

Doing
Good Science
in Middle School:
A Practical Guide to
Inquiry-Based Instruction

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Classroom Management and Safety

Welcome to the challenge of making good science come to life in your classroom. In this chapter we look at how to get the classroom ready for inquiry-based lessons and how to prepare students so their activities are engaging, productive, and safe.

The essence of classroom management in the middle school is teaching students to expect and to follow *procedures*. If middle grades teachers accomplish that task early, and reinforce it throughout the term, they can expect significantly fewer surprises and hassles when it comes to student behavior, lab safety, and upkeep of equipment and materials.

The First Days with Students

What you do on the first days of school will determine your success or failure for the rest of the school year. You either win or lose your class on the first days of school. (Wong and Wong 1998, p. 3)

Harry and Rosemary Wong's assertion above appears bold, but it is immediately relevant to teaching in the middle grades. Teachers preparing for the first days of middle school science need to tackle the following crucial issues before students ever enter the classroom door:

- classroom arrangements that enable success (e.g., strategic groupings of students, posting classroom procedures and safety expectations, posting exemplary student work around the classroom),
- an idea of the instructional “big picture”—that is, where you want to go, in keeping with the National Science Education Standards (NRC 1996) and your school's curricular objectives, and
- lessons and assessments that bring about continuous instructional improvement and student achievement.

We should add that we don't recommend designing your entire curriculum over the summer. Good science is most often achieved through



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small steps and “subtle shifts,” as San Francisco’s Exploratorium calls them, guided by an overall plan. The key concept here is recognizing that much of the accomplishment attributed to master middle school science teachers stems from their preparations for the opening of school, which, in turn, are founded on their expectations for themselves and for their students.

In a learner-centered classroom, the teacher must be aware of the range of needs her students will bring to class on those first days. Middle schoolers start the school year in varying degrees of preparedness to learn, according to their home and family situations, their health and nutrition, their attitudes toward teachers and schooling, and their previous experiences with science as a subject. In the special case of students who are moving to middle school for the first time—where they will switch to a departmentalized class schedule with five or more

teachers, bell schedules, and passing time between classes—a number of basic uncertainties arise, as illustrated in the cartoon on this page.

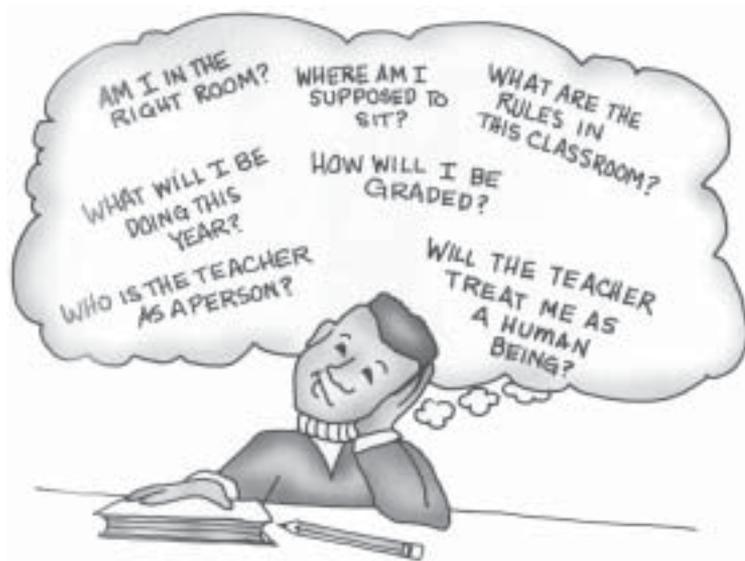
The answers to the questions asked in the cartoon, among others with which students begin the year, shape student expectations, attitudes, and behaviors. Their questions must be carefully considered due to the safety concerns, student dynamics, and the interactive nature of good science in the middle grades.

Classroom Management Management vs. Discipline

This is the section in which we connect the dots, so to speak, between the traits and needs of the middle school student described in Chapter 1, the characteristics of inquiry-based science instruction discussed in Chapter 2, and the procedural strategies teachers use to successfully channel bursts of adolescent energy in a meaningful direction. It can be done!

