

PART



Activities to Promote Place-Based Science Teaching in the School Building

As we move through the chapters in the second section of this book, we gradually trace larger concentric circles of activity as our sense of place moves outward from the classroom and into the community. While students will continue to spend most of their time in the classroom, one of the goals of place-based science teaching and learning is to look for ways to get students to both move and think beyond the classroom walls. The school building outside the classroom door presents the next context in which place-based science teaching and learning can be practiced. The school building includes places, such as the cafeteria, the gym, the library, and the auditorium, among others, where students engage in a range of academic, social, athletic, and community activities. Indeed, the school building provides multiple opportunities for helping students learn to form communities and to make choices about how to live their lives. In this chapter we focus on the many ways to enhance place-based learning within these school settings that are outside the classroom but inside the school.

Activity

9 Student Nutrition and Eating Habits at School

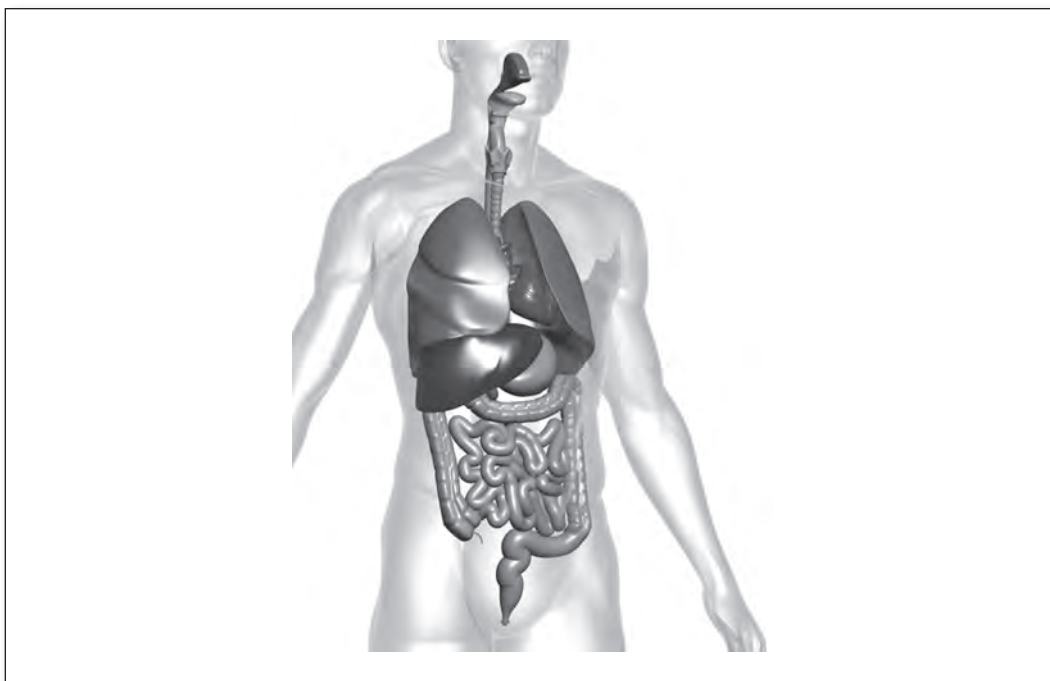
SCIENCE BACKGROUND

All students learn about the digestive system as part of their study of human biology. The following is a sample of what might typically be taught in a standards-based classroom:

We learn that we get the energy we need to function from the food we eat. The digestive system is made of the organs that break down food into smaller parts called nutrients. The digestive organs work together to turn food into energy, so our bodies can work and grow. We learn that the digestive system contains many structures and organs. Each has a special job. Parts of the digestive system include:

- Teeth and tongue—break down food into smaller pieces that you can swallow
- Esophagus or food pipe—the tube that carries your food into your stomach using a wave-like motion caused by smooth muscles
- Stomach—a J-shaped bag that works like a mixer, using smooth muscles to grind and crush the food into smaller and smaller pieces as they are bathed in acid
- Small intestine—a very long, narrow tube that breaks down the food mixture even more; food is digested here and then all the nutrients are absorbed into the blood
- Other important digestive organs such as the liver—send different liquids to the first part of the small intestine; these organs help to digest food and absorb nutrients
- Large intestine—a fatter, shorter tube than the small intestine; it absorbs water back into the blood; all that is left are the waste materials that leave the body

How does this type of learning connect with students in a meaningful way? Do students see any value in this knowledge? For many, if not most students, the answer to this question would be no. They are likely to learn this information for a test and then promptly forget it. Taking a place-based perspective can refocus a topic such as the digestive system in ways that can make science learning meaningful to many more students. Students typically learn all this information (and often much more) about the biology of eating in science class with only a minimal study of the importance of nutrition for life-long health. While problems with youth nutrition and childhood obesity have received attention in the popular press, little is actually being done in most schools to improve either students' nutrition education or their nutritional options. Nearly a quarter of elementary grade students in the United States are now considered to be overweight or obese, compared to about 15% of students two decades ago and less than



Human digestive system

10% of students four decades ago. What has caused this dramatic change? Nutritionists agree that the combination of a decrease in youth physical activity and changes in our diet are the two most significant factors.

CULTURAL CONNECTIONS

In 2004, Congress passed the Child Nutrition and WIC Reauthorization Act, which included a law requiring local education agencies to develop policies that address the growing problem of childhood obesity. These policies need to include nutrition education goals, physical activity goals, and nutrition standards for all foods available at school. Six years after this law was passed, however, most schools continue to offer a wide range of high-fat food choices as well as school day access to a range of low-nutrition snack foods and sugary beverages.

Considering the choices available and the choices that students make when it comes to eating at school can provide a fascinating and socially valuable opportunity for practicing place-based science learning that can serve to make the study of science topics such as the digestive system more personally meaningful for students.

ASSESSING NUTRITION AT SCHOOL

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

- Paper and pencil
- Student-designed surveys



School lunch

WHAT YOU WILL DO

Before the Trip

Learn background material on the human digestive system. What happens to the food we eat?

Conduct background research on school nutrition programs in the United States. When did they start? How did they evolve? What are the current guidelines?

Break class into small groups and let each group select one of the following nutrition-related topics: school lunches, lunches brought from home, snacks available, vending machines, breakfast (at home or at school).

Each group should construct a survey or interview that can be used to gather data about its topic around

the school. Questions can be designed to be asked of other students and/or of adults that are involved in the food purchase, preparation, and decision making for the school. For example, questions that the group studying school lunches could ask the cafeteria manager could include the following:

- What meals are served here at school?
- How much variety is there in the school meals?
- Have efforts been made to reduce the fat content of the foods prepared? How?
- Are there a la carte choices that are appealing and low in fat? What?
- What efforts have been made to encourage students to make healthy food and beverage choices?
- Is corn syrup found in many of the foods served?
- Is low-fat and skim milk available with every meal?
- Is soda available to students during lunchtime?
- Do students have enough time to eat their meals without rushing?
- Do you or other members of the food service staff ever collaborate with teachers to educate students about nutrition? How?
- Do you have opportunities for your own professional development to help you improve the food services you provide?

