CHAPTER ONE

Design Your Classroom *to Create Communities of Learners*

Science is a great game. It is inspiring and refreshing. The playing field is the universe itself.

—Isidor Isaac Rabi (1898–1988), 1944 Nobel Laureate in Physics for his resonance method of recording the magnetic properties of atomic nuclei.

How exciting! You have been given your teaching assignment and handed the key to a classroom. Now it is time to use your knowledge, skills, and experience to create a community of learners. Your first task is to set the stage for effective teaching and learning every day in your own science classroom. Your stage, as Isidor Isaac Rabi notes, is the universe itself.

EXPLORE YOUR SCHOOL AND CLASSROOM

Take a tour and see your school in action. As you walk around the building, take note of the layout and activities. Consider these questions: Are classrooms grouped by department or grade level? Do students enter from the outside or from an inside hallway? What types of projects do you see students engaged in, especially in the science classes? How and where do teachers obtain books and supplies? Where is your room located in relation to the other school facilities?

Here are some items you will want to see and discuss in order to be prepared for the first day of school:

District and School Offices and Areas

- Location of the district offices, staff development center, and instructional media center
- Location of the school main office, health office, restrooms, and lunchroom
- Location of the school library, media center, and technology labs
- Location of faculty parking and whether a permit is required
- Directions to the faculty lounge and restrooms

School and District Policies

- Copy of the school district teacher handbook and curriculum guide(s) for each course you are assigned
- Copy of the student handbook
- Copies of the school calendar and schedule
- Web addresses for all district and school programs and resources, including any user IDs and passwords

Science Teaching Assignment and Department

- List of your tentatively assigned grade levels and courses
- Copies of the course textbooks, laboratory manuals, supplements, and syllabi
- List of your assigned students noted with special needs (including learning, social, family, and health) and

information on whether you will have any instructional aides to support these students
- Location of your classroom (or rooms if you will be a traveling teacher)
- Location of laboratory classrooms (if different from your home classroom); portable laboratory equipment; supply cabinets and chemical stockroom; schedules/sign-up process for use of space and resources (if appropriate); safety resources; water, electricity, and gas access and emergency shutoffs
- Types of student desks or tables and chairs assigned to your classroom
- Availability of bulletin boards and display spaces in your classroom and hallway
- Availability of technology resources and storage areas within and near your classroom
- Location of your team/department office or planning room and storage areas

As you become acquainted with each of these items, you will generate more questions and begin to plan for your students. This "preview of coming attractions" will help you get centered and enhance your peace of mind about your career as a science teacher. We will discuss these items in much more detail throughout the upcoming chapters.

MEET YOUR DEPARTMENT AND TEAM

You are going to spend most of your school time outside of your classroom with your department or team members. Although you may have been hired to teach specific science courses, you also were hired to fit into a particular group of people. Most teams want you to be an individual who successfully balances working on your own with working with others. You may be sharing students with other teachers; you may be team teaching with other teachers. You may work together to develop lesson plans and standards-based benchmark assessments to monitor student progress. Each teacher will contribute to both your immediate effectiveness and long-term success in some way. And each teacher will have more or different experiences than you bring to share with you. Our first secret for success is for you to learn from each person's strengths and expertise as you refine your skills and independence.

Many schools are organized into grade levels or academic departments with a group leader known as a department chair. Department chairs usually have been teaching at their schools a long time. They will likely be the ones to help you get your course textbooks, supplementary materials, and classroom supplies. Sometimes department chairs determine course assignments and periods taught. They can usually link you to professional organizations and professional development opportunities. You may also be assigned a mentor who will be able to answer your questions and share information about school policies and procedures.

