Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY JANUARY 1994 $3.75

Plugged-In Medicine

HOW INFORMATION TECHNOLOGY WILL CUT THE COSTS AND IMPROVE THE QUALITY OF HEALTH CARE

ALSO IN THIS ISSUE:

- TOWARD REMEDYING THE ORGAN SHORTAGE
- BLIMPS ON THE RISE
- BUCKYBALLS: THE THIRD COMING OF CARBON
- LESSONS ON INDUSTRIAL POLICY FROM BRAZIL

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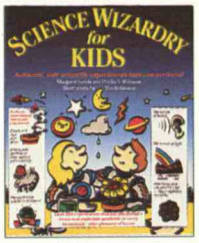
by Margaret Kenda and Phyllis S. Williams

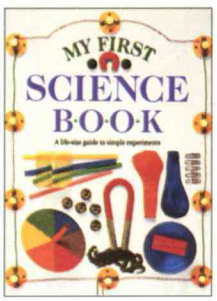


More than 200 authentic, safe experiments that use everyday, inexpensive materials. Kids will get to know the thrill of discovery by looking at their immediate world: making toy boats, brewing sun tea, growing violets, collecting rocks. Includes step-by-step instructions and glossary.

Ages 9-12, Spiral-bound, 316 pages, $13.95

My First Science Book

by Angela Wilkes

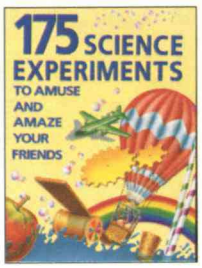


Kids can learn about the weather by making a rain gauge, barometer, and wind vane, or test acidity and alkalinity with their own litmus test. Includes instructions with color photographs, and clear explanations of why things happen. Over a dozen experiments.

Ages 6–10, Hardcover, 48 pages, $13.00

175 Science Experiments

by Brenda Walpole
Illustrated by Kuo Kang Chen and Peter Bull

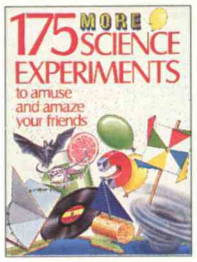


This collection of experiments will amuse and amaze every young scientist. Each page is filled with detailed full-color illustrations, photographs, and instructions on how things work and why things happen in our everyday lives.

Ages 8–12, Paperback, 172 pages, $12.00

New! 175 More Science Experiments

by Terry Cash, Steve Parker, & Barbara Taylor

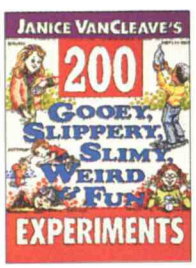


A sequel to the popular *175 Science Experiments*, this book brings further enjoyment to curious kids. Within four main sections—Sound, Electricity, Simple Chemistry, and Weather—it provides a lively menu of experiments, tricks, and things to make.

Ages 8–12, Paperback, 172 pages, $12.00

New! 200 Gooey, Slippery, Slimy Experiments

by Janice VanCleave

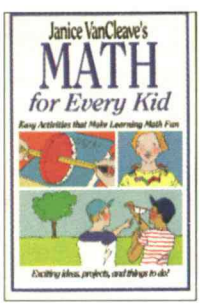


Zany, wacky, entertaining, this book engages children's imaginations while answering their favorite questions about the environment. Your kids will have so much fun conducting these 100% fool-proof experiments they'll forget they're learning.

Ages 8–12, Paperback, 172 pages, $12.00

Math for Every Kid

by Janice VanCleave

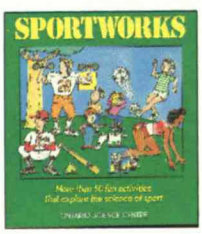


Easy activities that make learning math fun! Packed with illustrations, *Math for Every Kid* uses simple problems and activities to teach kids about measurements, fractions, graphs, geometry figures, problem solving and more!

Ages 8–12, Paperback, 215 pages, $10.95

Sportworks

by the Ontario Science Centre
Illustrated by Pat Cupples

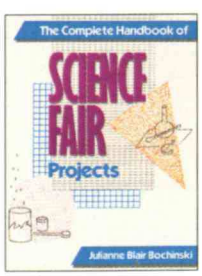


Why does a curveball curve? What makes a good football helmet? How do figure skaters spin so fast, and don't they get dizzy? You find answers to these sports mysteries and much more in this fun-filled book by the world-famous Ontario Science Centre.

