

Q: What makes for a good science fair project?

By Bill Robertson



A. Ah, one of my pet peeves. I used to judge a lot of science fairs, but I stopped because I seldom agreed with the evaluations of the other judges. Our main point of disagreement usually centered on glitz versus substance. No doubt about it—a science fair project that *looks* impressive tends to sway the judges. Of course, I had other disagreements with other judges, so I'm glad for the opportunity to suggest what people should look for in judging science fairs, and thus what students should focus on in doing the projects. My main concerns are with the kinds of questions the project answers and the extent to which the project mimics what scientists actually do in an investigation.

Choosing the Right Question

One way to address this issue is to name a few questions that are *not* good for science fair projects. “Why is the sky blue?,” “Can plants survive without water?,” and “What causes volcanoes?” are examples of questions that aren't so great. The reason they're not great is that scientists already know the answers to those questions. A student doing a project inspired by such questions is simply learning a concept and reporting on it. Now, that's okay for a science classroom. It's good to learn answers to those questions and students can use inquiry to answer those questions. The purpose of a

science fair, though, should be for students to answer a question, the answer to which cannot be found in a textbook. Here are a few questions for which you won't find textbook answers and which might be pretty interesting for students to answer:

- Does chewing gum help students do better in school?
- Does playing video games improve your reactions and your memory?
- Do people in certain-colored cars obey traffic laws better?

These happen to be actual science fair questions I've come across over the years. The students who posed the questions had various reasons for asking the questions, but the important thing was that the students genuinely wanted to know the answers to these questions. Clearly, finding out that chewing gum helps you do better in class or discovering that playing video games is good for you are pieces of information useful for the average student. Beyond that, though, the questions lend themselves to true investigation.

Do What Scientists Do Rather Than Follow the “Scientific Method”

In the heading for this section, the words scientific method are in quotes because there are disagree-

ments as to what constitutes the scientific method. There is a “text-book” definition, though, that goes something like the following:

- Ask a Question
- Do Background Research
- Construct a Hypothesis
- Test Your Hypothesis by Doing an Experiment
- Analyze Your Data and Draw a Conclusion
- Communicate Your Results

Anyone who has done basic research in any scientific discipline can tell you that scientists only rarely follow this kind of structured approach. Although scientists might begin with a general question, this is followed by a whole bunch of messing around with things to become familiar with the territory. This messing around leads to refinement or even restructuring of the original question, and it might lead to a totally new question. Let me give you an example from my own research and then an example of how this might apply to a science fair project.

When I began graduate work in science education and cognitive science, I wanted to study the difference between people who understand science and people who memorize science. From my experience I knew there was a difference, but I had only primitive ideas of how to determine the difference. It took me a year and a half to get to where I knew how to conduct my research. Part of that was spent researching what others had done, part was spent simply talking to physics students, and part was spent talking to physics professors. My advisor gave me great advice in

the beginning, which was to define *understanding* and *memorization* for myself before researching what others had done. That helped me keep my own perspective on the issue rather than simply parrot what other researchers thought. So, I did a lot of messing around before I formulated any kind of researchable question. The bottom line was that I didn’t formulate a hypothesis and then jump into my experiments.

Let’s apply that to the chewing gum question. To approach this as a scientist might, one should spend a fair amount of time observing other students and talking to teachers in an effort to define what one means by “doing better in school.” Do you look at test scores alone? Does attentiveness in class count? There are lots of ways of determining how well one does in school, and you have to refine things down to a specific measure of performance in order to get meaningful results. You also should simply observe students chewing and not chewing gum in a variety of school situations (gotta find a sympathetic teacher to allow you to do this one!). In the process, you might find behaviors related to chewing gum in class that have nothing to do with your original question. For example, you might discover that kids who chew gum in class tend to talk less. How does that relate to performance, or does it relate to performance at all?

Controlling Variables

One of the most difficult things for students to do is figure out how to structure an investigation so as to

focus on the question you’re asking while minimizing the effect of other factors. For chewing gum in class, you want to be able to control such contributing factors as the time of day, the day of the week, the style of the teacher, the health of the students, and the prior performance of the students. Suppose you are going to measure performance with before and after tests. It would be a good idea to give students various kinds of tests without gum chewing involved at all, so you know something about how much students either improve or don’t improve based on things other than gum chewing. In other words, you have to mess around with things again before settling on a procedure. A student who does a good job of messing around and has seriously addressed the issue of controlling variables should be commended for a job well done, even if it means not “finishing” the project with a distinct conclusion.

Sometimes You Discover Nothing

Often scientists learn nothing from an experiment other than how to restructure the experiment. Neat, clean results are the exception rather than the rule. Yet, I have seen many science fair judges mark students down for not getting those neat, clean results. It’s okay to learn nothing from an experiment other than what you did wrong, because that’s a common result in science. This is especially true given the relatively short amount of time students have for a science fair project. If scientists can go

years without a decisive answer to a question, why expect students to get that decisive answer in a month or two?

Judge the Process More Than the Result

Given the short amount of time students have to complete a project, given that questions that truly interest the student are likely to be complicated and difficult to define, and given that true scientific investigation seldom follows the structured steps outlined in the typical expression of the scientific

method, it makes sense to grade students with a greater emphasis on the process of the investigation than on an eye-catching, snazzy finished product. In this way, the students gain a better understanding of scientific investigation and learn to focus on what scientists do rather than on how much mom and dad can help them create a cool-looking report.

I should end by saying that, over the years, I have seen improvement in what schools require in a science fair project. It is more and more common to find requirements that the students do an experiment

rather than a report. That said, there is still too much reliance on the structured scientific method and not enough focus on, or understanding of, what scientists really do. Needless to say, the judges one uses for a science fair have at least as much influence on what the students get out of the experience as do the requirements outlined by the school.

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