

# Book Review

The Physics of Superheroes, by James Kakalios

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In an often-quoted essay, New York Times columnist Russell Baker wrote about the difference between being “serious” and being “solemn,” observing that “The transition from seriousness to solemnity occurs in adolescence, a period in which nature, for reasons of her own, plunges people into foolish frivolity. During this period the organism struggles to regain dignity by recovering childhood’s genius for seriousness. It is usually a hopeless cause.” The contrast between seriousness and solemnity can unfortunately often be seen in introductory science courses, where serious subjects are presented in solemn ways, the result being that students who are not already committed to science end up being bored by them, see them as mere mathematical manipulations to be mastered, conclude that they lack “the science gene,” and vote with their feet.

In contrast, in the spirit of Heisenberg, who once observed that there are things that are so serious that one can only joke about them, James Kakalios has written *The Physics of Superheroes*, a book that tackles the task of presenting to non-scientists the basic ideas of physics – a serious subject if ever there was one – in a refreshing way that lacks all solemnity.

The book grew out of a freshman seminar entitled “All I Know About Physics I Learned From the Comics,” in which Kakalios, a physics professor at the University of Minnesota reached back to his lifelong love of comic books, using the exploits of superheroes to illustrate the application (or , in some misapplication) of the principles of physics to such momentous questions as:

- Does the fact that Superman can leap tall buildings at a single bound tell us anything about the gravity on Krypton? (Newton’s first law)
- What really killed Spiderman’s girlfriend? (momentum)

- How much food does The Flash have to eat in order to run so fast? (conservation of energy)
- How can Electro run up the side of a steel-frame building? (Faraday's laws)
- Why can't Superman change history by traveling into the past and altering events? (quantum mechanics and the many-world interpretation)

Kakalios writes with a clear style, incorporating plenty of humor, as illustrated both in the chapter headings (“Deconstructing Krypton,” “Does Size Matter?,” “The Central City Diet Plan. Conservation of Energy,” “Through A Wall Lightly. Tunneling Phenomena”), and in some of his numerous (but mostly serious) parenthetical remarks. Using examples taken from comics (of which he clearly has an encyclopedic knowledge) as a jumping-off point, he manages to cover all the basic topics in a physics survey course, including mechanics, thermodynamics relativity and quantum mechanics. Aiming at non-scientists, he eschews mathematics almost entirely, relying instead on verbal exposition and the use of imaginative parallels that suggest he would be an enjoyable and effective classroom instructor.

In addition to principles of physics, *The Physics of Superheroes* conveys considerable information about the history and production of comic books. It also includes numerous illustrations from classic comics. Though it would have been more visually appealing had they been reproduced in color, I imagine this would have increased the price of the book considerably (though still keeping it far below the near-astronomical cost of the average contemporary science text).

I found no obvious mistakes and few typos (though manganese was accidentally transmuted typographically to magnesium at the top of page 275). One point that did seem potentially confusing, though, was the discussion of uncertainty, using as an example a hypothetical attempt to determine the frequency of a vibrating string by touching it gently and feeling its vibrations (p. 239). “... [O]nce we have touched the string, it will no longer be oscillating at the same frequency as before. It will either have stopped shaking altogether or be vibrating at a different frequency.”

Kakalios had already pointed out earlier that the frequency of a vibrating string, like that of a pendulum, depends only on its length. Thus, if one only touched the string lightly enough to feel it beating against one's finger (as opposed to pressing it firmly against a fret), one would logically expect its amplitude to be changed, but not its frequency (unless the touch creates a node, thereby producing an overtone or two frequencies beating against one another).

On p. 307, in his discussion of adamantium, the defect-free “covalently-bonded metal,” composing Wolverine’s claws, Kakalios writes, “In order to break these bonds, one must remove the electrons from all of the bonds connecting an atom to all of its neighbors.” To a chemist’s ear this sounds more like multiple ionization than bond cleavage, but is probably more a matter of unfortunate phrasing.

One amusing point: Kakalios’ own alter ego. The photo on the back fly-leaf of a smiling, benevolent teacher-author bursting with humor, contrasts strongly to the rather stern photo of the researcher in his University of Minnesota website, evoking an echo of the “serious-solemn” distinction!

For the reader who gets bitten by the physics bug after finishing *The Physics of Superheroes* and wants to scratch it, Kakalios includes plenty of suggestions for further reading in the back – mostly semi-popular books, biographies, histories, and occasional texts. This is still a good-sized jump (though not one of superhero dimensions), and, given people’s propensity for brief reading, I would have liked him to have included some articles of the *Scientific American* genre, though this is at best a minor criticism.

Overall, Kakalios has done a great job of presenting the principles of physics to non-scientists in an effective and enjoyable way. By sensitizing them to look for the basic principles of physics at work in the everyday world of superheroes, Kakalios may succeed in getting them to apply a similar approach to their own daily experiences, thus helping them develop into the kind of scientifically literate citizens our technological society needs. His book could also be profitably read by someone with only a modest, or a dimly-recalled, background in physics.

Personally, I thoroughly enjoyed reading *The Physics of Superheroes*, and I think I would have liked to be a fly on the wall in Kakalios’ freshman seminar. Unfortunately, being a mere chemist of ordinary gifts, I have neither the requisite size nor sufficient adhesiveness in my hands and feet to accomplish this task. Maybe I should wander into the lab and wait for some transformative mishap to occur ...“