> *I meet once a week for planning with other science teachers. We share ideas, labs, and lesson plans.*
>
> *—Seventh-grade life science teacher*

INVESTIGATE YOUR SCHOOL'S AND COMMUNITY'S HISTORY AND CUSTOMS

School buildings are frequently named for individuals who may be famous nationally or well known locally. Sometimes the namesake is still living, visits the school, and makes donations. It is exciting when you and your students meet the person for whom your school is named, and learn what contributions this person made to the community to receive this recognition. Or there may be a business or industry that partners with your school, providing mentoring, materials, and professional development for teachers.

Investigate your school's background. Frequently there are trophy cases, wall plaques, and group photographs displayed throughout the building. One secret is to look at the annual yearbooks to explore school traditions and learn the names of teachers. These may be housed in the library. If you ask about your school in the faculty lounge or department planning room, it is likely that someone will be happy to share stories of the school's history. It is both fun and informative to find out more about your school.

Your school also functions around a set of customs and traditions (Cattani, 2002). By watching and listening carefully, you will realize and be able to promote and replicate the accepted ways of doing things at your new school. You will learn who is responsible for various aspects of the school's operations, how teachers and administrators expect you and your students to behave, and so forth. These are excellent topics to discuss with your department chair,

team members, and/or a mentor. Current students, alumni, families, and the community look forward to annual and special events.

And don't forget to consider the local culture of the area. See Box 1.1 for examples of science in the local culture of the area. Explore the unique features of your community and region.

BOX 1.1

Examples of Connections Between Local Culture and Science

- **Oldest Tree in Anaheim**—Science teachers in Anaheim, California, might use the "oldest tree in Anaheim" as a starting point for discussing botany. This Moreton Bay fig is over 150 years old and is situated on the property of the Anaheim Mother Colony house of the original settlement in the area. The tree is one of the largest of the particular species found in the Southern California region.
- **Santa Ana River Bottom**—In Riverside, California, science teachers often take students on field trips to the Santa Ana River Bottom. As is true for much of California, the geology of the Santa Ana River watershed is defined and created by seismic activity. Lessons may focus on the geological features, water demand, or plants and animals of the region.
- **San Diego Kumeyaay**—Ethnobotany is the study of the plant lore and agricultural customs of a group of people. The Kumeyaay were among the earliest inhabitants of the San Diego area, and they took advantage of the food and plants in many different habitats in order to survive.

ACCESS TEXTBOOKS AND EQUIPMENT

Once you've obtained copies of your course textbooks and sample syllabi, you may begin reading them to prepare for the coming school year. Also ask for the teacher's manuals for your text, laboratory manual, and supplementary print and electronic teaching materials that either accompany the books or have been purchased for your courses. Some of these items may be available at the district, so explore thoroughly. The teacher's version of your laboratory manual is very important; it will include all the instructions for setting up the laboratory activities and mixing necessary solutions.

BOX 1.2

Science Materials and Equipment

- **Technology Resources**—including SMART Board; overhead and/or ELMO or other electric imaging projector; document camera; television; DVD, CD, and/or videotape player(s); computers—desktops, laptops; or AlphaSmarts®; printers, scanners, copiers; Internet connections for one or more computers; LCD projector and large screen for projection; cameras, probes, recorders, and other devices to record observations; and audience response systems for interactive slide presentations
- **Permanent Equipment—**including student laboratory stations and storage facilities
- **Visual Aids—**including specimens, models, prepared slides, charts, and posters
- **Portable Laboratory Equipment**—including animal cages; balances, meters, testers, and scales; Bunsen burners and laboratory torches; brushes and sponges; buzzers and bells; ball and ring apparatus; carts and dollies; centrifuges; clamps, ties, rings, hooks, and support stands; electroscopes and calorimeters; dissection equipment; filters; glassware; incubators; hot plates and lamps; microscopes, cameras, and telescopes; motors and generators; magnets; optical filters; stools; timers; tongs, tweezers, and scissors; and wave machines
- **Safety Equipment**—including aprons, disinfectants, eye protection, eye washes, fire protection blankets, first aid, fume hoods, gloves, safety charts and posters, sanitation products, and waste containers
- **Materials and Supplies—**including pH and chromatography papers and materials, specimens, indicators and test solutions, chemicals, lens-cleaning products, lubricants and adhesives, microplate supplies, batteries, bulbs, biological, balance papers, paper towels, and water and soil test kits