Student groups should come up with their own interview or survey questions depending on their topic and who they are interviewing or surveying (i.e., students or adults).

If the group is conducting a survey, it should decide how many people it would like to survey and make enough copies of the survey.

If the group is conducting an interview, it should decide how many people it will interview and how it will record the participants' answers (i.e., take notes, use an audio recorder or a video recorder). It should also determine how it can summarize the results.

On the Trip

The interviews or surveys can be conducted at lunch, before school, or after school, or groups can be allowed to make plans to conduct the interviews during class time.

When conducting the interviews, make sure that the participants understand the questions and that you understand their answers. Repeat or clarify as needed.

When you are done, ask participants if they have any questions for you. Use this as an opportunity to share some of what you have been learning about nutrition in schools.

Back in the Classroom

Groups should examine their data. They should consider the following questions:

- Are there patterns in the participants' responses?
- What kinds of nutritional choices are available in your school and what choices are students making? Why?

Create a way to share your data with other people beyond your class so that they can better understand the state of nutrition in your school. Consider making colorful posters or other visuals that show graphs of the data about the nutrition choices that are available and the nutrition choices that are being made.

Make a class commitment both to make healthier nutrition choices and to encourage the school to provide more healthy and appealing meal and snack options.

THINKING LIKE A SCIENTIST—CAUSE AND EFFECT

Some scientists worry that the eating habits that people form as children have a strong influence on what those people eat as adults. The eating habits of people in the United States have changed a great deal over the last few decades. What have been the effects of these changes? Do you think these changes are taking place in other countries as well? Explore this website, <http://www.schoolfoodpolicy.com/> (then search for Country Watch), or others that you find, to consider the following questions:

- How are the school lunch options typical in other countries similar to or different from the options in the United States?
- How are the school day snack options typical in other countries similar to or different from the options in the United States?
- Which country's foods would you rather eat in school? Why?
- What are the causes of these changing food options, both in the United States and in other countries?
- If the United States does not change its school nutrition policies, what do you think the long-term effects will be?

SAMPLE GRADE-LEVEL MODIFICATION—EARLY ELEMENTARY

Younger students can still conduct school nutrition interviews or surveys with modifications. Instead of a survey with written answers, they can construct a survey that uses check boxes of what is available in the cafeteria. For an interview, invite subjects into the classroom and videotape the interviews, then watch the tape with the students, pausing it to ask relevant questions about the subject's responses.

SAMPLE INTERDISCIPLINARY CONNECTION—SOCIAL STUDIES

Studying traditional foods of other countries is a typical part of international social studies, but when this is done, connections are rarely made to the science of nutrition. Learn to think about traditional foods in other countries not just as an interesting part of their culture but also as a part of their health and well-being. What do we know about the diets of people in countries with the highest life expectancies? Compare things like the amount of fats and processed sugars in these diets.

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about diet and nutrition would include doctors or nurses, nutritionists, cafeteria workers, or other food industry workers. Invite one or more of these individuals to your class to ask them questions about nutrition and to share what you have learned.

Correlation With National Standards

NSES Science: C1; F1

NCTM Math: E3

NCTE Language Arts: 7; 11; 12

NCSS Social Studies: 1; 5

Study of Student Exercise Habits

Activity

10

SCIENCE BACKGROUND

In the previous activity on school nutrition, we mentioned the relationship between nutrition and exercise. Just as students often learn about the digestive system in science class without making connections to the importance of nutrition, students likewise learn about the respiratory and circulatory systems without making connections to the importance of regular exercise for our long-term health and well-being. While there has been more of an emphasis on the importance of exercise in our schools than on the importance of good nutrition, there is still not enough done in most schools to promote physical fitness. For example, the trend to remove recess from elementary schools in order to increase academic instruction has occurred in many states in response to increased high-stakes testing and accountability. This combination of increased stress and decreased physical activity may well result in negative health consequences for students both in the short term and in the long term.

As with student nutrition, a place-based emphasis on teaching and learning about exercise and physical fitness can serve to connect academic learning with meaningful social action. In this activity, you will begin by surveying students and adults in your school about the exercise they get—how much, how often, and what kinds. Then you will develop a model exercise program to help meet the needs of people in your school (again, both students and adults) who are not finding ways to get sufficient exercise. Third, you will create a school advertising campaign to encourage people to participate in your program. Then, in the following activity, you will create the opportunity for people to participate in your program for a month and help them to monitor their fitness levels.

CULTURAL CONNECTIONS

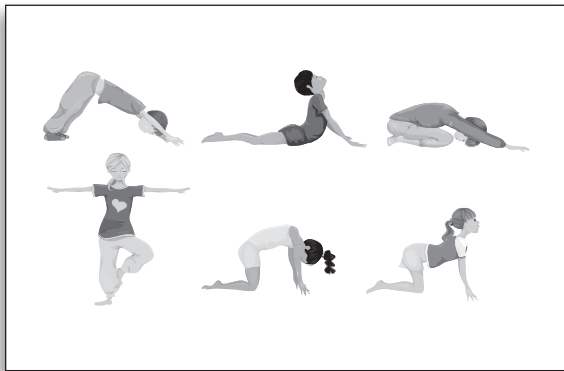
Exercise is not always about doing jumping jacks and push-ups. Many cultures have developed other types of exercise involving meditation and martial arts.

One of these exercise styles that has gained increased popularity in the West is the Chinese tradition of Tai Chi. Tai Chi literally translates as “boundless fist.” It involves three primary elements: health, meditation, and martial arts. Have students explore how Tai Chi works as a total system as well as a type of exercise. Have them compare it with related types of meditation and exercise such as yoga.

DEVELOPING A SCHOOL EXERCISE PROGRAM

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

- Paper and pencil
- Student designed surveys



Students exercising

WHAT YOU WILL DO

Before the Trip

As a class, design a short survey about people’s exercise habits that students and adults in your school can take. The following sample questions can get you started. Some questions may have a numerical response, such as:

I typically exercise for at least 30 minutes how many times in an average week?

Some questions could be short fill-in-the-blank, such as:

The top 3 most common ways I get exercise are: 1. _____ 2. _____ 3. _____.

