SHARING SCIENCE WITH CHILDREN:

A Survival Guide for Scientists and Engineers

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.

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 to classroom.

You and your colleagues working in science and technology fields 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.

Now —

Get ready!

Get set!

Go!

GET READY!

Survival Tips for Your Classroom Visit

Before you go into the classroom...

- **Decide on your approach.**
  You may select some aspect of the curriculum. An alternative, more personalized, approach is to focus on what you do.

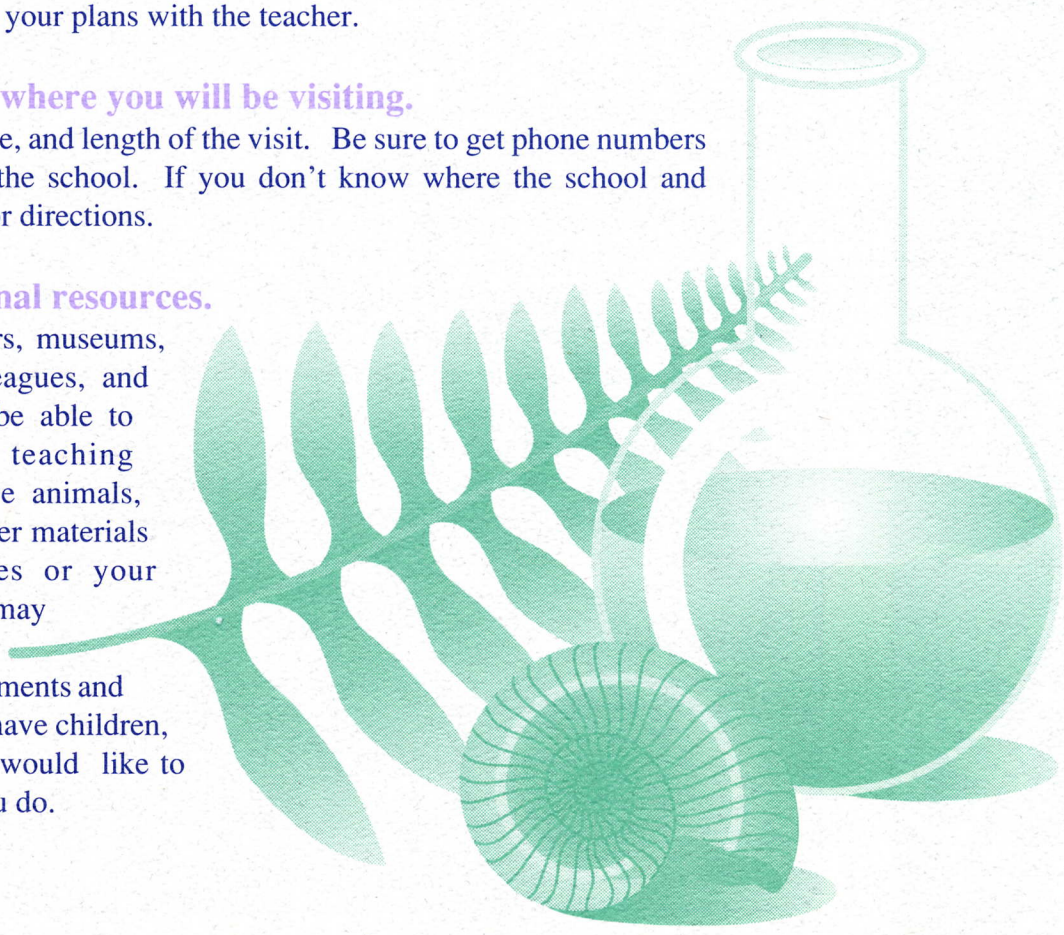
- **Prepare your activity based on children's needs and abilities.**
  Ask the teacher what students already know. *"Typical Science and Technology Topics"* on page 6 will give you a general understanding of what students typically learn at different grades. You can also check with the teacher about local curriculum and/or texts.

  Know the age of the class you are visiting and their *"Thinking and Learning Characteristics"* (page 7).

- **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 may 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, 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 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, 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.**
  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 every day 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.

- **Leave more than a memory behind you.**
  Help set up an experiment that students can continue after you leave. Hand out an assignment — find out how many birds live in the local area, gather samples of leaves from local trees, make a cardboard glider — for the students to complete on their own or with their families. Invite them to write to you with questions — and plan on answering those letters quickly!

- **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.

Call on many different members of the class because everyone wants to be involved.

Model good safety practices 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 (clapping, flipping light switch, etc.) 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.

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.

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.

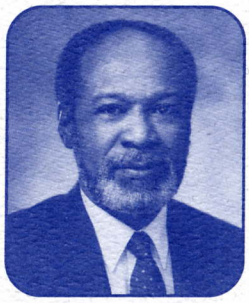
Enjoy the students, their enthusiasm, and their sense of wonder because they have a fascinating perspective on the world!