Take inventory of the various kinds of available teaching equipment and resources. Inquire whether there is a catalog of your school and/or district video and software collections. The types of equipment you can easily access certainly will impact the ways that you plan and implement your teaching strategies and learning experiences. You will need information on how science supplies are obtained and funded, how to make purchase order requests, whether personal expenses will be reimbursed, and even whether there is a limit on the

number of photocopies allowed each semester. Begin a wish list of items you would like to obtain when there is money available in the school budget or a grant-writing opportunity arises. Check to see whether your district has equipment standards for science classrooms. See Box 1.2 for suggested science materials and equipment.

If you conduct an Internet search on "grants for science teachers," you will find an extensive list. Get ideas at Vernier's Grant Writing Guide at www.vernier.com/grants and the Texas Instruments Funding Sources Grantwriting Site at http://education.ti.com/educationportal/sites/US/sectionHome/grantandfunding.html. You might also consider:

- **Toyota TAPESTRY Grants for Science Teachers:** www.nsta.org/pd/tapestry. Grants up to $10,000 for projects that promote exciting and innovative activities to motivate students in science.
- **Toshiba America Foundation:** www.toshiba.com/tafpub/jsp/home/default.jsp. Grants for projects in math and science designed by classroom teachers to improve instruction for students in Grades K–12.

PLAN FOR EXPLORATION AND EXPERIMENTATION

> *My room is arranged in small pods/groups. I believe it is essential so that students have the opportunity to work together in cooperative groups.*
>
> *—Seventh-grade science teacher*

The classroom environment sets the tone for your students (Kottler, Kottler, & Kottler, 2004). You want your room to be both attractive and functional. It should be a place where students feel welcome, safe, and comfortable. Post your name and room number near the door. If possible, place a science-related picture on or beside the door that indicates the subjects taught in your room.

To begin, imagine what your students as well as other visitors will see as they first enter, and display science materials and objects in this space. You may use specimens, equipment, models, timelines, posters, books, and so forth. To stimulate new ideas, periodically change your exhibits to reflect the topics and issues

that you are studying in your courses. Display data and reports created by your students. Your goal is to captivate your students' interest and to communicate that engaging, challenging, and rewarding science education is happening in your classroom.

Second, arrange desks and furniture to allow students to move around the room quickly and easily; they need to be able to see you and the boards without any obstructions. Position the desks or tables into groups, semicircles or circles, or a horseshoe shape to offer the most effective learning environments for your activities. Seating arrangements reflect your teaching styles. You want students to interact with one another and to work in collaborative learning groups. Sitting at tables, desks, or laboratory stations grouped in fours can facilitate these activities readily.

I like the classroom arranged with lab partners, so if you don't understand anything, you can get help, and have someone to work with.

—Amy, age fourteen, ninth grade

Third, determine where you will place three-dimensional items, such as specimens and models. For example, your room might have terrariums, fish tanks, skeletons, and/or rock collections. Some objects you will let students handle, while others may be fragile and personal and you will want students to only look at them. Strategically place bookshelves, side tables, and/or display cases within students' view. Then move other furniture, such as filing cabinets, to the walls or corners where students can access them for books, materials, and supplies; this way, you will see all parts of the room. You may have to make accommodations if your classroom is small, the seating is fixed, or other furniture is immovable.

Fourth, consider where to place your desk and your personal cabinets and shelves. You need a place away from students' eyes and fingers to store your computer, grade book, student information cards, and lesson plans. Some teachers want their desks placed near the door; others want them near the front of the classroom, which is usually where the SMART Boards or whiteboards are located. Other teachers want their desks placed near the back of the classroom. Each location has benefits and limitations, and each teacher is unique. We suggest that you walk through other teachers' classrooms and see how they are arranged. You might

want to match them since it will be the configuration that the students will expect. Or you might want to be different to capture your students' attention and signal what activities they will engage in while in science class.