At the outset, we need to make a distinction between *discipline* and *classroom management*. In our experience, *discipline* almost always entails reacting to disruptions and then assigning consequences, usually negative; *classroom management* is about planning and preparing procedures to maximize student time-on-task and productivity. The most effective middle grades teachers structure their lessons—from the pivotal first few days of class—using procedures that students learn and internalize as routine.

This is not to say a teacher shouldn’t have rules, which are what most teachers associate with “discipline”; indeed, a limited number of rules are an integral part of the classroom management plan. A middle school teacher who is a “disciplinarian” tends to post a list of rules—or sometimes may involve students in writing the rules and then posts them—as an account-



These are the seven things students want to know on the first day of school.

Source: Wong, H. K., and R. T. Wong. 1998. *The first days of school: How to be an effective teacher*. Mountain View, CA: Harry K. Wong Publications. © Harry K. Wong Publications. Reprinted with permission.

ability measure: “The rule is posted up there [teacher points with an index finger]; therefore, if you break it, you knew better and deserve what you get.” In this sense, the rules are about deterrence—punishment—and are not integrated into the learning continuum.

An effective classroom manager may post the same rules—literally—and may or may not involve students in determining what they should be. The key difference is that a classroom manager teaches the rules to the students over the course of the first week or so of school, in conjunction with other procedures for taking roll, training students to begin each class by sitting down and working on a short assignment posted on the board, breaking down labs with five to ten minutes remaining in class, and being dismissed (where appropriate) only when the teacher says so. “Discipline”—or fear of punishment—now becomes “classroom management”—a learning process that manifests as a practiced behavior. This is the power of teaching procedures.

Perhaps the cardinal rule governing the behavior and attitudes of middle schoolers in good science classrooms would be something like this:

As long as you act like a scientist when we do science, you will be treated like a scientist and enjoy many exciting investigations and discoveries. If not, you get to watch the rest of us do science! (Variation: You get to be a retired scientist!)

This expectation has served us (and many of the teachers we consulted in writing this book) as a very effective management strategy with middle-level students.

In Table 5.1, we list a sampling of ineffective methods and effective procedures that illustrate the advantages of a well-planned approach to classroom management.

Procedures, and rules in particular, satisfy an adolescent’s need for structure, safety, and predictability, as discussed in Chapter 1. Part of the objective when teaching about the rules is to make students aware of the need to follow procedures to avoid unfavorable outcomes, such as accidents. We’re not suggesting that classroom management plans not feature consequences for poor choices. Indeed, the most effective plans include rules with consequences that logically fit the student behavior in question. Middle school students need, and on a certain level, *want* to know the limits, but they are also looking for evidence that the world, and adults, are basically fair. That is why we advocate “teaching the rules” rather than simply posting them like a skull and crossbones! Serious infractions and disruptions, and certainly any behavior that endangers another individual in the classroom, demand major but also reasonable consequences, and middle school students should be taught why the consequences follow—and fit—misbehavior in the science classroom.

In the best-managed middle school classrooms we’ve seen, rules, consequences, and management procedures are *taught*—and tested (or quizzed)—during the first week of school and throughout the year.

Some effective middle school teachers prefer to determine and post the rules without consulting their students; others use a more democratic approach. Either approach can be compatible with classroom management plans tailored to adolescent learners and to the inquiry-based approach, although the more-participatory systems help to develop a sense of classroom community that is common in the effective middle school classrooms we’ve known. Kohn (1996) asserts that community building in a classroom

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TABLE 5.1
INEFFECTIVE METHODS VS. EFFECTIVE PROCEDURES FOR MIDDLE SCHOOL CLASSROOM MANAGEMENT