Ages 8–12, Paperback, 96 pages, $8.95

The Complete Handbook of Science Fair Projects

by Julianne Blair Bochinski



The only book you'll need for selecting, preparing, and presenting award-winning science fair projects. Written by a veteran contestant and judge, this step-by-step guide describes 50 projects in detail and suggests 500 other topics suitable for grades 7 and up.

Ages 12 and up, Paperback, 206 pages, $12.95

The Scientific Kid

Written and illustrated by Mary Stetton Carson
Photographs by Sing-Si Schwartz

A collection of 35 fun experiments and projects to teach your kids some basic scientific concepts, from a vinegar and baking soda reaction to static electricity.

All ages, Spiral-bound, 78 pages, $13.00

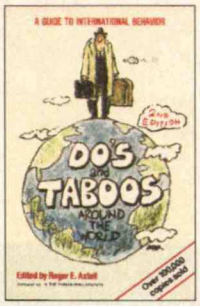
Snafooz Puzzles

These squishy foam puzzles will test your mettle and creative energy with dozens and dozens of complex shapes to build and rebuild. Six different levels to master, from easy to brain buster!

Ages 8 to adult, Package of 6, $6.95

Do's and Taboos Around the World

Edited by Roger E. Axtell

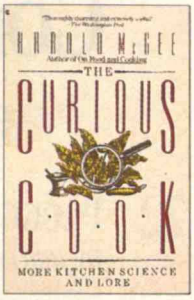


This fascinating guide helps thousands of high-powered executives and tourists avoid the missteps and misunderstandings that plague the world traveler. It includes facts and tips on protocol, custom, etiquette, hand gestures, body language, idioms, and gift-giving.

Paperback, 200 pages, $12.95

New! The Curious Cook

by Harold McGee

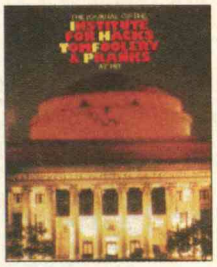


How can you keep the green in guacamole and pesto sauce? What's the best way to make fruit ices? Packed with fascinating scientific lore, *The Curious Cook* answers these questions and more to help the home cook make use of scientific discoveries about food.

Paperback, 339 pages, $13.00

Journal of the Institute for Hacks, Tomfoolery & Pranks at MIT

by Brian M. Leibowitz

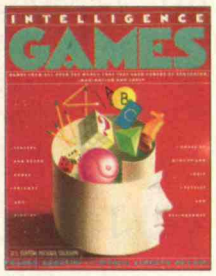


This hilarious book recounts the history, folklore, and ingenuity of MIT students in their quest for the ultimate prank. From welding trolley cars to their tracks to steers grazing atop the great dome, this journal captures the spirit and playfulness of a rich MIT tradition.

Paperback, 158 pages, $19.95

Intelligence Games

Edited by Roger E. Axtell

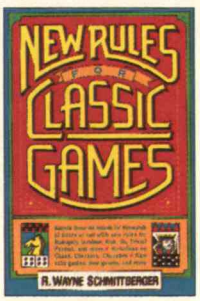


A collection of riddles, logic, boardgames, and enigmas from all over the world to test your powers of reasoning and savvy. A great book that will provide hours of fascinating fun.

Paperback, 185 pages, $15.95

New Rules for Classic Games

by R. Wayne Schmittberger



If rules are made to be broken, then dust off those old games lying dormant in your closet, because your game playing just got a lot more exciting! This book is a complete guide to hundreds of new twists and variations guaranteed to expand and enliven your game repertoire.

Paperback, 245 pages, $9.95

Puzzlegrams

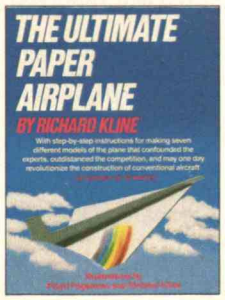
by Pentagram

A collection of 178 classic puzzles recreated by one of the world's leading design firms. The book is a stunning, four-color combination of design and conundrum. It appeals to all ages and levels of expertise—and challenges your intuition as well as your intellect.