Typical Science and Technology Topics

	Kindergarten	First and Second	Third and Fourth	Fifth and Sixth
Animals 	Many kinds Have different coverings Eat different kinds of foods	Are alike and different Move and grow Different homes Different sounds Care of pets	Adaptations to the environment Defense mechanisms Helpful and harmful animals	Animal classification Selective breeding Interaction with the environment Balance of nature
Plants 	Many kinds Grow in different places Vegetables and fruits	Characteristics of plants Collecting parts of plants Seeds become plants Uses of plants	Classification of plants Effect of soil, water, air, and light on growth Conservation Prehistoric plants	Parts and functions Life processes Plant movements Adaptation
Weather 	Days can be sunny, cloudy, rainy, and snowy Four seasons	Air occupies space, has weight Atmosphere Air has pressure Wind is moving air	Effect of sun on earth Temperature and thermometers	Evaporation and condensation Precipitation Air masses Forecasting and instruments Factors affecting climate
Physical & Chemical Properties 	Things have colors, sizes, shapes Classifying objects Hot and cold Serial ordering	States of matter Different types of matter Dissolving Movement of things in air, water Sinking and floating	Expansion and contraction Heat Fuels Producing sound Music	Atoms Chemicals Mixtures and compounds Matter and energy Sources of energy Reflection/refraction Lenses
Electricity & Magnetism 		Sources of electricity Uses of electricity Safety	Magnets Simple compass Uses of magnets	Static electricity Nature of electricity Simple circuit Batteries Series and parallel circuits Safety
Earth & Space Science 	Moon Day and night Water Soil	Sun, moon, earth Stars Day and Night	Heat and light Seasons Day, night, year Tides and eclipses Solar system Gravity, inertia and orbit Comets, meteors and meteorites Space exploration	Ecology Pollution Recycling Constellations Space travel Flight Oceans Water cycle Properties of water

Message to all members of the scientific and engineering communities concerned about improving science education in the nation's schools:

I encourage practicing scientists and engineers to share personally some of their knowledge and experience with school children.



In September of 1989, President Bush convened the historic Education Summit with the Nation's Governors in Charlottesville, Virginia. The National Education goals developed following the Summit established targets for American educational achievement by the year 2000. The National Science Foundation and other Federal agencies, in partnership with the States, school districts, academic institutions, private industry and professional organizations, are generating the systemic reforms needed to realize these national goals as they apply to mathematics and science achievement for all students. Yet these reforms, which include improved curricula and better teacher preparation, cannot in themselves convey fully the excitement and dynamics of modern science. There is no substitute for personally meeting real scientists and engineers in the classroom and learning first-hand about what they do.

Many of you may have little formal teaching experience. Others who are teachers may never have taught at the grade school level. Some may question their ability to convey their knowledge and experience adequately to school age children. Yet each of you has a unique and important story to tell. This pamphlet provides reliable, time-tested guidance as to what to expect when you enter the classroom, how to support and complement the school curriculum, and how to make your visit a valuable, enriching experience for the students. You will find that it can be a deeply rewarding personal experience for you as well.

I urge each of you to contribute in this unique way to the enrichment of mathematics and science education in our schools. By doing so, you can help today's students to lead fuller and more productive lives in the future. You might also help to inspire and motivate the students who will become the next generation of professional scientists and engineers.

Luther S. Williams

Assistant Director for Education and Human Resources
National Science Foundation

Thinking and Learning Characteristics of Young People

Early Elementary (K-2)

As a thinker . . .

- Learns through manipulating objects.
- Believes what he or she sees.
- Can't trace steps back from a conclusion.
- Sees parts, not the whole.
- Does not understand that making physical changes in an object does not change its amount.

As a learner . . .

- Is expansive, adventurous, curious, eager to learn, energetic, always in motion, loud, and emotional — has mood swings.
- Wants to please adults.
- Has difficulty controlling impulses and regulating behavior.
- Is very "me" centered. Seeks attention. Loves praise.
- Likes to work in groups, but will need assistance.
- Can sit still and listen 10-15 minutes; needs frequent change of pace.

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.
- Developing understanding of ethical principles.

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.

COMMIT TO THE CHALLENGE

Learn about and support science related activities in your local community and those sponsored by state and national organizations. Here are some resources:

Each year the **National Science Foundation** (NSF) designates the last full week in April as National Science & Technology Week. NSF provides instructional kits with student activities, educational posters, and other materials. It encourages teachers, scientists, and others to participate through school activities, community projects, and public lectures. National Science & Technology Week will be celebrated in 1992 on April 26-May 2.

The **Association of Science-Technology Centers** and its member science museums promote experiences in science and technology for children, families, and the general public. Science centers and museums feature hands-on exhibits, science activities, and teacher training workshops and serve as educational resources to their communities. Contact your local science center to offer your support. ASTC can refer you to museum contacts in your state. Call (202) 783-7200 for assistance.

The **American Association for the Advancement of Science** (AAAS) sponsors activities through its Committee on the Public Understanding of Science and Technology including a project which encourages scientists to volunteer at science and technology centers and other places of science. Call (202) 326-6602.

Many professional societies lend support to local schools, museums, and other community institutions. Check with your national organization to find out what programs or materials are available.

Developed by the North Carolina Museum of Life and Science based on numerous publications, guidelines, and other sources drawn from all over the United States. Non-commercial duplication is encouraged. We want to know how you use this guide and any suggestions you have for improving it. Contact: Georgiana M. Searles, Director of Education, North Carolina Museum of Life and Science, P.O. Box 15190, Durham, North Carolina 27704.

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