Diverse suggestions for improving physics teaching FREE

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distribution of the 353-GHz map. The BICEP2 and *Planck* teams are now working together to perform that correlation analysis, and they are also including new data from the Keck Array in the South Pole at 100 GHz and 150 GHz.

Several other experiments will also expand the observed frequency range and make measurements on different and broader regions of the sky. In particular, the Cosmology Large Angular Scale Surveyor experiment, scheduled to be deployed next year, will observe at 40, 90, 150, and 220 GHz and will separate polarization components in situ.[5] If there are indeed detectable cosmic *B* modes, they should be seen with similar amplitudes by those other experiments, not only on the BICEP2 patch of sky but everywhere else as well. Furthermore, a true inflationary gravitational-wave signal should exhibit additional hallmarks, such as a characteristic angular power spectrum and statistics.

Overall, the *B*-modes story demonstrates how progress in science is truly achieved. Rather than through a direct march to the truth, science advances in a zigzag path that involves many false starts, detours, and blind alleys. Crucially, the scientific method requires that theories should make falsifiable predictions that can be tested through subsequent experiments or observations. Science therefore allows for self-corrections. Still, there may be some lessons to be learned here about the importance of communicating exciting and promising new scientific results to the public in a way that stresses the process, the uncertainties involved in measurements and interpretation of data, and their possible implications.

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Letters

Diverse suggestions for improving physics teaching

The photograph in figure 1 of "Psychological insights for improved physics teaching" by Lauren Aguilar, Greg Walton, and Carl Wieman (PHYSICS TODAY, May 2014, page 43) showed a physics lecture with an audience that appeared to be almost all white males. The caption suggested that most readers might not see what a woman or member of a minority group would see in that audience. I can attest to what one female high school student saw in a strikingly similar situation.

About 20 years ago, I was conducting an on-reservation summer program for Native American students, which ended with a class visit to an off-reservation college. The engineering school had offered a tour, which the dean conducted himself. He showed us an engineering lab with about a dozen people working diligently, mentioned the investment in equipment that allowed such research, and asked if there were any questions.

One of the female students in my class raised her hand and asked, "Why aren't there any women in there?" Her question brought the dean up short, but he handled it honestly, confessing that she had seen something important that he had not and that he was embarrassed and chagrined. So the question "Is there anyone like me here?" in the photo's caption certainly does get asked.

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■ **The authors of** "Psychological insights for improved physics teaching" made some good points, but I think an equally important factor affecting classroom success is the image of scientists in popular culture. Scientists are generally shown as either antisocial eccentrics or brilliant adventurers. Who wouldn't like to lead the life of Indiana Jones, an exceptional archaeologist who somehow, in his exciting and adventurous life, took time out to do the dull work of actually studying his subject?

According to the popular stereotype, successful scientists are so bright that everything comes easily to them. The assumed corollary is damning: A student who doesn't understand something immediately will never be successful as a scientist.

Even the brilliant Richard Feynman, though, had to work hard in his field. Unfortunately, he never stressed that fact in his own books. I guess his editor felt that describing in detail all the time he spent on his work would make his books too dull for popular reading.

Although Indiana Jones is a purely fictional character, his image can still have a strong effect on young people. The message that science is easy (for geniuses) and exciting can be found everywhere, including in science-oriented television programs like *NOVA* and *Cosmos*, where only the results of learning are discussed, but never the hard work.

Perhaps it is time to show that real academic work is necessary and that one doesn't have to be a genius to be successful. A reasonable level of intelligence together with a willingness to work hard can lead to a satisfying career even if it doesn't lead to the Nobel Prize or a popular television program.

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■ **The insights** by Lauren Aguilar, Greg Walton, and Carl Wieman on how students perceive their classroom experience and on suggested interventions for improving physics teaching are indeed helpful in elementary and perhaps middle schools. By the time students reach high school and college levels, however, it is too late. Many stu-

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