Fifth, dedicate distinct portions of your walls to highlight each course that you are teaching. This space may include your national, state, or district content standards as well as a weekly calendar of lessons and activities. Save one area for general information. Use bulletin boards or cork strips to post reference information and related articles from newspapers, magazines, and journals. Set aside a special section to recognize student work. Here are two extremely important secrets. First, find ways to display samples of every student's work from all your courses, and rotate the student work regularly throughout the school year. We also encourage you to display emergency procedures near the door and prepare everyone for all types of emergencies and evacuation from the first day of school. See Box 1.3 for suggested materials and purposes for science bulletin board displays.

BOX 1.3

Materials and Purposes for Science Bulletin Board Displays

- Visual aids *to build background knowledge*
- Political spectrum *to illustrate varying perspectives on a scientific issue*
- Prompts *to stimulate discussion*
- Quotes by historical and contemporary figures *to inspire student actions and interaction*
- Current event articles from journals, newspapers, and magazines *to connect science to students' daily lives*
- Science-related humor, including jokes and cartoons, *to put a human face on science*
- Examples of professionals in science-related pursuits *to identify science careers*
- Examples, charts, and tables *to provide advance organization for student thinking*
- Timelines *to relate the perspective of time and events in the past or present*
- Rubrics *to show criteria for student work*
- Displays *to recognize students' accomplishments*

COLLECT MATERIALS AND RESOURCES

It is time to brainstorm the kinds of materials and resources you would like to use to make your curriculum and instruction come alive. Look through your textbooks to identify the topics and issues to be covered. Consider what supplies you want for experiments and demonstrations, and what items you will use to illustrate concepts emphasized in your units and lessons, such as charts, tables, photographs, models, and specimens. A subscription to a science trade magazine, such as *Discover* or *National Geographic,* will provide pictures that can quickly be clipped, laminated, and used to create an interesting display on science-related issues. In addition, local utility Web sites often offer free information on energy conservation. Consider using your own photos and videos—this also demonstrates your enthusiasm for science and commitment to lifelong learning. Borrow educational and scientific catalogs from your school's department chair or librarian. We suggest you familiarize yourself with the following scientific catalogs:

- ***Flinn Scientific:*** www.flinnsci.com
- ***Carolina Biological Supply:*** www.carolina.com
- ***Fisher Science Education:*** www.fishersci.com
- ***Science Lab:*** www.sciencelab.com

Student work is another source of visual aids to introduce and reinforce concepts. One high school–level idea is to assign "element posters" and laminate the best ones for display and to use as a model in the future. At the middle school level, students might complete an oceanography art project with the creation of three-dimensional models of the ocean. Students at any grade level will benefit from creating models of the solar system, plant and animal cells, and molecules, and these models can decorate your classroom in the years to come.

Consider also what specific classroom supplies, such as calculators, graph paper, colored pencils and markers, and construction paper, students will need to use in class. Place these materials in plastic bags on shelves, or in storage bins for easy student access, cleanup, and check-in. Take time to collect materials to keep you organized, such as plastic crates, stackable baskets, or colored file folders. You may store some of these items in your classroom, some in the department or grade-level office, and some at home. You will be amazed at how quickly supplemental materials will accumulate, and in science classrooms they take up a great deal of room. You will

also want to talk to your department chair and science colleagues to determine what resources the school already has. Other items may be purchased online or from your local teacher supply store. Schools vary in their budgets and procedures for obtaining resources.