Paperback, 187 pages, $15.95

The Ultimate Paper Airplane

by Richard Kline



More than just a toy, the Kline-Fogleman airfoil earned its inventors two patents and was tested by NASA. Here is the story of its creation, along with the secrets behind its unmatched performance. Plus, instructions and patterns for making seven different models.

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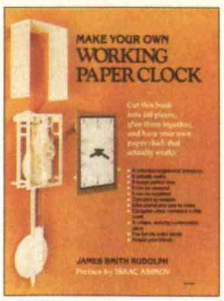
by James Smith Rudolph



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JANUARY 1994

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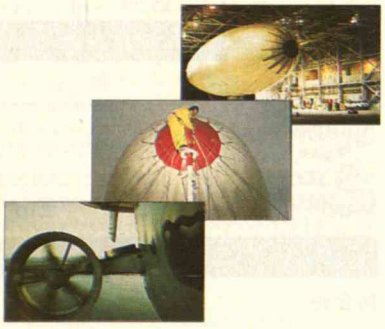

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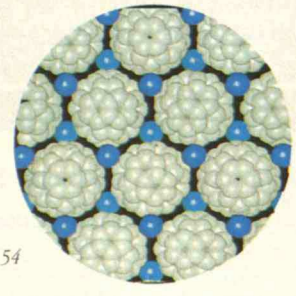

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COVER: JON MCINTOSH

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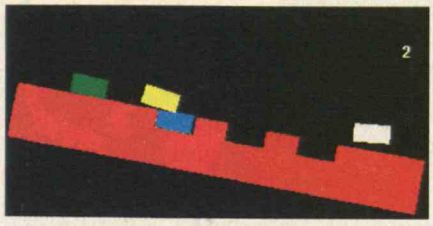

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First Line

Confessions of a Picky Eater

In Voltaire's *Candide*, the world-weary Lord Pococurante was impossible to satisfy. There was no poem, no play, no painting, no musical composition ever created—regardless of its acclaim elsewhere—that could earn his unqualified praise. "What a superior man," exclaimed the naive young traveler Candide. "Nothing can please him." But Candide's older and wiser companion had a different reaction. "The best stomachs," he observed, "are not those that refuse all food."

I was recently reminded of this passage after speaking with an environmental scientist who wished to write for *Technology Review*. He had some concerns. "You're developing quite a reputation," he told me, "as the country's second most difficult magazine to get into—after the *New Yorker*."

It's an honor to be put in the company, even if backhandedly, of what is arguably the world's finest magazine. But the scientist's statement also caused me to wonder: Is *TR* indeed a little too big for its britches? In our continuing quest for excellent articles, does our stomach refuse all food? Or, since we do manage to fill our pages, are we nevertheless insufferably picky eaters?

I reflected long and hard on these questions. And my answer, as comedian Steve Martin might conclude under similar circumstances, is: "Naah!"

Essentially what we ask is that our articles reflect good journalism. But imposing professional standards on nonjournalists—in our case, specialists in technology-related fields—is easier said than done. There are lots of casualties, not so much because of rejection by us but because many would-be authors, once they realize that the project may not be a walk in the woods, tend to disappear.

Technology Review's purpose is to provide a public forum for the knowledge and ideas of scientists, engineers, and related experts. But along with their erudition can sometimes come a little arrogance and, with regard to *TR*'s niche in publishing, some ignorance as well. The expert-author knows the informational needs of his or her colleagues, as well as what's required for professional journals—where papers (as opposed to articles) are submitted mostly on a take-it-or-leave-it basis and little or no editing occurs. That expert-author is usually unfamiliar with the editorial process—both its nature and extent—in the altogether different world of journalistic publishing, which serves a much broader audience. In fact, experts often use the word "journalistic" pejoratively, not as a descriptor of professions fully as complex, arduous, and thorough as their own.

Presenting a delectable and nourishing feast to our readers means having to send some courses back to the kitchen.

The results of good journalism usually make it look easy. But the fact is that great effort is required of writers and editors to produce a successful article, much as the labors of hundreds of professionals come together to make a compelling movie, in which scene after scene appears to have popped effortlessly into view. The reader of an article should similarly feel as if it fell from a tree, fully ripened, onto the page.