Most questions should use a Likert scale for responses, such as Almost Always, Frequently, Sometimes, Occasionally, and Almost Never, or Strongly Agree, Agree, Unsure, Disagree, Strongly Disagree, such as:

I approach exercise as something fun and relaxing:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
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I vary the types of exercise I get to include activities that build endurance, strength, and flexibility:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
It makes me feel good to exercise:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
When I exercise, I tend to overdo it, and then I feel pain afterward:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
I am satisfied with the amount and types of exercise that I do:	<ol style="list-style-type: none"> 1. Strongly agree 2. Agree 3. Unsure 4. Disagree 5. Strongly disagree
I wish that I exercised more than I do:	<ol style="list-style-type: none"> 1. Strongly agree 2. Agree 3. Unsure 4. Disagree 5. Strongly disagree
I prefer to exercise alone:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
I prefer to exercise with other people but in noncompetitive ways:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
I prefer to exercise through sports or in other competitive ways:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
When I exercise, it makes me also want to eat a healthier diet:	<ol style="list-style-type: none"> 1. Strongly agree 2. Agree 3. Unsure 4. Disagree 5. Strongly disagree

(Continued)

(Continued)

I have trouble finding the time to exercise:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
I have trouble getting motivated to exercise:	<ol style="list-style-type: none"> 1. Almost always 2. Frequently 3. Sometimes 4. Occasionally 5. Almost never
I would exercise more if I had a fun and convenient opportunity:	<ol style="list-style-type: none"> 1. Strongly agree 2. Agree 3. Unsure 4. Disagree 5. Strongly disagree

Come up with other survey questions of your own, but keep the total number of questions under 20 so it does not take people too much time to fill out the survey.

Once you have designed your survey, decide who you would like to give it to. All the students and teachers in your grade? Younger or older students? All the adults in your school? Make copies and plan a time to administer the survey. Physical education class might be a good time to give the survey to students. Before or after school might be the best time to give it to teachers and other adults.

On the Trip

Take your survey directly to people and ask them if they will fill it out while you are there. If you leave it for them to fill out later, you will get a much lower response rate.

Tell them that you will be using the results of the survey to design a school fitness program that people can participate in voluntarily.

Encourage people to be honest in their responses since the survey will help to guide the design of the program.

Back in the Classroom

Look at your survey responses and compile the data. What patterns do you see in the responses? How do the people you surveyed feel about exercise? What are they currently doing? Would they like to exercise more? What kinds of exercise do they prefer?

Design an exercise and fitness program that builds on what you learned from your exercise survey. Here are some guidelines to consider when developing your program:

A balanced exercise program should include opportunities for exercise focusing on endurance (cardio training), strength (weight or resistance training), and flexibility (stretching). Knowing how to balance these different types of exercise can be confusing. Does the order matter? Should you do more than one type of exercise on the same day? Should you do cardio and strength training on the same day? Which one should you do first? This depends on your goals and how much time you have to exercise. The

most important thing is to start slowly and allow for some recovery days in between exercise days.

Starting a program that meets for about 45 minutes 3 days a week is probably ideal. A typical program would begin with 5 to 10 minutes stretching followed by 30 minutes of some sort of cardiovascular training and ending with another 5 to 10 minutes of stretching or light resistance training. The details of exactly what to do are up to you to decide.

Once you have developed your exercise program, the next step is to get people to participate. It's time to do some advertising. Create posters with information about the program. Go on the morning announcements and make an announcement about the program. Send information home in the school newsletter and put it on the school website or listserv. Talk about it with your friends. See how many people, including students and adults, you can get to commit to participating in the program for one month.

THINKING LIKE A SCIENTIST—HYPOTHESIS AND EVIDENCE

Many people are likely to say that they know they do not get as much exercise as they should. What is your hypothesis about why people don't get more exercise? Use your survey questions to gather evidence about what people in your school say about the amount of exercise they get. Were the reasons you hypothesized common in the survey responses? Did people give reasons you did not think of? Were there differences between students' answers and adults' answers? Explain.

How can you use the survey responses to design an exercise program that meets the exercise needs of the people you surveyed? How are the activities that you planned in your program similar to and different from what you are doing in physical education class in school? Which do you think is more appealing? Why?

SAMPLE GRADE-LEVEL MODIFICATION—MIDDLE SCHOOL

Some middle school students have already decided that exercise is “not for them.” Sometimes this is for social reasons such as that they do not want to be associated with the “jocks” in school. Spend some time talking with middle schoolers about the psychological and sociological side of exercise and how it relates to perceptions of identity. Brainstorm ways that adolescents can still get exercise without having to change the way they are perceived by their peers.

SAMPLE INTERDISCIPLINARY CONNECTION—MATHEMATICS

Compiling and analyzing the data from a survey provides many opportunities for applying math skills. How should you total your data? What kinds of averages could you use and what would they tell you? Compare the mean, median, and mode of survey responses and interpret the differences between these three types of averages. What is the clearest way to express your findings? What sorts of charts or graphs could you construct? Would different types of graphs highlight different things in the data? Explain.

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about exercise programs and their benefits would include doctors or nurses, personal trainers, fitness

center workers, and your gym teacher, among others. Invite one or more of these individuals to your class to ask them questions about exercise and to share what you learned from your survey.

Correlation With National Standards

NSES Science: A1; C3; F1

NCTM Math: B1; E1; E2

NCTE Language Arts: 7; 11

NCSS Social Studies: 4

Activity

11

Study of Fitness Levels

SCIENCE BACKGROUND

On average, the U.S. population is getting older, more obese, and more sedentary. It has long been known that it becomes harder and harder for people to stay fit as they grow older. Endurance, strength, and flexibility all decrease as we age. Additionally, low fitness levels increase our risk of many diseases and eventually interfere with our ability to function and live independently. All of these changes are natural and, to some degree, unavoidable. There are many things we can do, however, to both slow and reduce the effects of this gradual physical decline. For example, maintaining a healthy body mass index (BMI), not smoking, and being physically active can all lead to higher life-long fitness levels.

It's very important, however, not to wait until you are an adult to begin addressing these fitness issues. While it is possible for a person who has not been physically fit to change his or her fitness practices later in life, it is both easier and more effective to develop healthy fitness practices when you are younger and maintain them throughout life. Additionally, there are benefits that come from physical fitness as a youth. For example, a recent study of the nearly 2 million students in Texas schools found that students who scored high on the state cardiovascular fitness test were more likely to do better academically, to have better school attendance, and to have fewer disciplinary referrals than students who scored low on the fitness test. In other words, there are both short-term and long-term benefits to starting a fitness program as a young person and then sticking with it.

In the previous activity, you developed a model fitness program based on information you gained from a survey of students and teachers in your school. Then you created an advertising campaign to encourage participation. In this activity you will help to run a fitness program in your school for a month and help students and teachers track their participation and their fitness levels.

CULTURAL CONNECTIONS

Exercise can provide not only physical benefits but mental benefits as well. The German philosopher Friedrich Nietzsche, for example, said that “All truly great thoughts are conceived by walking.” Explore with students the different aspects of exercise and its importance for physical and psychological well-being by discussing quotes on fitness and exercise found on the Internet (use the search terms “exercise quotes” and “fitness

quotes”). For example, A. A. Milne wrote, in reference to his creation Winnie the Pooh, that “A bear, however hard he tries, grows tubby without exercise.”

