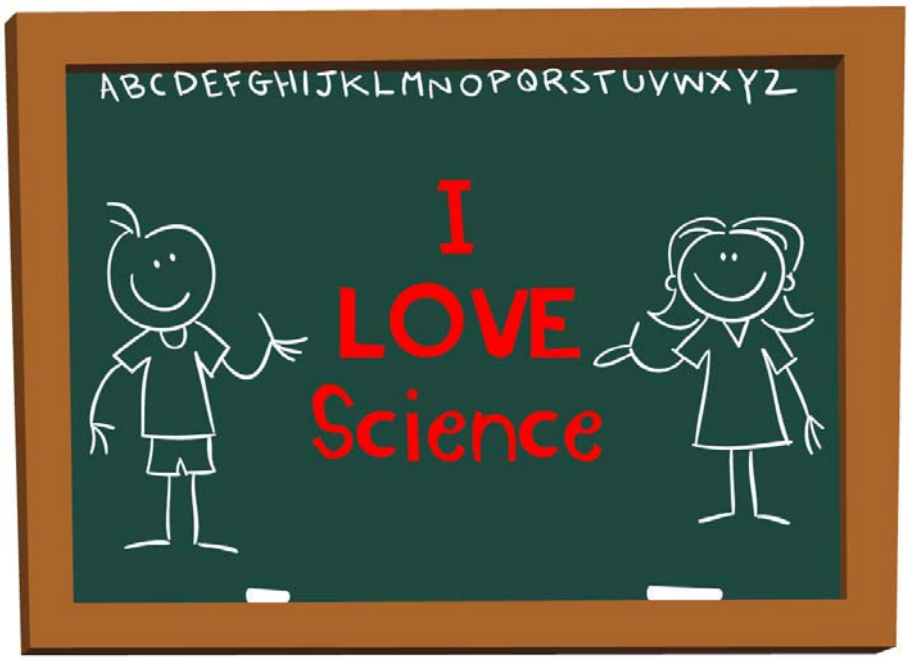

I LOVE Science

Hands-On Science Volunteer Guide

http://www.ihmc.us/community/ILOVEScience

Portions adapted from *Sharing Science With Children,* North Carolina Museum of Life and Science

The Task

We face a challenge. Our children need to learn about rapidly changing science and technology. Already, many of your colleagues, along with educators, parents, and local, state, and national organizations, have joined together to meet the challenge. They support science education by allocating resources, building community support, and providing tools and materials for teachers.

You can help. One of the best tools any teacher can have is a person who knows and understands science and technology - a person like you. By sharing science in the classroom, you can help students...

- understand the positive and vital role of science, mathematics, and technology in today's world,
- gain an understanding of the work scientists do,
- see scientists as real people,
- lay the foundation for careers in science and technology, and
- grow in their enjoyment of the world around them.

By working directly with students, you will be able to make valuable contributions

- modeling scientific inquiry
- sharing your passion for science
- connecting science and technology to the "real" world
- augmenting the science background of the teacher and students
- helping end the stereotype of scientists as "nerds"
- help teachers and students feel comfortable saying "I don't know"
- help teachers recognize good questions
- model how scientific questioning has different goals than the usual questions asked in the classroom
- introduce students to new technologies
- promote inquiry skills and understandings
- promote scientific literacy and an inclination to life-long learning
- help develop a more diverse workforce

In the science classroom what this comes down to is that scientists can help support reflective and critical debriefing of hands-on activities and encourage students to ask and discuss questions that begin with "How?" "Why?" and "What if?"

In addition, in working with students inside and outside the classroom, scientists put a personal face on science and help students see why one would choose to do science or to become scientifically literate. They help debunk stereotypes of who scientists are, what they look like, and what they do in their professional and personal lives. Scientists can be personal as well as intellectual role models for students. Scientists can help students understand how they got to where they are, including how they personally faced and met difficult challenges and even seemingly insurmountable obstacles.

Just a few hours of your time can make a big difference. Teachers are eager to invite you into their classrooms and to help you work with their students. This guide provides suggestions to smooth your transition from lab or office to the classroom.

You and your colleagues are doers ... doers can teach - by example, by working to expand science education in all levels of the educational system, and by sharing with teachers and students in the classroom.

Survival Tips for Your Classroom Visit

GET READY!

Before you go into the classroom...

- **Decide on your approach.**

Will you stick to the chosen activity as presented? Do you have other materials relevant to the topic or have ideas for expanding the activity? Think of how you might relate this activity to your life.

