

example, K-12 or college students—where 99% have never heard of “wotoiks” or “vefarps.”

My experience provides a special case of Benka’s theme: “Eliminate nonessential technical details and broaden the take-home message.” Regrettably, many well-meaning scientists go in exactly the opposite direction when dealing with the public. Impress them! Get them to say, “Wow!” Use “nano” at least three times, and drop a “Higgs boson” occasionally. That’ll turn them on to science!

As scientists committed to the truth, we should reject all attempts to bamboozle lay audiences with the arcane language of science. At this time of national change, we, as citizens, must heed President Dwight Eisenhower’s warning, from his valedictory speech of 17 January 1961, about the twin dangers of “the military industrial complex” and the “scientific and technical elite.”

Benka has the right guidance for scientists who have the task of addressing legislators: “It’s the audience, stupid!” Respect them.

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Every first-year graduate student in the physical sciences should be required to read Stephen Benka’s great article. I have observed that a key difference between research scientists and engineers who have truly remarkable careers and those who get stuck in a technical box is their verbal communication skills.

When I started as a graduate student in chemistry at the University of California, Berkeley, in 1972, the department chairman David Shirley told the entering students that they should attend seminars regularly because they needed to develop the ability to learn by listening to other people talk. He should have added that students also need to develop the ability to speak in such a way that their audience learns something.

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Engines for the 21st century

In the article “Research Needs for Future Internal Combustion Engines,” (PHYSICS TODAY, November 2008, page 47), authors Dawn Manley, Andrew McIlroy, and Craig Taatjes examine some of the physics issues involved in improving the efficiency of the internal



“He just keeps shouting,
‘It’s mutable! It’s mutable!’”

combustion engine. However, some alternative approaches may be more efficient yet.

For 20th-century automobiles, internal combustion engines had several advantages: They could produce power from a cold start and were reasonably efficient across a wide range of output power. For the 21st century, other, potentially more efficient heat engines, such as the Brayton gas-turbine cycle and the Stirling engine, are also worth noting. Hybrid cars eliminate most of the disadvantages of such heat engines by using electric motors for the primary drive function, so that the heat engine is needed only for the production of electrical power to charge the battery. The heat engine can thus be run under its

most efficient conditions, not at a compromise setting to maximize torque.

A high-efficiency heat engine concept on which we have done considerable work at NASA’s John Glenn Research Center is the free-piston Stirling engine. This remarkable design eliminates the kinematic couplings and thus reduces the engine to only two moving parts, the displacer and power pistons; a linear alternator produces power directly as electricity. Small, light, and efficient, the Stirling engine—and not the internal combustion engine—may be the real future of the automobile engine.

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