General—that is, nonspecialist—readers, like theater audiences, require smooth execution to remain absorbed. But although few moviegoers get up and walk out when a film is disappointing, general readers will quickly stop reading. Retaining that audience's attention requires abandoning the notions that first drafts become final drafts with only a few cosmetic changes, and that editors who think otherwise are mischievous or hypercritical.

Judge our criteria for yourself:

- *The golden mean.* An article should be neither too narrow and esoteric on the one hand nor too broad and ambitious on the other. The first would fail to interest most of our readers; the second would be vague and fail to satisfy them.
- *From each according to one's ability.* An expert author should tell a story and take a position appropriate to his or her profession and expertise. A scientist should not come on like a politician, for example, or vice versa.
- *Follow-through.* Authors shouldn't litter the manuscript with long digressions or leave gaping holes. If they believe, say, that a certain program is a model worth emulating, they should explain why.
- *An exercise in teaching.* Technical descriptions should be clear and logical, and backed up with enough data, examples, or anecdotes for readers to stay tuned. Jargon or specialized references, when unavoidable, should be defined.
- *Share the experience.* Similarly, judgments and opinions should be preceded by discussions of whatever convinced the author in the first place.
- *Do unto others.* Besides offering their own points of view, authors should also provide brief but fair depictions of "the other side"—alternative points of view—so that readers can put the issues in context and draw their own conclusions.

The above items boil down to two very simple requirements that don't seem so forbidding or exclusive: that the author be credible and that the argument be of high quality. We don't expect such excellence right away; it evolves through the outlines and drafts, with readily provided editorial help, that are the necessary precursors to the final product. Ultimately, what we need from the author is not flawless style but reasonable content. If that's what it means to be "difficult to get into," then we're truly serving our readers.■

—Steven J. Marcus

Letters

LIGHTENING UP ON DESIGN

"Toward Human-Centered Design" by David Norman (*TR July 1993*) brings to mind three examples of imperfect design from my own experience.

First, my Saab 9000, though a wonderful automobile in most respects, has a central control panel that contains 50 (I counted them) push-buttons for temperature, defrosting, station select, sound volume, and so on. Each button performs its function properly, but it is nearly impossible to use any of them without taking one's eyes off the road.

My second example comes from my job. I've been a professional pilot for over 20 years and currently fly the Boeing 757 and 767. A high level of automation gives these excellent airplanes capabilities that would have been remarkable a few years ago. However, the design breaks down when some significant change of plan is introduced, which may happen because of an equipment failure or, more commonly, because of difficulty with the air traffic control system or the weather. The problem is that unless the computer is reprogrammed in these situations, it is useless. And reprogramming must often be done while landing preparation is being completed, which is an extremely busy time.

My third complaint is that the "autopilot/flight director system" (APFDS) control panel on the Boeing 757 and 767 has a drawback similar to that of the control panel on my Saab. It consists of a few knobs for selecting things like airspeed and altitude and many identical square push-buttons. When properly selected, these push-buttons will cause the aircraft to respond exactly as the pilot wishes. But on portions of most flights, safety depends on the pilot's ability to look outside the aircraft to avoid hazards, and the APFDS panel can't be operated by feel.

Pilot technique has evolved to compensate for such less-than-ideal design. Pilots are being taught that when automation is no longer a help, they should disregard it and operate the plane as if it were a Piper Cub, or a bicycle, or even a lawn mower. My suggestion to designers is that less thought be given to precise control and more to allowing the operator to make decisions based on direct observation. Look to the primitive machines or tools that work well and emulate them.

For example, steering a car probably requires hundreds, perhaps thousands, of small wheel adjustments per mile. Though that's a lot of "control input," almost anyone can do it. But imagine steering a car by reading a computed drift angle on a keypad with your index finger. Almost no one could do it. Or consider something even simpler, like the screwdriver. Exactly how much torque should you use in a given situation? Who cares? Your hand and arm will tell you when the screw is tight enough.

WILLIAM M. FERREE
Mont Vernon, N.H.

