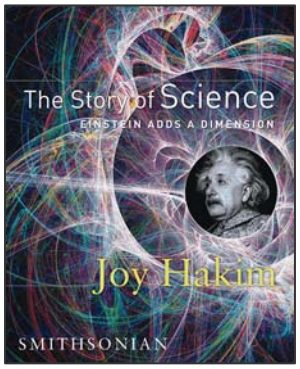
# A Note from Joy Hakim




The teacher was young, intense, and very bright. I had just given a talk, and she stayed to continue the conversation, telling me about a science lesson she had taught a few months earlier. She had led her students from experimentation, to discussion, to written analysis and, at the time, thought it the best teaching she had ever done. So six weeks later, when her students were given a standardized test, she knew they would all get the correct answer to the question that dealt with the material she had taught on that inspired day. As it happened, not one student got it right. And when she spoke to some of them about the material, they hardly remembered her wonderful lesson.

She was baffled and asked if I had an explanation for her. She wondered, *How do we make science stick? How do we take those terrific hands-on activities and help students turn them into concepts that they will hold in their minds?*

The quick answer is not easily. Finding ways to help form retentive, thinking minds is a central educational challenge, especially today when knowledge, and the ability to find and use it, is key to success in almost every field of endeavor. Science, perhaps more than any other subject, seems to offer unique opportunities for mental stretching, and yet it's a subject that misses much of the school population. Why isn't contemporary science permeating curricula? Why are so many of our school graduates "scientifically illiterate." How can adults with prestigious diplomas in languages, literature, or law consider themselves educated if they are without a basic understanding of modern physics or chemistry? Does it matter? Is broad scientific literacy really important?

Yes. We live in what is probably the greatest scientific era ever. The 20th century was a golden age for physics; we're in the midst of a golden age of cosmology; biophysics is coming on fast. Anyone without basic knowledge of those sciences is missing the intellectual underpinnings of our time. And yet that describes much of our population.

But aren't today's sciences very difficult? Aren't they only understandable to an intellectual elite? No question, the mathematical specifics of quantum theory and relativity (the two great physical science concepts of the modern era) are beyond many of us. But the overarching ideas are not.

Do these sciences impact our everyday world? You bet. We wouldn't have TV, computers, or cell phones if we hadn't delved into the quantum world. We wouldn't have GPS or space travel without general relativity. As to cosmology, it now takes us back—with stunning specifics—almost to the moment of creation. Recently we learned, with measured precision, the direction the universe is heading. The search for alien life, once the domain of science fiction, is now mainstream. School science is boring? Maybe we've been leaving out the good stuff.

In *Einstein Adds a New Dimension* you'll struggle with some astonishing concepts. Much of modern science is counterintuitive. It doesn't seem to make sense. That makes it challenging, and

also—to use an appropriate cliché—mind-blowing. Science is a critical-thinking subject. It's an analytical-reading subject. It's a stretch-your-mind subject, and we've been missing its potential. There are political implications: Leadership in science translates into world leadership. Science is now too important to be left just to scientists.

So what do we do? We consider science as a reading and thinking subject—without eliminating the traditional experiment-based approach. How can we possibly add anything else to the curriculum? We don't. We do some rethinking of the literary arts (and maybe social studies, too). Today's dominant literary form is narrative nonfiction. And some of the most creative nonfiction is coming from science writers. We're proposing that you consider science as both a reading subject and a *doing* subject.

Then science becomes a several-bangs-for-your-buck endeavor. Link activities to a narrative and you will teach subject matter as you hone reading and thinking skills. There's an important bonus: Educational psychologists tell us that students are likely to remember facts woven into a story. Our experience tells us that reading comprehension scores go up with vocabulary-rich narrative nonfiction. It's the classic approach to teaching.

From Homer to McGuffey's readers, stories are the way that cultures have traditionally passed on their most important ideas. In our time, we've gotten away from storytelling. The very word *story* has been given a negative connotation—"Don't tell me a story, tell me the truth." But the best stories are true. And we all know that truth is stranger than fiction.

Why did Dutch police set out after Daniel Fahrenheit when he wanted to build a thermometer? What happened when Niels Bohr tried to rappel up a bank building in Copenhagen? What famous American physicist was a prankster skilled at cracking safes? Science is boring? No way. *Einstein Adds a New Dimension* takes the scientific adventure into the 21st century (it began in ancient Greece in *Aristotle Leads the Way* and sojourned into the world of classical physics with *Newton at the Center*).

Schools talk a lot about multidisciplinary learning, and The Story of Science books are intended to help make it possible. Ideally, science, language arts, history, and math teachers will use the books in a joint exploration. However, if no team is available and you're on your own with the books, just put on multiple hats. Science is an arena where everyone can become an explorer.

You don't feel secure with the material covered? So much the better. You won't be tempted to lecture. Create an environment in which you and your students learn together. Let them become the experts. They'll love taking that role. These books were written with the hope that you and your students would question, research, discuss, and write—thus honing essential information-age skills.

Science is an unending search for answers; the best scientists are those who learn to pose challenging questions. This teachers guide will ease you and your students into the process. We expect you to embark together on an adventure for your minds. Hardly anything is as intellectually satisfying as today's science.