INVESTIGATE LABORATORY SPACE AND EQUIPMENT

> *We use balances, Bunsen burners, microscopes, and many other scientific instruments in the lab. We have SMART Boards too.*
>
> *—Robin, age sixteen, eleventh grade*

When your students conduct investigations and experiments, they need appropriate space and equipment. An ideal secondary science facility should include the following (Butin, 2000):

- *Laboratory space to conduct investigations*. This space should include flat, durable top surfaces with adequate natural and task lighting. Sinks and electrical/gas outlets should be placed along the perimeter of the room. All science room, preparation room, and storage room doors should lock. Safety equipment and rules should be easily accessible.
- *Preparation room.* The preparation room should be directly accessible from the classroom and may be restricted to teacher preparation for experiments. The room should have the necessary utilities—electricity and water—to prepare for and conduct classroom projects. The room should also have a phone, an acid-resistant sink with hot and cold water, an ice-making refrigerator, and the capacity to handle specialized fixtures such as an autoclave or distiller.
- *Storage room.* This room should be used primarily for the storage of chemicals, specimens, and materials. To prevent sparks and potential explosions, there should be no electrical or gas outlets in this room. A fire-resistant storage cabinet and/or noncorroding acid cabinet (situated below eye level) should used to store hazardous materials. Storage areas should also be earthquake safe.
- *Greenhouse or greenspace.* A greenhouse can greatly enhance the curricular offerings of the science program. The greenhouse should range from 200 to 400 square feet; have separate thermostatic controls, access to ample water, a floor drain, and humidity control;

and be able to function when school is not in session. If a greenhouse is not possible, a greenspace can be established in a large corner of the classroom.

With large classes, teachers often divide students into groups and set up learning centers or stations where they take turns engaging in different activities. Students may either be assigned to or self-select from a list of varied assignments. Or half the students might work on assignments at their seats while the rest perform laboratory experiments. Teachers then have the opportunity to meet with students individually or with small groups to answer questions, monitor progress, and adjust instruction and assessment as needed.

> *I change my room depending on the unit. Sometimes I set up a hands-on station at the back table. Or, to form expert groups, students move their desks into quads.*
>
> *—Third-grade teacher*

SAFELY USE AND STORE SUPPLIES AND EQUIPMENT

Safety is of paramount importance. Bunsen burners, chemicals, and dissection tools are just a few of the multiple hazards lurking in every science classroom. Butin (2000) recommends that all science facilities should have a hands-free eye wash, fire blanket, fire extinguisher, and first-aid kit. A chemical hygiene plan should be revised annually to identify potential health and safety hazards in the classroom and laboratory, precautions and preventive measures that are in place, and required safety rules and procedures. If the space is to be used for chemistry or advanced biology classes, you should consider installing a fume hood and safety shower. A clearly marked master cutoff switch for utilities should be readily accessible, and the classroom area should have easily accessible telephones to summon emergency technicians. Resource A at the end of the book provides a science safety checklist for the classroom.

ESTABLISH YOUR POLICIES AND PROCEDURES

> *One of my favorite expressions is: Don't forget your PANTS (pencil, assignment, notebook, textbook, and smile).*
>
> *—Middle school math teacher*

There are three sources to consult as you establish your classroom policies and procedures. You will need to comply with regulations adopted by the school district (i.e., dress code and weapons), school building (i.e., hall passes and tardies), and your team or department (i.e., interactions and assignments). You want to be firm, fair, consistent, and—most of all—patient as you reflect all three layers of regulations and express your own style. Keep in mind that, for most of you, your students spend only one class session a day with you. They move through many different spaces and must comply with everyone's expectations. Your environment communicates your plans and makes teaching and learning the focus of the school day.

You have several choices when it comes to establishing classroom policies and procedures. Although you could simply tell your students how you expect them to act in your classroom, we encourage you to model effective science by brainstorming possibilities, examining rationale, and reaching consensus. Try accomplishing this during the first few days of class. Divide the class into small cooperative learning groups, and ask each group to construct a list of classroom expectations along with associated consequences (rewards and punishments). Prompt your students to write the list as positive rather than negative statements. You will have to decide whether you want to call them rules or whether you think that term conveys negativity.