- **Prepare your activity based on children's needs and abilities.**

Review the relevant chapters in the text book. Note some of the vocabulary covered in this topic. *"Typical Science and Technology Topics"* on page 6 will give you a general understanding of what students typically learn at different grades. Review also the "Thinking and Learning Characteristics" (page 6).

- **Be prepared for student reactions and behavior.**

Keep in mind that teachers and parents may have concerns about how sensitive issues, such as evolution or reproduction, are presented to their children. If you have questions about appropriate ways to present your subject, discuss your plans with the teacher.

- **Know when and where you will be visiting.**

Verify the time, place, and length of the visit. Be sure to get phone numbers for the teacher and the school. If you don't know where the school and classroom are, ask for directions.

- **Look for additional resources.**

Local science centers, museums libraries, your colleagues, and other sources may be able to provide hands-on teaching materials, films, live animals, activity kits, and other materials to use. Colleagues or your professional society be able to give you good ideas for experiments and things to do. If you have children, ask them what they would like to know about what you do.

GET SET!

- **Assemble your notes and materials in advance.**

If each student is to have a handout or materials, make sure you have enough of each. See that materials are organized. Do a test run of experiments, games, or any other activities you plan to do.

- **Prepare to use terminology that is appropriate for the students.**

If there are a number of words or concepts students would benefit by knowing in advance, give them to the teacher and (s)he can help students learn them.

- **Allow yourself enough time to get to the school and to find the classroom.**

GO!

- **Share yourself.**

Let the children know you are a real person with a family, pets, and hobbies. Talk about how you got to be a chemist, an anthropologist, an engineer.... Was there a special event or person in your life - a teacher, a learning experience, a book, a visit to a museum - that aroused your interest in your field'? What was your favorite hands-on activity when you were a kid? What is your educational background, how did you get to be where you are? What do you do on an average day? What is interesting or unique about your work?

- **Involve the students in doing.**

Bring an attention grabber if you can. Keep in mind that your goal is to arouse curiosity, excitement, and eagerness to know more. The tools of your profession may be commonplace to you, but they are mysterious, unknown, even fascinating to most of the students (and teachers) you meet. When possible, let students handle models, equipment, samples, plants, prisms, stethoscopes, rocks, or fossils.

- **Involve students in the process of science.**

Do a simple experiment in which the students participate. The process skills of science – observing, identifying, classifying, measuring- are the skills that enable students to apply science to everyday problems**.**

- **Stimulate thinking by asking questions. Start with What? Move to Why?**

Questions that ask students to make a prediction, to give an explanation, to state an opinion, or to draw a conclusion are especially valuable. Be sure to allow time for each student to THINK before anyone gives answers.

- **Use language the students will understand.**

Be conscious of vocabulary. Try not to use a difficult word when a simple one will do. Define words students may not know. For example, don't say, "I am a cytologist" and begin a lecture on semipermeable cell walls. Rather, ask students if they know what a cell is and then tell them you study cells, how they are built, and how they act, and, that you are called a cytologist.

- **Make what you are talking about real to the students,**

Show the students that the area of science or technology you work with everyday is part of their everyday lives, too. How has what you and your colleagues have learned up to this time changed how we do things or understand things? How will what you do make the students' lives better or different in the future? How does what you do and know relate to what they are learning in school?

- **Prepare the students for the unexpected, if appropriate.**

Unexpected loud noises, bright lights, unusual odors, graphic photographs, and similar experiences that evoke strong emotion or fright can disturb some children. It may be wise to warn students that a surprise or something unusual is coming even when evoking a degree of surprise is one part of your goal.

- **Teach vocabulary on demand.**

We all remember copying the glossary to define our assigned science vocabulary words. Instead, as ideas come up during the activity, give them a name and write it on the board.

- **Ask for an evaluation of your efforts.**

Ask the students what they liked (and didn't like) about your visit. Ask the teacher to critique your presentation and help you improve your in-class skills.

Schedule your next visit!