EXERCISE AND FITNESS LEVELS

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

Materials depend on the type of fitness program designed—they could include exercise mats, jump ropes, resistance bands, hand weights, yoga balls, and other inexpensive exercise equipment. The following items are particularly useful:

- Stopwatch
- Meter stick
- Blood pressure monitor (optional)
- Fitness charts
- Attendance sheet



Exercising for improved fitness

WHAT YOU WILL DO

Before the Trip

Prepare the materials you will need for each fitness session. This will include any exercise equipment as well as any tools needed to monitor and record fitness level and an attendance sheet (be sure to have everyone sign in during each session using the attendance sheet).

On the Trip

During the first session of the fitness program, participants should do the following three tests to get an initial fitness measure in each of the three basic forms of exercise: *flexibility* (stretching), *endurance* (cardiovascular), and *strength* (lifting). Be sure to have everyone record their

results so that they can compare these to their results at the end of the fitness program.

Flexibility Test

- Place a meter stick on the floor. Secure it by placing a piece of tape across the meter stick at the midpoint (the 50-centimeter mark).
- While sitting, place the soles of your feet even with the 50-centimeter mark on the meter stick.
- Ask a helper to place his or her hands on top of your knees to anchor them.

- Reach forward as far as you can, holding the position for 2 seconds.
- Note the distance you reached compared to the 50-centimeter mark. This could be a negative number if you cannot reach as far as the 50-centimeter mark or a positive number if you reach beyond the 50-centimeter mark.
- Repeat the test two more times.
- Record the best of the three reaches.

Endurance Test

To assess your aerobic fitness, take a brisk 1-mile walk. You can do the walk anywhere—on a track, around the school grounds, or even in the school building. Before and after the walk, check and record your pulse in your notebook or journal.

To check your pulse over your carotid artery, place your index and third fingers on your neck to the side of your windpipe. To check your pulse at your wrist, place two fingers between the bone and the tendon over your radial artery—which is located on the thumb side of your wrist. When you feel your pulse, look at your watch and count the number of beats in 10 seconds. Multiply this number by 6 to get your estimated heart rate per minute.

After you've recorded your pulse, note the time on your watch and walk 1 mile. After you complete the walk, check your watch and record the time it took you to finish. Then check and record your pulse once more.

Strength Test

Push-ups can help you measure muscular strength. If you're just starting a fitness program, do modified push-ups on your knees. If you're already fit, do classic push-ups. For both types:

- Lie facedown on the floor with your elbows bent and your palms next to your shoulders.
- Keeping your back straight, push up with your arms until your arms are extended.
- Lower your body until your chest touches the floor.
- Push your body upward, returning to the starting position.

Count each time you return to the starting position as one push-up. Do as many push-ups as you can until you need to stop for rest. Record the number of push-ups you complete in your notebook or journal.

After the initial fitness testing session, all subsequent sessions should begin with stretching for at least 5 to 10 minutes. The following site is one good resource for basic flexibility training. There are many others available online as well.

<http://www.sport-fitness-advisor.com/flexibility-exercises.html>

After stretching, the majority of your session's remaining time should be dedicated to cardiovascular training. This can take many forms and can be as simple as taking a brisk walk or jog, doing laps around the school for at least 20 minutes. Other possible types of cardio training that you could use in your fitness program could include cycling—either stationary (“spinning”) or riding around the neighborhood—swimming, or sports that are cardio intensive, such as basketball or soccer. What you do should depend on participant interest, materials available, and the fitness level of the participants.

To avoid injuries, don't try to do too much too fast—work up to higher levels of fitness.

Depending on participants' fitness levels, follow the cardio training with some strength training or alternate between cardio training during one session and strength training during the following session. For strength training, you can use hand weights, resistance bands, or even just simple strength exercises such as push-ups and sit-ups.

The following site is one good resource for basic strength training. There are many others as well.

<http://exercise.about.com/cs/exbeginners//blbegstrength.htm>

Try to hold your fitness sessions three times a week for a month. During the last session, repeat the same three fitness tests that you did during the first session. Have participants record and compare their results to their results from the first session. Did everyone's fitness improve?

Back in the Classroom

Use the data from the beginning and ending fitness tests to draw conclusions about the effectiveness of the fitness program you developed. Look for patterns. Did participants show more growth in one of the three fitness areas than in the others? Did participants who attended more regularly show more growth than people who missed some sessions? Did kids or adults show more growth? Any differences between males and females? What other patterns can you find?

Prepare more posters to share the results of your fitness program and post them around the school. Share your success with the school in other ways such as on the morning announcements, web page, newsletter, and so forth.

Ask the participants if they wish to continue the fitness program for another month (maybe even all year). Keep at it and watch as everyone's fitness level improves!

THINKING LIKE A SCIENTIST—CAUSE AND EFFECT

In many areas of science, pre- and posttests are used to measure the effect of some action or event. If there is a difference between the pre- and posttest results, the events that took place between the two tests can probably be assumed to have caused the difference. In the case of the fitness tests that you gave at the beginning and the end of your exercise program, what can you conclude about the effects of your program on the participants?

What factors do you think influenced people's decisions about whether or not to stick with the program?

Based on what you learned, what are some things we could do in this country to support people in improving their fitness levels?

How is your fitness program an example of place-based learning?

SAMPLE GRADE-LEVEL MODIFICATION—EARLY ELEMENTARY

Students are never too young to learn about healthy exercise practices. Younger students will need more guidance to both develop and test out their fitness program. Additionally, young children must be especially careful with strength training exercises—it is

better to focus on stretching and aerobic fitness. With the proper supervision and guidance, this activity, like nearly all of the place-based activities in this book, can be done in meaningful and rewarding ways with young children.

SAMPLE INTERDISCIPLINARY CONNECTION—LANGUAGE ARTS

The results of this activity lend themselves very well to a mock science convention poster session. Have small groups of students create a poster describing their project and showing their results. Hold an interactive poster session where students from other classes, parents, and family members or other members of the community come to learn about the fitness project. After the interactive session, the posters can be put on display somewhere in the school. Be sure that students use their best language arts skills as they create their posters.

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about exercise programs and their benefits would include doctors or nurses, personal trainers, fitness center workers, and your gym teacher, among others. Invite one or more of these individuals to your class to ask them questions about exercise and to share what you learned as a result of implementing your exercise program.

Correlation With National Standards

NSES Science: A1; F1

NCTM Math: B4; E2

NCTE Language Arts: 6; 7

NCSS Social Studies: 4

Activity

12 Water Fountain Water Versus Bottled Water

SCIENCE BACKGROUND

Drinking bottled water has become increasingly popular in recent years in many countries. Why do you think this is? Most people who drink bottled water say that the number one reason is that it's convenient. Many people also believe that bottled water is cleaner or purer and that it tastes better than tap water from the sink or water fountain. Much of this perception is a result of advertising that emphasizes the idea that bottled water comes from crystal-clear mountain springs or the run-off of pure glacial water. Commercials and magazine ads for bottled water emphasize the "exotic" origins of this water and also imply that drinking this bottled water is a sign of high class and good taste. Some brands of bottled water now come in designer bottles that are often prominently displayed in fancy restaurants and gourmet food stores.