I think that the way to make rules is for students to make suggestions. Obviously for science, there are some rules that have to be made, but for everything else, students and teachers can make them together.

—Maggie, age fourteen, ninth grade

You might be amazed at the detailed lists your students will generate. Through consensus, you and your students can determine which expectations to adopt and how they will be managed. You will discover that some items can be grouped together into one overarching expectation, some items have multiple implications, and some items you need to maintain control over. These discoveries are all part of the negotiation and consensus building—excellent models of science processes used in the real world. If you have multiple classes, you will have to decide whether you want one set of expectations for all your classes or whether you want to customize the expectations for each of your classes. Keep in mind

the need to revisit and revise both the expectations and the processes from time to time, just as scientists revise theories.

When you talk with your colleagues, you may find that most of them follow similar procedures. This approach makes it much easier for your students and for you, if you are comfortable with the procedures. Then you can discuss the outcome with your team to make changes as a group or individually.

> *All of my rules are stated positively. For instance, treat others as you would like to be treated, help keep our classroom a neat and orderly place to learn, and be accountable for your actions.*
>
> *—Eighth-grade science teacher*

CREATE A SHARED LEARNING ENVIRONMENT

Your goal is to make your classroom a shared learning environment. Therefore, you need to refer to it as "our classroom" rather than "my classroom." The same advice applies to your classroom management. By setting expectations together, you and your students have a sense of ownership and responsibility relative to how everyone will participate in the shared learning community.

Some student expectations from the school and/or district include:

1. Wear clothing in compliance with the dress code.
2. Respect all people and the school campus.
3. Avoid gum, tobacco products, cell phones, and music players on campus.

Some student expectations from teachers include:

1. Arrive to class on time ready to participate.
2. Bring supplies and assignments to class every day.
3. Do your best on every assignment.

Some student expectations from the students include:

1. Talk only at appropriate times and in consideration of other speakers.
2. Use polite language and speaking tones.
3. Take responsibility for your actions.

There will be several opportunities to review these expectations and share them with your students' parents and families. Most schools require them to be posted on classroom walls, and included in the information sent home with letters of introduction at the beginning of the school year, and at "Back to School" night. Parents/guardians will also appreciate information on how to contact you (school telephone number, time to call, and school e-mail address).

ENSURE EQUITY AND FAIRNESS

You want to be fair (Danielson, 1996), you want your students to understand fairness and act fairly, you want to ensure fairness among your students, and you want your students to appreciate fairness in the classroom and in the world. Fairness entails a significant concept of science that assures that everyone is provided equity and justice. Think of this as providing everyone equal information, access, and opportunity (Gallavan, in press) for effective learning and living.

Equity and fairness do not mean you treat all students exactly the same. Some students will require more time and attention; some students will need less energy. You need to be aware of each of your students' individual needs and interests so you can provide for them appropriately. And not all students will need the same amount of attention at the same time. Equity and fairness should be considered in terms of what you think or believe is a student's past performance, what you see is a student's immediate progress, and what you predict is a student's long-term potential. These conditions are all important aspects of equity and fairness. The triad of performance, progress, and potential can guide you in working with your students throughout the school year. See Box 1.4 for suggestions for establishing equity and fairness in the classroom.

BOX 1.4

Suggestions for Establishing Equity and Fairness

1. Establish and maintain high academic and social expectations for all of your students at all times.
2. Share expectations with students and parents in writing.
3. Model and reinforce respect and politeness with everyone at all times.