INEFFECTIVE METHODS	EFFECTIVE PROCEDURES
Let students sit where they like.	Assign student seating on day one.
Post rules on the wall; refer to them when students act inappropriately.	Teach and test classroom expectations in first weeks; reinforce throughout year.
Leave parents out of the loop until a situation escalates, course grade drops, and/or end of term nears.	Involve parents in classroom management with early positive communication and follow-up.
Neglect to properly educate students about what to do in the event of an absence, an emergency, a substitute teacher, a missed assignment, and unexpected "free" time.	Establish class procedures well in advance of absences, emergencies, substitute teachers, makeup assignments, and unexpected "free" time.
Take roll while students chat or sit idly.	Start class with a brief student task.
Begin teaching without outlining the lesson, expectations, or objective(s).	Post daily schedule, including start- and end-of-class activities (bell work), what's due, activity/lab, and task(s).
Announce assignments verbally, with little notice; no student accountability for recording assignments or completing or submitting them.	Post assignments in advance to be recorded and checked in by students on calendars they maintain (which are checked periodically by the teacher).
Correct inappropriate work habits as they occur; limit cooperative/lab activities based on poor behavior.	Teach students how to work independently and in groups, how to get your attention, how to clean up after lab or activity.
Respond inconsistently to requests to move or leave based on circumstances.	Train students how to move about or leave the classroom during seatwork and labs.
Respond to inappropriate questions or comments.	Teach students how to offer and respond to questions and criticism.
Give free time at end of class—e.g., allow students to congregate at door.	Instruct students how to end a class and let them know that you, not the bell, are in charge of when they can leave.

begins when teachers invite students to participate in finding solutions and developing rules and procedures; as Kohn notes, “Students learn how to make good choices by making choices, not by following directions” (p. 78). Kohn’s position is especially compelling when considering the developmental levels of middle schoolers, who “are more likely to be better behaved when there is no need for them to struggle to assert their autonomy” (p. 81).

Beyond developing classroom unity, successful middle school educators strive to develop broader agreement when it comes to classroom management by collaborating with other staff to adopt schoolwide behavior expectations—for students *and* teachers. Such expectations can help to unite the independent groupings or schools-within-schools (sometimes called “tribes,” “houses,” or “teams”) that are increasingly common in U. S. middle schools.

A Strategy to Avoid

There is a “discipline” strategy teachers sometimes employ that we strongly discourage. In keeping with the goal of building community (and in the spirit of developing relationships with students), we believe middle school science teachers should avoid publicly singling out or humiliating individual students for misbehavior. A better way can be as simple as asking a student to step outside briefly to avoid a public confrontation or to meet for a discussion at lunch, homeroom, or recess, depending on the circumstances of the situation and the need for immediate intervention. (A private conversation about expectations eliminates many peer pressure complications.) Often a calm, respectful request to confer one-on-one is all it takes to encourage a student to refocus his or her attention, and the lesson can continue with minimal

disruption. Other times, it’s not quite that easy—but remember that the teacher’s objective should always be to build relationships and community rather than break down a student’s will or self-esteem. This should be a guiding principle of a middle school teacher’s classroom management efforts. Presence of mind, objectivity, and several deep breaths will pay off in the long run.

Rewards and Praise

Negative consequences are commonplace middle school disciplinary approaches. However, many middle-level educators also incorporate positive incentives such as praise and rewards into their classroom management plans. Is positive reinforcement an effective management strategy? The answer is, “It depends.” Some experts argue vehemently against the use of tangible rewards such as candy and stickers. We are conditioning our children to expect a reward for certain behaviors, the argument goes, and reinforcing their need for extrinsic motivation, diminishing their intrinsic drive, and programming the next generation with a “‘what’s in it for me’ welfare and bribery system” (Wong and Wong 1998, p. 163). According to Kohn (1993) “The more rewards are used, the more they seem to be needed” (p. 17). Meanwhile, teachers have become so dependent on doling out rewards as incentives that they lack other, more creative motivational strategies.

Some forms of rewards are effective and appropriate in the middle grades. Our experience and some studies (e.g., Marzano, Pickering, and Pollock 2001; Jensen 1998) indicate that positive reinforcement in the form of verbal praise is actually more effective than tangible rewards such as candy. Praise applied appropriately and sparingly appears to have a positive impact on student attitudes and behaviors when it is

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contingent on students having reached a set standard or expectation.

Acknowledging Differences

Also in regard to classroom management, we urge teachers to be sensitive to the behavior patterns of children from cultural or demographic backgrounds that are different from their own. When teachers fail to take into account such differences, they can develop management procedures that are ineffective or that provoke a very different reaction than the teacher intends.

