LETTERS

Physics education reform in lab and classroom

As a retired college physics teacher, I found the article "The past and future of physics education reform" by Valerie Otero and David Meltzer (PHYSICS TODAY, May 2017, page 50) well written and important. As a longtime member of the American Association of Physics Teachers, I have had many discussions with high school physics teachers, and I often found that their concerns are similar to those of instructors of introductory college physics.

I agree that students can learn from discoveries made in physics laboratories. However, because only a limited amount of time, often only about two hours per week, is allotted for a physics lab, we must be realistic about our goals. It is also important to remember that students have access to so much information on the internet that they can learn about an experiment and its results well before they enter the lab. And when courses have multiple sections, students can learn from those who took the lab on a previous day, which ruins the experience of discovery.

To properly revise physics courses, schools must consider more flexible scheduling instead of brief, specific blocks of time. A longer laboratory session would probably give students a more meaningful experience.

I have one further comment: Aspects of the scientific method should not be restricted to science courses. The process of theorizing and logically following implications of theories can be applied to

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history, political science, sociology, and other subjects. For example, instead of just teaching about the history of World War II and asking students to repeat information on tests or in term papers, we could ask them what might have happened if the US had entered the war at a different point in time or not at all and then have them consider the logical consequences of each possibility. Getting students to hypothesize and follow a logical sequence should begin well before they study physics or any other science.

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Magnetic monopoles and a cheap detector

The letters from Ken Frankel and Christopher Harrison (PHYSICS TODAY, June 2017, page 13) in response to Arttu Rajantie's article on the history of searches for magnetic monopoles (PHYSICS TODAY, October 2016, page 40) brought back a memory. After Blas Cabrera's 1982 publication of a candidate monopole event detected with a superconducting loop,[1] three groups[2]—a University of Chicago, Fermilab, and University of Michigan collaboration; IBM; and Imperial College London—built Faraday induction detectors with larger areas. Using a coincidence technique of two gradiometer detectors in a nonzero but pinned magnetic field, Joe Incandela and coworkers showed that a likely explanation of the candidate event was a flux jump rather than the transit of a monopole.[3] I was invited by the organizers of the First Aspen Winter Conference to give a review talk of the hot though cryogenic topic.[4]

I had been a graduate student at the University of California, Berkeley, and had great admiration for Luis Alvarez, so I sent him a draft asking for comments. I had leaned over backwards to give him credit for inventing the Faraday induction technique, as my looking in depth at monopole detection by ionization brought home that there was no way to calibrate the ionization detector, and hence a nondetection could never be definitive. Faraday detection, however, can be calibrated with a "pseudopole," a very long but small-diameter, tightly wound, magnetic solenoid much akin to a Dirac string.

I was working at my desk when my phone rang, with a furious Luis on the other end. Without any introduction, he barked, "Henry, this was my idea, and I should be the first reference." I was stunned, as I thought I had done him proud, but I managed to say, "Luis, the guys ahead of you are not to be sneezed at—Faraday, Maxwell, Dirac. . . ." Still angry, he said, "Yes, but who are these other guys?" Luis later sent a nice note praising the review, and all was well.

A brief addendum: Sunil Somalwar's PhD thesis followed up on Incandela's superconducting gradiometers by showing that using just copper wire and a field-effect transistor operating at liquid nitrogen temperature, one could build an inexpensive detector, capable of covering large areas and sensitive to a single Dirac charge.[5]

References

1. B. Cabrera, *Phys. Rev. Lett.* **48**, 1378 (1982).
2. J. Incandela et al., *Phys. Rev. Lett.* **53**, 2067 (1984); S. Bermon et al., *Phys. Rev. Lett.* **55**, 1850 (1985); A. D. Caplin et al., *Nature* **317**,