4. Apologize sincerely when you make a mistake.
5. Provide specific feedback and show genuine appreciation. If you applaud for one presentation, you must applaud for all.
6. Allow students to finish speaking and redirect interruptions, although you may have to ask students to keep their comments to a limited amount of time.
7. Select students equitably, using name cards, sticks, or tokens (for questions, comments, activities, errands, and so forth). All students need to know that they should be prepared at all times and that you have both the right and responsibility to call on them at any time.
8. Delve fairly; this means that you probe and follow up with all students using higher-order and critical thinking.
9. Use a stopwatch or clock to monitor ample wait time when asking students questions or giving them instructions to demonstrate an action. Your students will appreciate the consistency.
10. Establish clear consequences for students who cannot show respect and fairness for others.

USE APPROPRIATE AND NEUTRAL LANGUAGE

Your students and their families look to you as a positive role model. For some of your students, you are one of the few educated individuals who will help prepare them for their future studies and career success. And for some of your students, English is a language they are learning. They need to hear, speak, write, and read proper English in both formal and informal conversations and written communications.

Using gender-neutral language is important for both modeling and inclusion. Be aware of your word choices so your female students feel valued and all your students experience the power of language. When addressing your students collectively, call them "ladies and gentlemen," rather than "girls and boys" or "guys" for everyone. When referencing professions, use words such as "firefighter" and "police officer," rather than "fireman" and "policeman." Use the term "humankind," rather than "mankind," when talking about all people. You might want to ask a colleague to

listen to your word choices to be sure you are using appropriate and gender-neutral language.

The same guidelines apply to using culturally sensitive language. You want to be aware if you use any inappropriate cultural references or imply bias. Sometimes teachers make comments that communicate prejudice, such as stereotyping or making negative comments about the nutrition or health practices of a particular people as a whole. All educators must be cognizant of their word choices. And as science teachers, we should lead others in this effort. You should emphasize that science is and has been done by men and women of all cultures. Textbooks often emphasize the contributions of Western Europeans. You will want to make sure that you included examples of scientific discoveries from all over the world. Our History of Science examples, used throughout this book, are provided to demonstrate this diversity of discovery. See Box 1.5, which provides a summary of how multiple scientists were involved in the development of an understanding of germs and the cause of disease. In addition, Chapter 10 includes a list of Web resources for information on women and minority scientists.

BOX 1.5

History of Science

Microbes or Miasmas?

Dutch lens maker Antoni van Leeuwenhoek (1632–1723), playing with a newly invented microscope, scraped some plaque off his own teeth and looked at it through a microscope. To his horror, he observed tiny organisms or "wee animalcules," invisible to the naked eye.

About two centuries later, knowledge of this invisible universe led Hungarian Ignaz Semmelweis (1818–1865) to reconsider the causes of diseases. In 1840, Semmelweis theorized that doctors and medical students were killing large numbers of new mothers by working with festering wounds in surgery (or worse, cadavers) and then immediately assisting with births without even washing their hands. He conducted an experiment to demonstrate that childbed fever could be prevented by making doctors wash their hands between patients.

The theory that diseases are caused by invisible microorganisms, rather than by "miasmas" (poisonous vapors mistakenly believed to cause disease), spontaneous generation, or supernatural causes, is the foundation of modern medicine and public health, and a major contributor to the welfare of people all over the world. Other scientists also built upon van Leeuwenhoek's work. Frenchman Louis Pasteur (1822–1895) proved that spoilage and disease occurred only by contamination or infection (1860s). Joseph Lister, an Englishman (1827–1912), developed aseptic surgery. In the 1870s, Robert Koch (1843–1910) proposed his Postulates, which are still used to demonstrate the connection between a specific microbe and a specific disease. Koch, a German Nobel Prize winner, is also famous for isolating *Bacillus anthracis* (1877), the *tuberculosis bacillus* (1882), and the *cholera vibrio* (1883).

Final note: Semmelweis's theory was initially dismissed by the medical community and he spent his final years in a mental institution.

