FIGHTING SCIENCE ILLITERACY FROM THE PLANETARIUM

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"Science illiteracy" is becoming a serious problem in the United States. Part of the problem may be unfamiliarity with the process of the scientific method. Although this is most effectively handled in the classroom on a regular basis, there are ways for museum-based planetaria to help solve the problem. In 1988 the Lafayette Natural History Museum began an informal program of activities designed to help teachers and students with the scientific method.

Why the Scientific Method Is Important

While judging a middle school science fair a few years ago, I asked each of the 17 entrants whose projects I was judging if he or she had ever heard of the scientific method. Out of the 17, 15 claimed never even to have heard of it! Of the two who had, only one had even a vague idea of what it might be. I later overheard the kids telling their teacher what I had asked. Her response was, "You remember the scientific method – we talked about it at the beginning of the school year.

I thought that episode spoke volumes about one aspect of the crisis in US science education. If students are not learning about the scientific method, then much of science must look pretty much like magic to them – a set of answers with no way to know if they are better or worse than other possible answers. They would certainly not know how scientists update our knowledge and learn new things.

When I reviewed the science texts being used locally at the time, I discovered that concepts such as the scientific method, experiments, controls and variables, hypotheses, and theories were not even indexed in the texts in use through 6th grade (Barufaldi et al., 1981). Some of these concepts were not included in the 8th grade text, either. Although the situation has improved since then, it may be that many of our local students are not being adequately introduced to these critical ideas. (When these concepts are introduced, they may be done poorly – for instance, the 8th grade text used in Lafayette through most of the 1980's called a theory nothing more than an educated guess! (Bishop et al., 1976)).

I suspect that lack of familiarity with the heart of science is one of the main factors in U.S. science illiteracy, including the inability to tell legitimate science from pseudosciences like UFOs, creationism, psychic powers, and the like. I think a basic understanding of the scientific method is pretty important for adults as well as students.

What the Planetarium Staff Can Do

At the Lafayette Planetarium we are now trying to include the scientific method in more of our programming, and are discovering that this is a subject that is difficult to teach effectively and difficult for people to learn. Perhaps a planetarium that an individual class may visit for less than an hour every couple of years is limited in its effectiveness in teaching something as basic and complex as the scientific method. That may need to be handled mostly in the classroom, not by mentioning the scientific method in passing at the start of the year but by repeatedly using it in classroom activities throughout the year.

Despite this, there are some things planetarians can do beyond regular programming to help bring a basic understanding of scientific inquiry to students and the general public. Our planetarium's efforts in this are still rather tentative, and include both successes and failures.

Try making presentations at school in-services on any level: state-wide, system-wide, or at individual schools. Presentations at science teacher conferences can be effective, too. Our presentations have particularly targeted science fairs, suggesting that they be used to produce projects utilizing the scientific method instead of projects using simply posters and reports (something that a receptive teacher in an audience once told me was a "really radical idea"); we also suggest that helping the students learn about the scientific method by using it properly should be a major overall goal of the science fair. We hand out science fair teacher information booklets (often available from regional utility companies; see "Your Guide," 1984), along with details such as possible multi-month project calendars. Another popular handout is a listing of possible projects; we don't pretend that it even comes close to exhausting all the possibilities, but it can give a teacher an awareness of the types of projects that can be done (from simple to complex) while perhaps stimulating student imaginations. We also remind teachers of such excellent resources as the magazines "Science & Children" and "The Science Teacher," from the National Science Teachers Association (Teachworth, 1987; Stedman, 1975; Smith, 1980).

Of course, doing this puts a planetarium staff into a delicate position: we don't want teachers to perceive us as just another bunch of outsiders trying to tell them how to do their jobs. Happily, I have found teachers to be uniformly receptive to our programs and enthusiastic about getting some actual science into their science fairs. Sometimes they seem relieved to hear someone else

saying things they have been thinking themselves. Our presentations seem to be effective; the schools we've worked with most closely have had noticeable changes in the scientific content of the average project.

Outreach Activities

It is also effective to volunteer to judge local science fairs at individual schools. This provides an opportunity to speak with teachers on an individual basis (even those who don't regularly visit your dome), and science fair help is usually highly valued. This can be very time-consuming, though, so you may need to limit how many you do each year.

Working directly with the students provides another opportunity. Like most planetarians, we have for years worked with individual students who contacted us for help; however, at one school we were given the opportunity to do in-class presentations for the sixth and seventh graders about using the scientific method in science fair projects. It was quite successful, and the science faculty there thought the students had increased enthusiasm for the science fair that year. Although we have been able to do that on and off several times, the school's tradition of having the science fair coordinated by different people each year has meant not making the presentation annually.

Workshops

Our planetarium sponsored a Young Astronaut chapter until our three-year closure in the early '90s, and for several years we emphasized the scientific method in activities done throughout the year. Our 4th through 6th grade Young Astronauts designed experiments to determine the speed of sound from a videotape of a Shuttle launch, to search for variations in the sprouting of seeds depending on whether or not the seeds had been accelerated on model rockets, and to measure Earth's acceleration due to gravity. They also participated in NASA's *LDEF SEEDS* project. The important thing was that once a subject was selected, *they* designed the experiment; it was the group's responsibility to formulate the hypothesis, identify and control variables, devise the experimental procedures, take the data, draw the conclusions, and so on.

Incredibly, this became so popular that they actually ask to be allowed to do even more experiments! One advantage of working with a group of this type is that it helps us ensure that the kids are exposed to the scientific process in several ways so they don't get an oversimplified cookbook approach. An important part of this is for the students to learn *how* to think rather than *what* to think.

Experiment-based summer workshops have been less successful, with few kids signing up even when something as popular as model rockets is involved. Science demonstrations and model rocket "fun launches" work well, but apparently even simple experiments are unpopular when school is out. For the last couple of years, though, we have offered summer workshops specifically about using the scientific method in the science fair, and they have been quite successful (for small audiences!). We make the handouts from the class available to students, parents, and teachers on request throughout the year.

We will keep trying these types of activities, and in coming years we hope to develop a “scientific method” program to be presented in middle schools each year by volunteers. Programs for adults in this area may be still another project for the future.

Curriculum and Textbook Review

In addition to developing planetarium presentations, it is possible to fight science illiteracy individually. One way is to work with your state's science curriculum review committee. Most planetarians have seen enough students and teachers to have a feel for where some of the weaknesses in science education are; find out how often the curriculum is reviewed and write a letter expressing your opinion.

Another way is to find out when your local science texts are being reviewed. Proposed new texts are usually put out for public scrutiny during the acceptance process; review them and write an intelligent letter about their strengths and weaknesses to the proper committee. Look for the quality of treatment about key items such as the nature of theories and hypotheses, and the nature of the scientific process. See if the scientific method is used in recommended classroom activities throughout the year, or is mentioned in the first chapter never to be referenced again (two options that send very different messages to students). Check the general accuracy of the contents, and how important concepts such as evolution are handled. Just be careful about the size of this job, too. When I stopped by my local school board to look over the proposed texts, I found a planetarium-sized room literally filled wall to wall with piles of books!

Although learning about the scientific method is only one part of the battle against scientific illiteracy, I strongly feel that it is a critical part of the battle. Until the general public becomes aware of this fundamental concept, scientific illiteracy will be an important problem; fortunately, we can help do something about it.

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