Research by groups such as the Natural Resources Defense Council (<http://www.nrdc.org/>), however, suggests that the bottled water sold in the United States is not necessarily purer or safer than most tap water. In a 4-year study, the NRDC tested more than 1,000 bottles of 103 different bottled water brands. They concluded that there was no significant difference between the content of municipal tap water and bottled drinking water.

In the following activity, students will research the question of whether bottled water actually tastes better than the water from the water fountains in their school. The class will set up a water taste challenge and have other students and adults in your school sample different bottled waters and water from water fountains in the school to determine which tastes the best.

CULTURAL CONNECTIONS

Water has many uses besides just for drinking and washing. It can also be used to create music. Have students line up eight glasses of the same size and then fill them up with different amounts of water. The first glass should be $\frac{1}{8}$ of the way full and then each successive glass should be filled with an additional $\frac{1}{8}$ of the height of the glass ($\frac{1}{8}$,

2/8, 3/8, 4/8, 5/8, 6/8, 7/8, 8/8). Each glass when struck with a spoon will sound like one of the notes on the music scale (do, re, mi, fa, sol, la, ti, do). With a little bit of tuning by the addition or subtraction of water from each glass, students should be able to play simple tunes by striking the top of each glass with a spoon.

DOES BOTTLED WATER TASTE BETTER?

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

- Bottles of water collected from the school water fountains
- Several bottles of three different brands of bottled water (amount will depend on how many participants you plan on having)
- Small paper cups (four for each person participating in the test)
- Copies of water sample rating sheet

WHAT YOU WILL DO

Before the Trip

Have students find maps of the water resources in their community. Have them find out where the water comes from that they use in their home or in their school. This information can probably be obtained from the local water management district's website.

Next, consider these questions about bottled water: How does the bottling of water use valuable resources? Does the use of bottled water potentially contribute to the polluting of our environment? In what ways?

Do the following to prepare for the water taste test:

1. Announce to your school that you will be conducting a water taste test and determine when and where you will conduct the test and who you are asking to participate. You may choose to tell people that they will be comparing bottled water to water fountain water or you can choose to keep that a secret so as not to bias the participants.
2. You can make posters to advertise the event, time, and place.
3. Get your water samples together. Be sure to only get the water from the water fountain(s) just before the taste test because water that has been sitting around for a few hours or more will start to get a stale taste and will make for an unfair comparison. Also try to ensure that all the water samples are at about the same temperature because different temperatures can also bias the taste results. Most people can distinguish taste differences best if the water is cool but not cold.



Bottled water

4. Remove or totally cover the labels on each bottle and, using a permanent marker, number the bottles from 1–4.
5. Prepare a water sample rating sheet that participants can use to record the order of their taste preferences and any descriptions of the taste or smell of the samples (i.e., metallic, chlorine, and so on). Make copies of the rating sheet.

On the Trip

1. Travel around the school to get a range of participants.
2. Give each participant four numbered paper cups with a small sample (1–2 ounces) from each bottle.
3. Ask participants to taste each sample and then use the water sample rating sheet to rank order their preferences from 1–4 and make any notes they wish about the taste or smell of any of the samples. Try to get 100 participants if you can.

Back in the Classroom

Tally the results and then construct a bar graph based on participants' preferences. How do the commercially bottled water samples compare with the tap water samples? Were there strong preferences? If so, can you form a hypothesis about why?

Have students create a presentation to explain their findings. This could take the form of a poster, a slide show presentation, a video, or any other format that you decide upon. Share your presentation with other people in the school.

THINKING LIKE A SCIENTIST—CONTROLLING VARIABLES

When performing a taste test of any kind, one of the most important things to think about is how to make the test as fair as possible. Creating a fair test is largely a question of controlling variables. If you want the tasters to only taste a difference based on the differences in the minerals or other chemicals in the water, then what other potential variables do you need to be sure to control? We have already mentioned temperature—can you think of others?

Have students research the production of one or more of the following commercially bottled waters and determine how far each bottle has to travel to be sold in a store in your neighborhood.

- Aqua Fiji, bottled in the remote highlands of the Pacific Fiji Islands
- Arrowhead Mountain Spring Water, bottled on the slopes of the San Bernardino Mountains in California
- Hawaiian Spring Water, bottled on the slopes of Mauna Loa Volcano in Hawaii
- Virga Pure Tasmanian Water, bottled water from the island of Tasmania, Australia

Have students describe the resources consumed in delivering the water, starting with plastic for the bottle, the gasoline to fuel the transportation for shipping the water, the “carbon footprint” of the product, and so forth.

SAMPLE GRADE-LEVEL MODIFICATION—UPPER ELEMENTARY

Upper-elementary-grade students should be able to plan and organize a water taste test with only limited organizational help from the teacher. While teachers want to be helpful, by fourth or fifth grade, the students should be able to carry out this project mostly under their own leadership. The more opportunities we give our students to take on project leadership, the better they will get at it and the more easily they will learn to accept that responsibility.

SAMPLE INTERDISCIPLINARY CONNECTION—SOCIAL STUDIES

As mentioned above, the more expensive bottled waters get their appeal from the exotic locations they come from. Use maps to locate the origins of these bottled waters, calculate the distance from the place of origin to where you live, and explore how the bottles of water are transported to distant markets. Discuss the economic benefits and the costs of this practice. Who wins economically and who loses? Do you think these practices are sustainable over the next few decades? Why or why not?

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about water purification and bottled water would include water treatment plant employees, bottled beverage industry employees, health professionals, environmentalists, and chemical engineers. Invite one or more of these individuals to your class to ask them questions about water and to share what you have learned.

Correlation With National Standards

NSES Science: F1; F2; F4

NCTM Math: E1; E2

NCTE Language Arts: 7; 8; 12

NCSS Social Studies: 1; 3; 6

Activity

13

How Physical Space Is Used in Schools

SCIENCE BACKGROUND

The great British politician Winston Churchill (1874–1965) once wrote, “We shape our buildings and afterwards, our buildings shape us.” Very few of us spend much time thinking about school buildings and how they shape us, but their impact on us is undeniable. School buildings often span several generations. In many parts of the country, it is common to go to a school that is 50 years old and often possible to attend one that is more than 100 years old.

