



# The Essential Engineer: Why Science Alone Will Not Solve Our Global Problems

By Henry Petroski

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From the acclaimed author of *The Pencil* and *To Engineer Is Human*, *The Essential Engineer* is an eye-opening exploration of the ways in which science and engineering must work together to address our world's most pressing issues, from dealing with climate change and the prevention of natural disasters to the development of efficient automobiles and the search for renewable energy sources. While the scientist may identify problems, it falls to the engineer to solve them. It is the inherent practicality of engineering, which takes into account structural, economic, environmental, and other factors that science often does not consider, that makes engineering vital to answering our most urgent concerns.

Henry Petroski takes us inside the research, development, and debates surrounding the most critical challenges of our time, exploring the feasibility of biofuels, the progress of battery-operated cars, and the question of nuclear power. He gives us an in-depth investigation of the various options for renewable energy—among them solar, wind, tidal, and ethanol—explaining the benefits and risks of each. Will windmills soon populate our landscape the way they did in previous centuries? Will synthetic trees, said to be more efficient at absorbing harmful carbon dioxide than real trees, soon dot our prairies? Will we construct a “sunshade” in outer space to protect ourselves from dangerous rays? In many cases, the technology already exists. What's needed is not so much invention as engineering.

Just as the great achievements of centuries past—the steamship, the airplane, the moon landing—once seemed beyond reach, the solutions to the twenty-first century's problems await only a similar coordination of science and engineering. Eloquently reasoned and written, *The Essential Engineer* identifies and illuminates these problems—and, above all, sets out a course for putting ideas into action.

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## The Essential Engineer: Why Science Alone Will Not Solve Our Global Problems By Henry Petroski Bibliography

- Sales Rank: #1161722 in Books
- Brand: Vintage Books USA
- Published on: 2011-03-08
- Released on: 2011-03-08
- Original language: English
- Number of items: 1
- Dimensions: 8.05" h x .86" w x 5.13" l, .68 pounds
- Binding: Paperback
- 288 pages

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### Editorial Review

Amazon.com Review

**Amazon Exclusive: Henry Petroski on Science, Engineering, and Culture**



Science is by its very nature global. In fact, it is galactic, even universal. This is because science deals with universal laws, like the law of gravity. No matter where on earth I jump, gravity will pull me down according to the single law of universal gravitation. And no matter where an apple falls, it falls toward the ground. We believe that it has always been so, regardless of culture.

But this is not to say that practicing science is independent of culture. It is proper to speak of American science, as distinct from, say, Japanese science. Indeed, at least one Japanese scientist has taken note of the fact that his culture has yielded a paucity of Nobel laureates. This has been attributed to the deference that the Japanese culture expects of the young toward the elderly. Prize-winning scientific breakthroughs often depend on rebellion against the prevailing paradigm, not deference to it.

At the same time, the Japanese excel in technological endeavors. Their automobiles and consumer electronics are admired and bought around the world. The disciplined Japanese culture is well suited to the mass manufacturing of excellently engineered and highly reliable products. Those products that are exported fit nicely into the target culture; those that are for home consumption are distinctly Japanese.

So there appears to be a significant difference between science and engineering and how they relate to culture. A commonly cited difference between the two endeavors is that science seeks to understand what is, whereas engineering seeks to create what never was. It is wrong to describe engineering as mere applied science. There is some extra-scientific component to engineering, something often referred to as the creative or artistic component. The engineer designing a bridge does not deduce its form from scientific laws and mathematical equations. Rather, like a poem or a painting, the bridge is formed first in the engineer's mind's eye. It is only then that the hypothesized structure can be given a scientific or mathematical litmus test. In engineering, analysis follows synthesis--not the other way around.

It is essential that the similarities and differences between science and engineering be kept in mind when identifying and attacking global problems. Scientists and engineers come from different technical cultures as surely as Americans and Japanese do from different social ones. --*Henry Petroski*

(Photo © Catherine Petroski)

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From Publishers Weekly

For a quarter-century now, Duke University's Petroski has replaced Samuel Florman as the foremost American civil engineer explaining to lay audiences the nature of engineering and its crucial role in improving the world. Petroski has long been outraged by the persistent elevation of scientists over engineers in terms of intelligence and creativity. Yet none of Petroski's 14 books on technology has argued so aggressively as his newest that engineers do not merely apply what scientists discover. Instead, engineers seek the most appropriate solution out of several to any engineering problem—not the supposedly single solution requiring diligence rather than depth. Analyzing both historical and contemporary examples, from climate change to public health, Petroski shows how science often overlooks structural, economic, environmental and aesthetic dimensions that routinely challenge engineers. Moreover, he says, sometimes science trails technology, as when engineers had to design the first moon landing vehicles before scientists learned its surface composition. Far from being hostile toward science, Petroski pleads for continued cooperation between science and engineering. When, as Petroski laments, even President Obama has sometimes omitted engineering in touting science, this book could hardly be more timely. *Illus. (Jan.)*  
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From [Booklist](#)

In his latest book, the prolific Petroski is animated by an identity problem engineers have vis-à-vis scientists. The media and public tend to conflate roles that merge in some respects but starkly diverge in others. Rocket science exemplifies the confusion: the physics of spaceflight were solved in principle centuries before chemical and mechanical engineers achieved it in practice. Petroski's basic idea is this: "Engineers do not need to imagine the unimaginable; they need to imagine the manageable." In some of these 14 reflective essays, he elaborates in the context of particular building projects, recounts inventions by scientists who lapsed into engineering, and cautions green-energy enthusiasts on the economic trade-offs and design compromises inherent in any technology. In other chapters, he questions research-and-development linearity in technological progress, arguing by examples that engineers often create something that works (the airplane) before scientists figure out how it works. With customary acuity and variety, Petroski is sure to please his established readership with these interesting disquisitions on technology. --Gilbert Taylor

## **Users Review**

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**Betty Adkins:**

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