TEACHING TIPS

Make eye contact with the students *because they love the personal contact.*

Smile and feel comfortable telling amusing anecdotes *because kids love a good laugh.*

Organize all materials in advance *because kids sometimes have a hard time waiting.*

Use student volunteers to help you set up and distribute materials, samples, pictures, and handouts *because kids love to feel important.*

Require that students raise their hands to participate *because they will probably all want to talk at once.*

Don't be afraid to say "I don't know" *because that is often the right answer to a question.*

Call on many different members of the class b*ecause everyone wants to be involved.*

Model behaviors, including safety, that you wish students to follow *because kids learn by following role models.*

Give specific directions when distributing specimens *because kids sometimes disagree about who has been holding an object the longest.*

Use a prearranged signal to get students' attention during activities *because it is too hard to give good directions unless students are quiet.*

Stop and, wait for students to let you continue speaking if they get noisy *because they have probably heard the "cold silence" before and know that it means they need to be less noisy.*

Ask the teacher for help with discipline *because she/he will know exactly what to do.*

Wait to give handouts to students until it is time to read or use them *because if the students have the handouts while you are speaking they will be distracted.*

Encourage student participation and help them rethink the facts if they give an incorrect answer *because kids are sensitive and easily discouraged; they are eager to please and want to come up with the correct answer.*

Wait several seconds before calling on students to answer a question *because the whole class needs time to think about the question before someone answers it.*

Praise attentive or helpful behavior *because this is the behavior you want to encourage.*

Enjoy the students, their enthusiasm, and their sense of wonder *because they have a fascinating perspective on the world!*

Connect the activity to everyday experiences, even those considered not science *because you want to increase students' curiosity about the world around them.*

Be flexible and look for the unexpected *because you don't know what might happen.*

Practice and assemble all of your materials in advance *so you can go in ready to teach.*

Arrive early *so you have time to set up.*

Provide opportunities for the students to work alone and in groups *so they can have a variety of research experiences.*

Maintain high standards and high expectations for all participants *because students will try to meet what is expected of them.*

THINKING AND LEARNING CHARACTERISTICS OF YOUNG PEOPLE

Late Elementary (3-5)

As a thinker...

- Although still somewhat tied to seeing in order to believe, begins to understand concepts as well as objects.
- Understands hierarchical classification systems.
- Can combine, sort, multiply, substitute, divide.
- Begins to generalize, formulate hypotheses, use systematic problem-solving strategies.
- Likes to memorize, to learn facts.

As a learner...

- Understands rules and can follow them.
- Likes group activities and excursions.
- Is a great socializer and eager to fit in.
- Considers fairness to be important.
- Takes initiative and is self motivated.
- Is becoming an independent learner.
- Is a perfectionist who will practice the same thing over and over again.
- Avoids opposite sex.
- Can sit still and listen 20-30 minutes (variety increases attention span).

Middle Grades (6-8)

As a thinker...

- Can hypothesize, create propositions, and evaluate.
- Can conceptualize in the abstract and understand probability.
- Begins to understand multiple causation.

As a learner...

- Is emotional, restive, and eager to get moving.
- Is easily bored. Challenges rules, routines, and authority.
- Is beginning to have an interest in the opposite sex.
- Is typically more oriented to small group activity.
- Has a vulnerable ego, is very self-conscious and concerned about how he/she is perceived by others.
- Can handle 30-40 minute sessions.

SCIENCE PROCESS SKILLS

These are the steps of the "scientific method" kids are learning in class. Try to encourage the kids to think scientifically and follow these steps in your activity.

Introduce the kids to the topic through demonstrations. As you do each demonstration, ask the kids to **make observations**.

Next, pose the **question** they will address during the activity. Have the teams **make predictions**. Then have them **test their ideas** and **record the data**. What do they observe happening? How do their predictions **compare** to their results? (Note: Remind kids that it's okay if their predictions do not match the final results. When you make a prediction, you explain what you think will happen in advance based on current evidence or past experience. A prediction may turn out to be false, but you'll still learn information that helps guide the next steps in an investigation.)

Have them **repeat the test**. Discuss why they need to repeat the test. (They'll find that they won't get the same answer each time for a variety of reasons.) Since each test will produce a slightly different result, have them average their results.

Kids can further experiment by changing one thing and testing what happens. The thing they change is called the **variable**.

Whatever they choose, it's important that they **change only one variable at a time** and keep all the others the same. That way they can tell how each variable affects the test. Then have them **predict** what they think will happen based on what they learned from earlier tests. Finally, have them **test** it and **record** results.

During the "Wrap It Up" section of the activity, have kids **draw conclusions** and **share results**. Why did they make certain changes? What happened when they tested these changes? How did their predictions compare to their results? If they could test it one more time, what might they do differently?

After the class completes the activity, lead a group discussion about the science process skills they used. Briefly review these skills—**observe, ask questions, make predictions, test ideas, collect data, change one variable, and share results**. Then ask students to identify how they used these science process skills during the activity. For example, when were they making observations? When were there opportunities to make predictions? How did they use what they learned from each test to ask new questions and make new predictions? What variables did they test? What other variables could they have tested? What other ideas do they have about the activity?