Think about how most schools are designed. They incorporate many of the same features—many that have to do with control and regulation of both students and teachers. For example, think about the window that is included in most classrooms either in the main door or along the side of the door. The window is not of much use to see out from the classroom but is instead intended for seeing in. If you are sitting still in the classroom, the window in or at the door only allows you to see out to one fixed point. If you are walking in the hallway, however, you can scan the entire classroom from one end to the other—something a principal might find very useful. As another example, desks do not encourage sharing or collaboration. In many schools until the last generation, desks were actually bolted to the floor. This meant that only one type of instruction could go on, one that focused on the teacher at the front of the classroom.

CULTURAL CONNECTIONS

Think for a moment about the cafeteria. What types of exchanges does it encourage students to participate in? Are there cliques that meet together and control the space? What would happen if people were randomly assigned to eat at a specific table each week? What if food were served family style from the kitchen to the tables, as it’s done in some private schools, rather than by having students move through a line? What if food were brought to the classrooms on carts and then served to each other by the students as it’s done in Japan? Would the social dynamics of lunch change significantly?

Think about other spaces in the school. How is the library used? Hallways and commons areas? Have students discuss how changing the design of their school could improve the ways in which people interact and engage with each other.

DESIGN A SCHOOL**MATERIALS YOU WILL NEED FOR THIS ACTIVITY**

- Paper
- Pencils and pens
- A computer with a printer connected to the Internet

WHAT YOU WILL DO**Before the Trip**

Students will be divided into groups of three. They will be given the task of designing an ideal school. You might begin with a walking tour of the school and a discussion of why things might have been designed the way they were.

Students should then use the physical location of their own school but imagine that they are starting the design process from scratch. What types of things would they include to make the school function in the best ways possible for learning? Emphasize that they should not be silly—no shopping malls in the middle of the school—but that they should be trying to create what would be real school improvements for their community.

Groups should draw a blueprint or map of their proposed school and write descriptions of the various parts and their uses.

During the Trip

Once students have outlines of their proposed schools, take another walk around the actual school and compare what exists to what the different student groups have designed. Discuss the pros and cons of different models.

Back in the Classroom

Give students a chance to modify their designs based on their experience on the walking trip and then organize a charette. A charette is a type of a collaborative review process that architects use when they build a building. Designs are presented and discussed with the actual potential users of the building that is being designed. Other students, teachers, and/or school administrators should be invited to participate.

Have each of the groups briefly present its design ideas for a new school. Conduct a discussion that guides them to combine the best ideas that they have developed. Have students redesign their schools based on the discussion that took place during the charette. Students can post their proposed designs as part of a bulletin board display in the classroom or in the hall or take this activity even further and present one or more of the designs at a PTO meeting or school board meeting to see if any aspects of the design can get support for actual implementation.



Architecture

THINKING LIKE A SCIENTIST—CAUSE AND EFFECT

Does the learning environment actually have an effect on how well people learn? Have students design a series of experiments to consider this question. Experiment with different types of distractions (loud music, lots of talking, etc.) as well as with different ways to help students feel comfortable (add a sofa or some comfy chairs to the classroom, add some lamps instead of the fluorescent lights, etc.). What can students conclude from these experiments? How does this relate to other types of school redesign?

Have students think about how the school could be made safer, more energy efficient, and a more pleasant place to live and learn in. Have them see if there are ways that traffic patterns for student drop-off and pick-up, as well as pedestrian traffic in the hallways, could be improved. Could easier recycling opportunities be built into the design of the school? The possibilities are almost endless.

SAMPLE GRADE-LEVEL MODIFICATION—EARLY ELEMENTARY

For students in the younger grades, it will probably be best for the class to agree upon just one or two areas of the school they would like to design improvements for and then have all the groups work on those areas so that they can more easily share and compare their ideas.

SAMPLE INTERDISCIPLINARY CONNECTION—MATHEMATICS

Design work such as architecture requires a lot more mathematics than most people think. For starters, it requires a lot of work with scale to be sure that things will fit correctly. As students work on their designs and models, make sure that they always think about and record their units of measure and the scale that they are using (i.e., 1 centimeter = 1 meter, etc.). Have groups check each other to be sure that the scales being used are realistic.

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about topics related to school redesign would include architects, physical plant engineers, electricians, and custodians. Invite one or more of these individuals to your class to ask them questions about building design and to share what you have learned.

Correlation With National Standards

NSES Science: E1; E2; F5

NCTE Language Arts: 4; 7

NCSS Social Studies: 1; 5

Conducting a School Energy Audit

Activity

14

SCIENCE BACKGROUND

Doing a school energy audit provides students with an important means of learning to take responsibility for the energy that they consume while they are at school. In doing so, students not only learn basic ideas about energy but also develop energy conservation habits that will be useful throughout their lives.

Schools with effective energy conservation programs have been shown to save as much as 25% of their utility budgets per year. The most effective conservation programs are those that involve everyone in the school, including the students, staff, teachers, and administrators.

Many of the improvements that are possible by doing an energy audit are extremely simple to translate into action. For example, replacing incandescent light bulbs with energy-efficient compact fluorescent (CFL) light bulbs can save 80% of the energy used to produce an equally bright light. In other words, one cent of energy consumption with a CFL produces the same amount of light as five cents of energy consumption with an incandescent bulb.

Numerous websites are available to help students conduct an energy audit of their school. The National Energy Development Program (<http://www.need.org/>), for example, has a wide range of resources available at its site, including lists of student projects, as well as guidelines for developing a school energy audit. Another good site with similar types of information is the Alliance to Save Energy (<http://ase.org/topics/education>). Using these or other resources, have your class conduct a school energy audit.

CULTURAL CONNECTIONS

Have students consider what life would be like without electricity. When would their day begin and end? What would they do that would be different? Have them conduct an experiment where they use no electricity for a defined period of time (an hour, a half day, etc.). Discuss with them what would be lost and what might be gained.

CONDUCTING A SCHOOL ENERGY AUDIT

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

- A computer connected to the Internet with a printer
- Paper and pencil
- A thermometer



Electric meter

WHAT YOU WILL DO

Before the Trip

Discuss with students what an audit is and some of the different kinds of audits that are possible. Discuss what an energy audit of the school would look like and what its goals would be.

Divide the class into groups that will focus on different types of energy-consuming devices such as computers, lights, and electrical appliances.

Using the questions below as a guide, have each group create a data collection form that it can use to collect data on school energy usage for its category of energy usage.

Lighting

- Are lights turned off when people are out of the room?
- Are more lights on in a room than are necessary for the task being done?
- Are there incandescent lights on that can be replaced with more energy-efficient CFLs?

Heating and Cooling

- Can air conditioners be turned down or heat lowered in most rooms? Most people are comfortable in rooms that are only heated to 68 degrees or cooled by air conditioning to 78 degrees. Have students take measures of the temperature of the classrooms throughout their building.
- Determine whether there are leaks in heating or ventilating systems, as well as doors and windows that leak or don't close properly.
- Are programmable thermostats in use—particularly for rooms like the cafeteria, which may not be used all day?
- Determine whether hallways are being kept cooler than classrooms in the heating season or warmer during air-conditioning weather. Doing so will keep energy costs down by not losing energy to the outside.
- See if air conditioner and furnace filters are being cleaned regularly.
- Find places where the addition or replacement of weather stripping, caulking, or insulation will help keep energy use down.

