understood within the medical community. Being aware of the causes of asthmatic events and taking measures to prevent them are included under the banner of classroom safety. Allergies to dust and other substances may mean you cannot have furry animals in your classroom. Food allergies must also be identified, so you know which students cannot risk exposure to peanuts and other foodstuffs. We also caution you against the practice of culturing molds or bacteria in your classroom unless the school provides you with adequate sanitation equipment.

Even when students have no diagnosed allergies or other health concerns, a general awareness about the spread of germs is especially significant in the realm of science teaching. We urge you to consider how to have students dispose of objects that they use within science activities and that might spread germs. In terms of causing physical injury, soda straws and balloons may not seem too dangerous. But when we think about the potential for spreading germs as children play with these objects, we recognize these as possible safety issues. In general, we do not allow our students to leave the classroom with science objects that have been in contact with mouths. A special container, ideally lined with a plastic bag, should be identified as the proper disposal site for everything from cotton swabs to Petri dishes. The chance that germs will spread throughout the classroom always exists. Safe disposal of potential germ sources is a wise tactic. Hand sanitizers, disinfectant spray, and a well-stocked supply of paper towels are good pieces of classroom safety equipment.

Teacher Knowledge Is the Key

Few published guidelines about laboratory safety that specifically apply to science safety in elementary and middle school classrooms. However, what does exist provides us with useful information. For example, when the number of students in a high school or college science lab becomes large or when there is an insufficient amount of space within the lab, the frequency of accidents increases dramatically. Although this has obvious implications for university laboratories, it does reinforce the need for teachers to be aware of physical space and crowding as potential sources of safety problems.

For Reflection and Discussion

Along with the many other responsibilities of a classroom teacher are issues of safety. Where do you think a teacher who is new to the profession, or even just new to a school, might obtain all the necessary safety knowledge required for the classroom to be appropriately safe for the students?

Other issues linked to laboratory safety include storing chemicals in places that students cannot access and keeping the supply of chemicals small enough so the inventory is sufficient for just a couple of years. But of all the guidelines summarized in an *Education Week* article about laboratory safety, the one most relevant to elementary and middle school science teaching is teacher knowledge. When teachers are aware of potential safety issues, they are better prepared to anticipate problems than those teachers who have received less safety training. The implication is that schools ought to, but teachers have to, be willing to attend to safety issues. This means reading the warning labels on chemicals and the accompanying Material Safety Data Sheets. This means remaining alert to local workshops about lab safety. This means taking control of the knowledge about safety, because this knowledge will translate into providing a safer environment for your students.

Starting with Safety

The first few times you try something new, you consciously think through each step. You might have a checklist handy (Gawande, 2009), or you might try to pull the process from memory. Examples of thinking very deliberately to complete a task by a child include handwriting or even just learning to write the letters of one's name. You might be able imagine a child leaning into his or her paper, tongue poking out one corner of his or her mouth, and reciting the steps involved in writing a capital letter R. A more adult example is learning a new exercise or dance routine. Initially there is very little flow because of all the little hesitations, backtracks, and do-overs. What is so hard to recognize in people who do something with skill and grace is the fact that they had to struggle in the early stages of learning their craft. The polish and flow with which experts execute a performance (Csikszentmihalyi, 1990) can conceal the stumbling efforts that occurred when they were first learning.

We are describing the process whereby "practice makes perfect" because of what is involved with becoming an expert teacher. Dealing with safety issues is more likely to be incorporated into the flow of your teaching if it is included now, in the early stages of your professional development. You may already be aware of different teaching styles from visits you have made to various classrooms. You may wonder what your teaching style will be. Style refers not only to what you say and do but also to the subtle messages you send to your students and colleagues as an extension of how you go about your work.

Identifying for students the potential safety issues within a hands-on activity should become part of your teaching style. Once you have developed an effective way to secure the attention of the entire class, to explain the expectations for a lesson, and to identify the resources they are to use, then you should include a brief comment about safety issues. We even go so far as to recommend that you include this in your lesson plan. By always mentioning safety issues (the preventative and monitoring aspects) at the start of every hands-on activity during the early years of your career, you will more likely make this a common piece of your teaching style.

We are not advocating for the dry recitation of safety problems. We don't wish for you to become a human warning label. Rather you are to identify possible safety hazards involved with the equipment and its use. Talking about and physically demonstrating how the students are to use the equipment will reduce the likelihood of students being poked, cut, or injured. If the activity requires wearing safety goggles or glasses, then show how that equipment will shield the students' eyes. Identify potential trip and slip problems. Explain, or ask a student to explain, what is to be done to avoid creating a tripping hazard and what to do in case something is spilled. Also, explain how you expect the students to dispose of used materials, for example, what to do with the used litmus paper, toothpicks, and paper towels. In addition, plan ways to dispose of materials that do not belong in the classroom trash can or recycle bin. Here we would include soil and plant parts and so on. You don't want to have a hands-on activity become an awful experience because the clean-up process becomes a chore. This is all to say that by addressing these issues at the start of the lesson, at least as many as you can anticipate, you will make the room safer and reduce the distractions that interfere with students' science learning.

Classroom Climate

New teachers consistently express concern about creating a classroom climate in which learning can take place, and handling student misbehaviors is often at the very center of this worry. This concern is often exacerbated by the prospects of teaching in a classroom populated by students whose backgrounds are very different from those of their teacher. We feel these concerns are legitimate. When a teacher and his or her students have very different backgrounds, the likelihood for misunderstandings is very high (Milner, 2010). The misinterpretations of a student's actions or comments may lead a teacher to apply inappropriate discipline. What has its roots in cross-cultural miscommunication can deteriorate into a very emotionally charged and negative situation.

A trio of teacher educators from Rutgers University (Weinstein, Tomlinson-Clarke, & Curran, 2004) proposed the idea of Culturally Responsive Classroom Management. Their perspective is that when teachers are working with groups of students from cultures with which teachers have inadequate knowledge, five aspects must be addressed:

1. Recognizing one's ethnocentrism
2. Knowing more about the students' culture
3. Accepting the sociopolitical contexts of schools
4. Having willingness to adopt classroom management approaches that are culturally appropriate
5. Committing to the aim of creating a caring classroom community

Ethnocentrism describes a perspective where a teacher views her or his background and experience as being the standard against which all others should be compared. The second aspect of Culturally Responsive Classroom Management (becoming acquainted with students' background cultures) is tightly linked to becoming aware of one's ethnocentric perspective. Those who decline to recognize that their views are colored by their cultural backgrounds will operate in ways that are inherently dismissive of other viable cultural perspectives.

The third aspect in this list describes the need to understand that schools mirror the broader community in terms of social and political norms. For example, people in a town experiencing an influx of immigrant families might respond with hostility to these events, and local schools may well mirror this response. Patterns of discrimination in terms of gender, race, and social status occur within schools, because those practices and attitudes are parts of the local fabric. Prejudice against certain ethnic groups within the town may reveal themselves in prohibitions against students' speaking their native language (Adams, 1997). The walls of a school do not shield the occupants from the politics of the community. As a classroom teacher, you should remain attentive to opportunities to become an advocate for equity and an opponent to all forms of discrimination, even if some students have received different messages from adults in their community.

The next aspect of Culturally Responsive Classroom Management describes a step you can take at this very moment: deciding that you ought to make use of classroom management approaches appropriate for the cultural backgrounds of your students. This may be somewhat