TMI AS A NON-DISASTER

In "Learning from Technological Disasters" (*TR August/September 1993*), Wade Roush includes a rather extensive discussion of the 1979 core-melting incident at Three Mile Island. But having spent my entire career in the nuclear industry, I find it difficult to categorize TMI as a disaster. There was no loss of life, no life-threatening dose of radiation to the public or the operators, and no property loss other than the reactor itself. There was, however, psychological damage to the public in the vicinity of TMI, caused by the media and the special interest groups whose livelihood depends on encouraging the Chicken Little syndrome.

Also, Roush is wrong in suggesting that democracy has been left out of the process for regulating the nuclear power industry. The Nuclear Regulatory Com-

mission obtains formal technical opinions on all its actions from the Advisory Committee on Reactor Safeguards, a 12-member statutory body made up of independent consultants and people from academe and the industry. The five NRC commissioners, appointed by the president, must be confirmed by the Senate. Open hearings are held on all phases of the rule-making and licensing process. And finally, a lawyer aided by two technical members heads the boards that conduct adjudicatory licensing hearings. Anyone in the public with proper standing can participate in these licensing hearings, and the boards' findings can be appealed to an appeal board, the NRC, and the federal courts.

PETER J. DAVIS
Paris, Va.

UNWARRANTED CONFIDENCE IN CELLULAR PHONES

It's one thing to let the fox guard the henhouse, but it's quite another to let him lecture us on the best way to stand guard. That is what *Technology Review* has done in publishing a commentary by Norman Sandler, a consultant to the cellular telephone industry, on the scare over the health effects of such phones (*"Panic Gluttons," TR October 1993*).

Sandler says that biological effects "have never been seen at the power and frequency of cellular phones," but he neglects to add that no one has ever looked. When he writes that scientists asked to give their opinions during the scare could not "conclude with absolute confidence" that cellular phones do not cause cancer, he implies that we are a small step away from being able to guarantee safety. Nonsense. The truth is that the industry has spent virtually nothing on health research. The government has not done much more.

As a senior official of the Food and Drug Administration told the Cellular Telecommunications Industry Association last summer, "It is simply too soon to assume that cellular phones are perfectly safe, or that they are hazardous—either assumption would be premature. This is precisely why additional research is needed." The FDA also chastised CTIA for "an unwarranted confidence that these products will be found to be absolutely safe."

The irony is that Sandler is doing exactly the opposite of what he is preaching. By so grossly misrepresenting the scientific evidence on cellular phones, he guarantees public distrust of future assurances that technologies are safe. When a truly baseless fear comes along, people will still press the panic button.

LOUIS SLESIN
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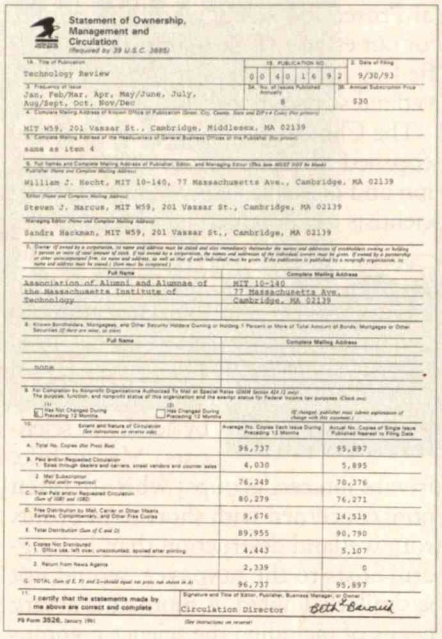
PROTECTING WETLANDS

As Douglas Thompson and Thomas Yocom note in "Uncertain Ground" (*TR August/September 1993*), resistance to wetland regulation is powerful. But it is useful to observe that in New England, where state wetland regulation preceded federal regulation by as much as 14 years, public support for local, state, and federal regulatory programs has been positive and strong. The federal agencies' failure to provide for public participation in developing the 1989 wetland delineation manual was probably a major error for many parts of the nation, as was the failure to insure that field personnel were adequately trained.

It's also worth pointing out that the segment of the agricultural community most vocal in its opposition to wetland regulation may be the one whose long-term interest is not in food but in land speculation for office parks, subdivisions, and shopping malls. After all, the soil maps that members of this community use as a tool identify wetland soils as high risk and low value for intensive agriculture.

