Science Projects and (Very) Young Analytical Chemists

Editors are somehow very visible to a wide span of folks outside the community of authors and reviewers and consequently receive a somewhat stochastic range of miscellaneous correspondence. This past month I received correspondence from an e-mail-literate, well-spoken 5th grader whom I will call DR. Upon reflection, I realized that I could not consider this miscellaneous or discardable correspondence. DR asked me about an experiment (which, if not DR's own, I suspect was either a science fair project dreamed up by an erudite general science teacher or a Dad or Mom) that had some serious meat on it. My teacher instincts kicked in, and I assembled and sent a response to DR. Then I realized that this scenario also represented an example of what scientists should leap to do to help educate the public about science—answer the questions of young people, down to the youngest, regardless of their hidden complexity. So I thought that I should climb up on my well-worn teacher soapbox and exhort my colleagues out there in *Analytical Chemistry* reader land to be attentive to science questions from young folks, even if it makes you spend some extra time refreshing yourself on some elementary basics.

So here's DR's question. Whether you love beer or soda, you have to like it. "I am measuring the amount (height) of foam that is created when a carbonated beverage is poured from different heights. My results so far show that more foam is created when I pour the liquid from a greater height. . . . Why is that?"

Here's a summary of my advice to DR. First, congratulations on trying an experiment that has some quantitative aspects. Like analytical chemistry, that's always challenging. Second, aim at controlling the details that will make your experiment reproducible. These would include making the container always either a dry, empty one or one with a constant amount of liquid in it, in addition to keeping the container at room temperature. Third, look for a sensitive response; use room-temperature, not chilled, soda. Fourth, formulate a model for the response of the experiment—which I made a stab at. I concluded that because (assuming constant acceleration) the kinetic energy of the poured, falling liquid is proportional to the height from which it was poured, the height of the foam head would be proportional to the kinetic energy and, thus, the height. I reasoned that the kinetic energy would be an important factor in driving the falling, splashing liquid to the container walls, where bubble nucleation could occur. I pointed out to DR some of the foibles of this prediction, but the main point was to have a model for the experiment's behavior. I tried to cast my prediction in 5th-grade terms; DR, I hope I gauged right.

All of the above should be familiar—in general outline—to any analytical chemist. Achieve reproducible experimental conditions, devise with a physical and/or chemical foundation a quantitative model for the response of the experiment, and take note of the possible "side reactions" that might cause a different response. DR gives you an example of facing this challenge at a young age. Some of you might come up with different advice to DR for the experiment. Be assured that I will forward any reasoned advice (on soda, not beer) or correction to Murray's model to DR, whom I thank for asking a question. I hope that all of you—wherever your employment—will be responsive to deep questions from young people. The dividends may be equally deep.