Are we advocating different rules for different students or that teachers apply consequences inconsistently? Perhaps this question is best addressed by asking another question: Is the goal of classroom management in the middle school to achieve “equal” treatment of all students? Our answer is no, because, as we discussed in Chapter 1, an important emotional need of middle-level learners is to be treated as individuals, with the teacher showing sensitivity toward the specific circumstances and emerging identity of each student. In fact, when it comes to disadvantaged students, who as adults are profoundly underrepresented among the ranks of science teachers, scientists, and scientific professionals because proportionally very few of them attend college, we are eager to discover and pursue new ways that will help all students succeed. In this regard, we direct readers to the important work of Ruby Payne (1998), whose research and training for educators on strategies for teaching children living in generational poverty is extremely useful for at-risk school communities in general. The future of good science—inclusive of diverse backgrounds and experiences—depends on this sort of resourcefulness.

Lesson Planning for Good Management

Basic to good science teaching is establishing an atmosphere of “investigation fervor.” Early in the year, teachers need to let students know that they *are* scientists and that in the course of the term they will use and reuse their skills in the class. What skills are necessary for students to think and act like scientists? First, teachers need to make students understand that scientific research always starts with a question or a puzzling observation that raises a question. This is a platform for introducing (or reintroducing) students to a “scientific method” they can employ to conduct investigations. Sample focus questions that teachers can use to generate and guide inquiry activities are found in Chapter 7.

Second, teachers must introduce students to the process skills used in science:

- observing
- collecting data
- estimating
- problem solving
- predicting, hypothesizing
- investigating
- measuring
- classifying
- building models
- making graphs
- controlling variables
- discovering or determining cause and effect
- making inferences
- communicating
- drawing conclusions

Teachers should design lessons to activate these skills while helping students become more

comfortable asking questions, defending or justifying their answers, and generally being skeptical of results and conclusions. These process skills are generic and applicable to any topic a teacher may choose to teach within the framework of the National Science Education Standards. Providing students with lab settings that maximize use of the greatest number of these process skills will expedite their competency and assist them in becoming scientists.

Teaching Safety

Middle schoolers are by nature incredibly curious young people. This trait, combined with their tendency to explore the limits of appropriate behavior, forms a potent recipe for science disasters. Consequently, no discussion of classroom management in the context of middle-level science education is complete without considering the issue of student and teacher safety. Safety is primary to good science—everything else is secondary.

Hands-on science experiences present more risks than those associated with reading textbooks and completing worksheets. The professional judgment of the teacher is the most important factor in determining which activities should be used and which activities should be omitted. Accordingly, science safety is maximized by teachers who set clear expectations for student behavior.

As with all management expectations, safety is a matter of teaching, testing, and reinforcing procedures. Questions about safety, particularly issues surrounding lab activities, should appear in the start-of-term student preassessment in order to determine the extent of the students' previous safety preparation.

In addition, prior to engaging in any science activities, students must be required to complete

and return a safety contract signed by their parents and also score 100% on a safety quiz. (Readers may refer to the Flinn Scientific Web site at www.flinnsci.com for a sample contract and quiz.) We urge teachers to include a specific clause in the contract that warns against unauthorized experimentation—good science is fun, but teachers are professionals and students should *not* try this at home!

Key procedures that we recommend teaching and implementing from the start of the term are the following:

- Make it clear that safety is the highest priority in your classroom and that students who choose not to behave like scientists during an activity or project will observe, rather than participate, for that day.
- Familiarize and train students regarding location and use of sinks, eyewash, chemical shower, first aid kit, and other emergency stations.
- Assign a materials manager for each group who inventories items before and after the activity.
- Designate a signal to indicate cleanup and inventory time.
- Establish an expectation for cleanup and materials inventories so that students understand class won't be dismissed until the room is in order and all supplies are accounted for.
- Make sure that materials are organized and packaged in a box or tub for each group.
- Locate materials so students don't have to carry them too far (how far is "too" far depends on the hazards associated with what is carried).



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- Arrange the physical space in the classroom to accommodate the traffic patterns of the specific lab activity, including access to safety equipment, as well as setup and cleanup considerations.
- “Declutter” prior to lab days, as clutter compounds the possibility of accidents and injuries.