I LOVE Science Program

Why teach science?

- part of human culture
- experiences for developing language, logic, problem-solving skills
- democracy demands citizens make decisions about issues which have scientific underpinnings
- create future scientists

Program Goals:

- Improve students' science learning
- Increase students' enthusiasm for science
- Provide scientific role models for students
- Increase the frequency of hands on instruction in the classroom
- Give teacher partners greater confidence to lead hands on activities themselves

How Volunteer Can Help Reach Goals:

- Allow "controlled chaos"
- Challenge the students to find or solve questions and problems
- Help students use their own experience to make sense of the scientific facts they are learning
- Help students understand why they are learning science
- Show students the myriad ways science education is used in the real world, even by non-scientists
- Provide novelty (new face, new style) to reinforce science lessons

How Program Works:

- Volunteer is partnered directly with teacher(s)
- Volunteer and teacher set date for activity, choose which activity volunteer will present
- Materials for main and alternate activities delivered to school in advance of month (though not materials for additional demos provided on website)
- Volunteer reviews materials, tries activity at home, preps for presentation
- Volunteer arrives at school, checks in, goes to classroom
- After activity, materials are returned to the kit for pick-up or use by another classroom

Inquiry science

Inquiry-oriented teaching engages students in investigations to satisfy curiosities, with curiosities being satisfied when individuals have constructed mental frameworks that adequately explain their experiences. One implication is that inquiry-oriented teaching begins or at least involves stimulating curiosity or provoking wonder. There is no authentic investigation or meaningful learning if there is no inquiring mind seeking an answer, solution, explanation, or decision. Where students operate with more autonomy, they are encouraged to channel their own interests and enthusiasms into the work.

Typical activity structure:

- Start with an open-ended question or demonstration (as opposed to beginning a lesson with definitions and explanations).
- Gather responses and subsequent questions from students with little comment or direction.
- Require students to collaborate on designing experiments or methods of inquiry.
- Student teams conduct experiments or gather data.
- If time allows, re-evaluate question based on new data and re-experiment or collect new data based on revised question.
- Students present findings.

It is important to let students explore and try to figure the experiment out on their own. This is hard to do because we all want them to feel success very quickly. Resist the temptation to give them a quick answer. Instead, try using probing questions which encourage participants to explore further:

- What will happen if...?
- How does it work?
- How did you do that?
- How do we know?
- What is the evidence?
- Why do you think that happened?
- Why do you think that will happen?
- What do you notice about … ?
- What do you think will happen if you try … ?
- What do you think you should do next?
- How can you find out? Why not try it?

An important part of your job as an activity leader is to monitor the participants' *frustration* level. Suggest that participants who are having difficulty get help from participants who are having more success. Make sure that your last resort is to grab the materials and show them the right way to do it! This will ensure that your participants will end up with an experience that is all their own.

During class discussions, ask students to provide explanations of what happened and why they think it did. Initially, students may provide vague or general explanations. Encourage them to better articulate their thoughts by asking them 1) to be more specific by providing an example or 2) to explain the significance of their statement. Also use follow-up questions to redirect students. Follow-up questions may contain clues to steer students to a conclusion when they are having difficulty coming up with an answer.

Identifying Characteristics of Different Experiment Approaches

Worksheet	Challenge	Open-ended/Inquiry
Clear expectation of what you are supposed to do Feeling of safety Stick to task at hand Has a clear beginning and end Directions are easier Structure can be limiting Worksheets can be boring Not much enthusiasm for the task Not many questions	Competition is engaging for some, stressful for others Provides clear goal Opportunity for problem solving Opportunity for a variety of solutions Encourages people to solve problems they might not think they can Can promote team building Less sharing between groups because of competitiveness People feel like failures if they don't meet the challenge	Learner invents own path of investigation Learner has greater ownership of work Very engaging/ stimulates curiosity Opportunity to ask a lot of questions Learner can explore a variety of ideas Open-endedness can create anxiety for some people Outcome is not necessarily predetermined Requires active facilitation Choices can be overwhelming

Uses for Various Approaches

Worksheet	Challenge	Open-ended/Inquiry
To get to a vary particular conclusion or illustrate a particular fact To help students learn to follow a procedure To introduce them to the steps of a skill such as controlling variables	To get students to demonstrate the application of knowledge To get students engaged in problem solving	To introduce students to the process skill of raising questions To help students become acquainted with a variety of materials and phenomena at the beginning of a unit