Finally, science is just as important in dealing with wetlands as it is in dealing with farms or forests, and in the last year of the Bush administration the science community was excluded from the White House. Wetland scientists spent thousands of hours field testing the Quayle-Sununu wetland delineation manual independently and presenting evidence of its flaws to the Environmen-



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tal Protection Agency and the public. For our efforts, some of us were disqualified by Bush staffers as potential EPA wetland science panelists.

The Clinton administration has now reopened the door to scientific information and dialogue. However, in inviting scientists to participate in a recent series of seminars, the White House provided no budget to cover travel costs. This policy could limit participation by academic scientists. Meanwhile, private interest groups, who are often more concerned with short-term profits from wetland destruction than in long-term costs to the taxpayer, would not be similarly limited. A more satisfactory means of including the science community in forming federal wetland policy needs to be developed.

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BIRDS IN JEOPARDY

In "Progress for the Birds" (*TR July 1993*), Samuel Florman states that because of the number of protected areas, including national forests, national wildlife refuges, and national parks, he is not pessimistic about the future for many bird species.

He seems unaware that most professional ornithologists, avian ecologists, and birders are concerned about the degraded state of habitat within these "protected" areas. Nor does he seem to know that the northern spotted owl and the marbled murrelet, for instance, are severely threatened by logging of old-growth forests in the Pacific Northwest, and deep-forest dwellers like the wood thrush are in serious trouble because of the fragmentation, which he extols, of eastern woodlands. It has also apparently escaped his notice that Partners in Flight, a major national effort involving federal, state, and private agencies, is under way precisely because there is disturbing evidence that many bird species are indeed declining, some precipitously. Unfortunately, Mr. Florman, in this particular column, fits the stereotype many biologists have of civil engineers, as people lacking knowledge of ecology.

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NIH DILEMMAS

In "What the Doctor Prescribes" (*TR Interview, October 1993*), Bernardine Healy fails to address two basic dilemmas that have plagued the National Institutes of Health throughout its history. One is whether to fund research at a wide range of universities or concentrate on a few elite institutions. Despite its mandate to do the former, the NIH has opted for the latter. As a result, many universities cannot provide research opportunities for their teaching faculty. Meanwhile, elite schools hire hundreds of researchers who do little or no teaching.

The second dilemma is how to set funding priorities. The NIH now lets university applicants submit proposals of their choice, which are reviewed by experts in the specialty. But these reviewers are not experts in the needs of the nation's health care system or in the mission of the NIH. The billions of NIH dollars spent in this way for research on cancer, AIDS, diabetes, arthritis, and other diseases have produced disappointingly few useful results. The NIH's standard reply that it is laying a groundwork of basic knowledge has lost credibility after almost four decades.

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VIRTUES OF VIRTUAL REALITY

In "Virtual Reality Check" (*TR October 1993*), Thomas Sheridan and David Zeltzer provide a thoughtful review of the current state of the art in the design and use of virtual environments. Granted, the field is not without challenges. Today's virtual environments fall far short of supplying visual, auditory, and tactile displays realistic enough to allow participants to suspend disbelief. Still, a great future lies ahead for virtual-environment technology.

The technology will be particularly beneficial for visualizing vast amounts of data and complex dynamic processes. Virtual-environment equipment also has the potential to significantly change the way we teach. Students could visit the Martian landscape, fly through an active volcano, or walk through the human body. Virtual reality will have interesting applications for the behavioral sciences as well, allowing participants to experience the world through the eyes and ears of others.

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SCIENCE ON THE AIR

In "Children's Science Radio" (*TR Trends, October 1993*), Simson Garfinkel reports on kids' reactions to Kinetic City Super Crew, a series of science radio programs used in their school classrooms. The producers have since modified the series based on the students' feedback, and our company has assessed the impact of the commercial broadcast of four half-hour episodes for the National Science Foundation.

We found that fourth graders in three schools in southern Maryland who heard the weekly programs at home liked them and wanted to hear more. The radio series attracted children irrespective of their ethnic group, prior attitudes toward science, and degree of experience in scientific activities. Interestingly, girls were significantly more likely to listen to the programs than boys.

Content tests indicated that the programs significantly increased children's knowledge and understanding of science phenomena. Listeners also reported doing more science activities at home during the four-week broadcast period.

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