Computers

- Determine whether power management features on computers are being used.
- Determine whether computer equipment is being shut off at the end of the day.
- Determine what equipment is high-efficiency Energy Star equipment (computers, monitors, printers, fax machines, copiers, etc.) and what is not.

During the Trip

Using the data collection form that each group has constructed, go out in teams and conduct an energy audit of the school. It's a good idea for groups to do their audit over the course of several different days to look for patterns in behavior and usage. What you see on one particular day might not be typical.

Back in the Classroom

Teams should find different ways to represent the data they have collected. This could include various forms of tables or graphs.

Teams should then analyze the data and design a plan that improves energy conservation for their energy usage category in their school. Challenge them to identify 10 specific actions that they can take and/or encourage others to take to reduce energy usage.

Students can create posters and signs to remind students and teachers in their school to be more energy efficient.

Once these new practices have been attempted for a few weeks, repeat the energy audit to determine whether significant energy savings are being achieved compared to the initial audit.

THINKING LIKE A SCIENTIST—CAUSE AND EFFECT

Can simple energy conservation practices cause actual financial savings for the school? How much? Is it actually worth making those changes or are the savings so small that it isn't really worth the effort? This energy audit, combined with cost information that your class should be able to get from your school district, will help you to answer these questions. When you conduct your initial energy audit, ask the school district for the electrical bill information for your school. After your campaign to save energy in your school has been going on for several months, repeat the audit and get the new billing information. Remember that if the season has changed, uses like heating or air conditioning may have changed as well. How can you take this into account?

Discuss with students why it is difficult to change human behavior. Why, for example, is it a problem getting people to switch from using incandescent lights to using CFLs when it is clear that they can save money? Have students consider whether rational behavior always drives people in their actions. Discuss ways that people can be encouraged to change their behavior.

SAMPLE GRADE-LEVEL MODIFICATION—UPPER ELEMENTARY

Elementary school students rarely have the opportunity to present their ideas to adults in authentic settings where they will be taken seriously. With some coaching and

practice, however, upper-elementary-age students can be prepared to do this. Once your class has compiled the findings from your school energy audit, see if you can get on the agenda for a school faculty meeting and have students share their findings and recommendations for increased energy efficiency with the adults in the school.

SAMPLE INTERDISCIPLINARY CONNECTION—SOCIAL STUDIES

While there are obviously many possible mathematics connections in this activity as well, the social studies connections are quite interesting. Some countries have been much quicker to embrace energy-reduction programs than others. Within countries, some regions and some populations have likewise been quicker than others. For example, in the United States, we currently have about 5% of the world's population, but we account for about 22% of the total world energy usage. How can this be explained? What, if anything, might cause us to begin to change these practices?

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about energy efficiency include electricians, architects, builders, engineers, and environmental conservation consultants. Invite one or more of these individuals to your class to ask them questions about energy efficiency and to share what you have learned.

Correlation With National Standards

NSES Science: B3; E2; F5

NCTM Math: D2; E1; E2

NCTE Language Arts: 4; 8

NCSS Social Studies: 8; 9; 10

Water Drops and Water Loss

Activity 15

SCIENCE BACKGROUND

A drop is a small volume of liquid that falls into free or open space. Drops are very interesting in terms of studying patterns. Drops tend to be round like soap bubbles—this is because they are a minimal surface—essentially taking the most energy-efficient form possible. Liquid drips are periodic, meaning that they tend to drip at regular intervals. Dripping water has been used to create highly accurate clocks and timers—much the same way that sand can be used to record the passage of time in an hourglass.

Dripping water can be interesting to study, but it is usually not a good thing. Running toilets and dripping faucets waste large amounts of water in homes and schools. A worthwhile place-based activity for students is to determine how much water is actually lost from a dripping faucet or a leaking toilet over the course of a year.

CULTURAL CONNECTIONS

The average person in the United States uses about 180 gallons of water a day for cooking, washing, bathing, and drinking. Have students consider what it would be like if they had to go to a well or a river (as do the majority of people in the world) and carry all of the water that they use in a day back to their home. Take gallon containers full of water out to the ball field and ask students to take turns carrying the containers back and forth across the field until they have simulated the equivalent of carrying 180 gallons. After the simulation, ask students how they think their water use would change if water were not so readily available.

WATER DROPS AND WATER LOSS

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

- Paper and pencil
- A faucet in an easily accessible public space (a classroom, kitchen, or bathroom)

- A watch with a second hand
- A graduated cylinder or beaker



Drop of water

WHAT YOU WILL DO

Before the Trip

Discuss a drop of water. Ask students to describe a water drop. What does it look like? What does it sound like? How much water is in a drop? Is it always the same amount? Why or why not? You might have students look for other images of water drops in magazines or on the web.

On the Trip

Find a sink in the school and open the tap slightly so that the water drips out very slowly.

Place a graduated cylinder or beaker underneath the drip and time how long it takes to accumulate 100 ml.

Using the time it took to accumulate 100 ml of water from the dripping faucet, calculate how much water would be wasted by a dripping faucet in a day. In a month. In a year.

Walk around the school and have students count how many faucets there are in the school. How many of them are dripping? If they are left this way, how much total water will be wasted in the school in a year?

Now, look at the toilets in the school. Check to see if the toilets say how many gallons or liters of water are used per flush. The typical traditional toilet uses 3.5 gallons (or 13 liters) per flush. Newer, more efficient toilets use either 1.6 gallons (6 liters) or 1.4 gallons (4 liters) per flush.

Walk around the school again and count the number of toilets. If the typical toilet in the school is flushed a dozen times per day (this could be low or high depending on the number of students and bathrooms in the school), how much water is used each day for a traditional toilet? For a high-efficiency toilet?

How much water would be saved each day by switching from traditional to more efficient toilets? In a 180-day school year?

Back in the Classroom

Have students create a Saving Water Campaign for the school. Think about the number of faucets and toilets you counted in the school. How could you make a dramatic point about how much water is being wasted?

Create posters that can go in each bathroom in the school that say how much water can be saved if everyone pays a little more attention to conservation efforts.

THINKING LIKE A SCIENTIST—HYPOTHESIS AND EVIDENCE

What is your hypothesis about why so many people waste water without thinking too much about it? Is it because water is cheap? Because it is perceived in this country as being a nearly unlimited resource? What kinds of evidence do you predict would be most effective at getting people to change their practices? Economic evidence? Social evidence? Using your posters, try to determine what kind of evidence is most compelling? Does it matter who your audience is (kids or adults, etc.)?

How could you take what you learned from studying how water is wasted in your school and spread this message around the larger community?