THERE IS NO SUBSTITUTE FOR SAFETY!

1. Train your students in safety and emergency procedures.
2. Provide equipment in good operating condition.
3. Supervise students AT ALL TIMES!

A lab safety checklist, which can be posted in the room following the teaching of a safety unit at the start of the year, might look like Figure 5.1. (See also the lab safety rules in Appendix D.) Teachers should review every item, with every student, before every lab.

We celebrate inquiry and are excited when our students are interested enough to pursue their investigations. However, over the years and increasingly, very dangerous “science” activities are available to young people with access to the Internet and other sources. Years ago, this prompted the “See Me” rule, which is as follows:

If you want to try your own experiment, please SEE ME first! We can investigate it together, and I will evaluate the safety of the proposed experiment—bring instructions or information if you have any. If it is safe, you may proceed with the investigation under my direct supervision.

After the first few times we explained the rule, we’d ask in a lab write-up or quiz for students to repeat it. This helped emphasize the

FIGURE 5.1

LAB SAFETY CHECKLIST

BEFORE YOU BEGIN

1. Do you know who your lab team members are?
2. Do you know the task for which your lab team is responsible today?
3. Do you know the procedures for teamwork?
4. Do you know proper safety precautions needed for today’s lab (goggles, apron, gloves, etc.)?
5. Do you know whom to contact in case of a classroom emergency?
6. Do you know where basic safety supplies (baking soda, eyewash, water) are kept in case you are asked to locate them?
7. What is the *first* thing to do in the event of an emergency?

AFTER THE LAB IS COMPLETED

1. Did your team work well together?
2. Did your team complete the assigned task?
3. Did your team follow all the safety rules?
4. Did your team need to use any first aid supplies?
5. If yes, which ones and why?

importance of open communication between teacher and students and reiterated the gravity of the expectation.

We also made sure the parents understood “See Me.” For added safety, we recommend that teachers require all independent investigations to include a complete description of the proposed inquiry with verifiable signatures of the parent(s) indicating they understand that all procedures must take place at school under the teacher’s supervision. (There have been cases

where teachers were held liable for student “science experiments” at home when the teacher talked about specific subject matter in class and neglected this sort of explicit caution.) Further, we advise that if a teacher is inexperienced or unfamiliar with the specific area of a student’s independent study interest, it’s essential to seek the advice of experts to help evaluate the safety and educational value of the student’s proposal.

An Emotionally Safe Environment

Beyond a conscious concern for safety in the classroom, the environment should be tailored to the needs and interests of students and teachers who have to live together in the room for months. We’ve seen a wide variety of middle school classroom environments that suited student needs and were associated with successful students and teachers year after year. Generally speaking they were places with some color, warmth, and public acknowledgment that students are important to the teacher (e.g., student work posted, birthdays listed). Some teachers find that creative and varied desk arrangements facilitate different instructional activities better (and can cause a fairly marked difference in how students behave and interact). In Chapter 1 we saw that middle schoolers need a blend of spontaneity and structure in a teacher’s instructional methods; this is probably a good rule of thumb concerning the class environment, too.

In sum, we agree with Rick Wormeli’s call for creating “an emotionally safe environment” (2001, p. 8), focusing on a teacher’s role of empowering learners in the middle grades:

There are many ways to boost the confidence levels in our middle school classrooms without getting lost in self-esteem hoopla such as putting up “happy” posters. Be pleasant to students. Call

them by their first names. Greet them at the door. Smile often. Catch them doing something well. Crack a few jokes. Ask questions that show your interest. Applaud risk taking. Share excellent homework or test responses with the rest of the class. Allow occasional democratic voting in the class. Refer one child who is an expert on something to another child who needs help, and make sure you rotate the expert’s role. Ask students to tutor their peers after school. Give them responsible jobs in the classroom. Ask them to serve as hosts for guest lecturers. Point out moments of caring among peers that occur in class. Post their accomplishments in class. Make at least one positive phone call or note home for each child per year. (pp. 8–9)

Efforts such as these will go farther, based on our experience, than any number of pop culture icon posters or slogan banners to win the loyalty and interest of middle school learners.

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