For more information on Semmelweis and his colleagues, consider the following resources:

- **Childbed Fever: A Nineteenth-Century Mystery:** www.sciencecases.org/childbed_fever/childbed_fever.asp. The context, steps, and results of Semmelweis's experiment are detailed in this case study provided by the National Center for Case Study Teaching in Science at the University of Buffalo (State University of New York).
- **What are Koch's Postulates?** www.cps-scp.ca/kochpostulates.htm. This site of the Canadian Phytopathological Society reviews Koch's Postulates as the scientific method for proving that a particular organism was the cause of a plant disease.

INVOLVE PARENTS AND FAMILIES

You have many different avenues for inviting your students' parents into your classroom. They are a wonderful resource, and the more you include them, the more effective you will be as a teacher. Parents and family members will understand your purposes and situation more clearly when they visit; they are more likely to listen and support you if you encounter difficulties with their children; and they will contribute their expertise to your classroom.

You can ask for parent volunteers to either work with you in the classroom and with individual students and/or assist you with clerical work and special events. With large classes in particular,

having additional adults in the classroom will offer supplementary supervision. Talk with your department chair and colleagues to investigate how other teachers involve parents. If you want to have parents help in your classroom, think carefully about their roles and their interactions with students. This would be a great topic to discuss at a classroom meeting with your students, too.

Another way to involve parents and family members is to invite them to discuss their professions, hobbies, special interests, collections, and personal life experiences as they relate to your curriculum. Send home a survey at the beginning of the school year with specific topics and issues to solicit potential speakers. You may discover that your students' parents have much to share on topics relevant to your standards.

> *I had a parent come speak to my classes. He was passionate about astronomy. He set up his personal telescopes that allowed my students to look at the sun and see its spots.*
>
> *—Seventh-grade science teacher*

Your school will sponsor all kinds of special events that you can relate to science, such as holiday festivals, unit culminations, science fair competitions, science Olympiad events, career days, and so forth. You will want to invite parents and family members to be in the audience and to participate in many different capacities. You might need help with handing out programs, decorations, sales, judging, scorekeeping, and/or prizes. These are ideal opportunities to connect with parents, strengthen relationships with students, and extend your classroom. We provide you with more ideas and guidance in Chapter 11.

Also, we recommend that you look at *Secrets to Success for Beginning Elementary School Teachers* (Kottler & Gallavan, 2007) or *Secrets for Secondary School Teachers: How to Succeed in Your First Year* (Kottler et al., 2004) for specific suggestions on organizing your room and creating communities of learners.

BEGIN EACH DAY ANEW

Be ready for each class and greet students with a smile every day. This means having all of your teaching materials arranged in advance so you are free to welcome students into your room. Find

a spot where you will stand and welcome students as they enter the classroom. This may be the same spot where you stand after you close the learning as you dismiss the students. Following these routines will let your students know you are approachable and help you stay organized.

Include a moment at the beginning of each class for everyone to get settled. This is the perfect time for you to discuss some current events and help your students take a breath to focus on science before you launch into your agenda. The more you can model and reinforce a positive and productive manner, the more your students will participate and achieve.

ESTABLISH A SENSE OF PLACE . . .

You've dreamed of this day, and now it is here. You want this classroom to be an inviting, exciting, and rewarding space where everyone engages in and contributes to the learning experience. You want to engage students in the game of scientific discovery, with the entire universe as the playing field. The secret is creating a safe and welcoming sense of place. Help the students feel comfortable around you and with science. When students walk in the door, they will experience immediately that this is a science classroom. Now you are ready to think about your curriculum.

Suggested Activities

1. Design your ideal classroom. Consider placement and movement, investigations and experiments, information and displays, resources and references, materials and supplies, presentations and demonstrations, and equipment and storage.

2. Develop one display—preferably interactive—that will attract your students' attention and motivate their interests in a selected science topic or issue.

3. Brainstorm and share ways to connect science concepts to the contemporary world of your students throughout the week. These may include pictures of students' activities and articles of interest to them.

4. On a bulletin board, feature a small group of scientists each week. Include a photo and their accomplishments.