How could you convince businesses, offices, and others in your community to replace their traditional toilets with low-flow models and to repair leaking sinks?

How could you convince people to make these changes in their homes?

SAMPLE GRADE-LEVEL MODIFICATION—MIDDLE SCHOOL

Extend the activity by connecting it with Activity 6—Distance Learning—and compare your findings about water usage in your school with findings from other schools in different parts of the country or the world. Look for patterns that might influence how people relate to water usage. Does geography matter? Economics? History? What can you conclude?

SAMPLE INTERDISCIPLINARY CONNECTION—LANGUAGE ARTS

Creating a poster campaign for saving water in your school provides students with an authentic reason to practice their persuasive writing. Come up with slogans and other short but persuasive statements that could be put on your posters to make readers think about how much water they waste and why it may be important to conserve water now to prevent serious water shortages in the future.

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about water conservation could include plumbers, engineers, city employees who work at the waterworks or other water-related facilities, geologists, and other environmental scientists. Invite one or more of these individuals to your class to ask them questions about water conservation and to share what you have learned.

Correlation With National Standards

NSES Science: C4; F2

NCTM Math: A3; B1; D2

NCTE Language Arts: 4; 5; 12

NCSS Social Studies: 7; 10

Activity

16

Science Performances

SCIENCE BACKGROUND

There was a time in our history before the Internet, DVDs, TV, or even radio—and it was only a few generations ago. While it may be hard for today’s media-saturated students to comprehend, people had to find other ways to get information until relatively recently in human history. When it comes to learning about science, one of these ways was to go see science lectures and demonstrations in the theater. These science presentations were partly educational and partly entertainment.

For example, the famous British chemist Michael Faraday gave a series of children’s Christmas lectures at the Royal Institution of London beginning in 1860 in which he performed demonstrations with burning candles and other simple household materials to teach basic chemical principles. These 19th-century science performances later became the foundation for 20th-century science TV programs such as *Mr. Wizard* (Don Herbert) and more recently *Bill Nye the Science Guy*.

Even more recently, there have been efforts to recreate the genre of live science performances in a theater setting, but with the addition of 21st-century special effects. For example, in 2002, Professor Richard Wiseman of the University of Hertfordshire and Dr. Simon Singh created and performed the Theatre of Science at the Soho Theatre in London. The show was a mix of science demonstration, probability theory, and comedy. This performance was so popular that they created a second show in 2006 with a larger budget and more impressive special effects, including the generation of 6-foot-long bolts of lightning between two specially constructed transformer coils.

We don’t recommend that you create giant lightning bolts in your school, but you can create and perform science theater. In the following activity, you will design an assembly for other students in your school in which you will present information based on one of the other place-based projects or activities that your class has done. The presentation should take the form of a dramatic performance. You should consider concluding the performance by making a proposal to the audience for a school-based project to address some aspect of a community challenge related to the information you presented.

CULTURAL CONNECTIONS

There are many great poems in literature that have science as their subject. An example is the following brief poem by Emily Dickinson (1830–1886):

“Faith” is a fine invention
When gentlemen can see—
But microscopes are prudent
In an Emergency.

Have students go online and search for interesting science poems by typing into their search engine “science and poetry” or “science poems.” Have them write their own poems on a science topic of interest to them.

PERFORMING PLACE-BASED SCIENCE IN THE AUDITORIUM

MATERIALS YOU WILL NEED FOR THIS ACTIVITY

- Materials will depend on the project you are addressing in your performance, but you should think about materials that will help you make your presentation engaging and visually interesting for your audience

WHAT YOU WILL DO

Before the Performance

Review the various place-based activities that you have done as a class. Discuss which activities you found the most engaging, which ones had the most interesting results, and which topics you would like to see gain more attention in your school. As a class, agree on one topic to be the focus of your science performance.

Prepare a performance about your topic that aims to be both educational and entertaining. You may wish to talk to the theater, band, and or chorus teacher to get some tips about how to put on a good performance. Build any props, create costumes, and gather materials. Watch the excerpt below from Wiseman and Singh’s Theatre of Science performance for a bit of inspiration:

<http://www.psy.herts.ac.uk/wiseman/images/ToS.mov>

Schedule your performance. Talk with the school administration to pick a time when you can perform in the school auditorium.

Advertise your performance. Make an interesting poster and put it up around the school. Talk to other teachers and classes and invite them to the performance.

Do a dress rehearsal. If possible, practice your performance on the stage in the auditorium so that you get a sense of the spacing of things on the stage, where setting and props should go, and so forth.



Student performance

During the Performance

Present your performance to other members of the school community. You may also consider doing an evening performance for family and community members.

Conclude the presentation with a proposal for a school-wide initiative for addressing some community challenge related to the information you presented. Try to get a commitment from your audience to help with this project.

Back in the Classroom

Discuss the performance and the response that you got from your audience.

What went as expected and what did not?

If you did a second performance, what would you do differently?

Make a plan for going around to groups who made up your audience for a follow-up conversation about the school or community project.

THINKING LIKE A SCIENTIST

You've been practicing three ways of thinking like a scientist—coordinating theory and evidence, controlling variables, and using cause-and-effect reasoning. As you developed your place-based science performance, did you find yourself building any of these three methods into your presentation? Are there ways that you could make these ways of thinking like a scientist more explicit for your audience? How? Was thinking scientifically part of the message you were trying to convey to your audience?

How was a live performance different from a TV show or a webcast?

Was it easier to engage the audience? To get them to agree to participate in the follow-up project? Why or why not?

Do you think live science performances could make a comeback as a way to teach about important science issues? Think about Al Gore's presentation of *An Inconvenient Truth* as one example. What are the strengths and limitations of performances of this kind?

SAMPLE GRADE-LEVEL MODIFICATION—EARLY ELEMENTARY

Younger children (and some older children too) may be intimidated about performing on the stage. They may also have trouble projecting their voices to be heard in a large space. It can be best to start by taking your presentation to other classrooms and starting on a smaller scale. As the students gain confidence and skill, they may decide that they would like to try a performance in a larger space and with a larger audience.

SAMPLE INTERDISCIPLINARY CONNECTION—LANGUAGE ARTS

Learning public speaking skills is an important part of language arts. While not everyone enjoys participating in theatrical performances, learning to speak clearly, to project one's voice loudly, and to learn the lines and actions that go with giving a live performance are important skills that are useful in many settings. Learning these skills from a young age can reduce anxiety about public speaking later in life.

SCIENTISTS IN YOUR COMMUNITY

Individuals in your community who might be knowledgeable about creating a science performance could include local theater performers, drama teachers, science teachers, and local TV personalities, among others. Invite one or more of these individuals to your class to share your presentation with them and to ask them about their own experiences with theater performance.

Correlation With National Standards

NSES Science: F5

NCTE Language Arts: 4; 12

NCSS Social Studies: 8; 10