The New York Times
nytimes.com

May 27, 2007

The Known World

By STEVEN PINKER

A baby sucks on a pencil and her panicky mother fears the child will get lead poisoning. A politician argues that hydrogen can replace fossil fuels as our nation's energy source. A consumer tells a reporter that she refuses to eat tomatoes that have genes in them. And a newsmagazine condemns the prospects of cloning because it could mass-produce an army of zombies.

THE CANON

A Whirligig Tour of the Beautiful Basics of Science.

By Natalie Angier.

293 pp. Houghton Mifflin Company. $27.

These are just a few examples of scientific illiteracy — inane misconceptions that could have been avoided with a smidgen of freshman science. (For those afraid to ask: pencil "lead" is carbon; hydrogen fuel takes more energy to produce than it releases; all living things contain genes; a clone is just a twin.) Though we live in an era of stunning scientific understanding, all too often the average educated person will have none of it. People who would sneer at the vulgarian who has never read Virginia Woolf will insouciantly boast of their ignorance of basic physics. Most of our intellectual magazines discuss science only when it bears on their political concerns or when they can portray science as just another political arena. As the nation's math departments and biotech labs fill up with foreign students, the brightest young Americans learn better ways to sue one another or to capitalize on currency fluctuations. And all this is on top of our nation's endless supply of New Age nostrums, psychic hot lines, creationist textbook stickers and other flimflam.

The costs of an ignorance of science are not just practical ones like misbegotten policies, forgone cures and a unilateral disarmament in national competitiveness. There is a moral cost as well. It is an astonishing fact about our species that we understand so much about the history of the universe, the forces that make it tick, the stuff it's made of, the origin of living things and the machinery of life. A failure to nurture this knowledge shows a philistine indifference to the magnificent achievements humanity is capable of, like allowing a great work of art to molder in a warehouse.

In "The Canon: A Whirligig Tour of the Beautiful Basics of Science," Natalie Angier aims to do her part for scientific literacy. Though Angier is a regular contributor to the Science Times section of this newspaper, "The Canon" departs from the usual treatment of science by journalists, who typically cover the "news," the finding that upsets the apple cart, rather than the consensus. Though one can understand why journalists tend to report the latest word from the front — editors' demand for news rather than pedagogy, and the desire to show that science is a fractious human activity rather than priestly revelation — this approach doesn't always serve a widespread understanding of science. The results of isolated experiments are more ephemeral than conclusions from literature reviews (which usually don't fit into a press release), and the discovery-du-jour approach can whipsaw readers between contradictory claims and leave them thinking, "Whatever."

Angier's goals are summed up in two words in her subtitle: beautiful basics. "The Canon" presents the fundamentals of science: numbers and probability, matter and energy, the origins and structure of living things, and the natural history of our planet, solar system, galaxy and universe. These are, she judges, the basics that every educated person should master, and a prerequisite to a genuine understanding of the material in any newspaper's science coverage. And she presents these basics as beautiful: worthy of knowing for their own sake, even if they won't help us save the planet, age successfully or compete with the Chinese.

"The Canon" begins on an engaging note, lamenting what is one of my pet peeves as well — the idea that science is something for kids. When their children turn 13, Angier notes, many parents abandon their memberships in zoos and science museums for more "mature" institutions like theaters and art museums. And who can blame them, when visiting a modern science museum, in her priceless description, consists of a "mad pinball pinging from one hands-on science exhibit to the next, pounding on knobs to make artificial earthquakes, or cranking gears to see Newton's laws in motion, or something like that; who bothers to read the explanatory placards anyway? And, oops, hmm, hey, Mom, this thing seems to have stopped working!" Many new science museums seem to be built on the dubious theory that a person's life interests are formed in childhood — that "just as the twig is bent, the tree's inclined." Instead they may be conveying the message "When I was a child ... I thought as a child: but when I became a man, I put away childish things."

Angier's first chapter, "Thinking Scientifically," makes the case for scientific literacy and portrays the mind-set of scientists. Anyone who knows a boffin (as the British affectionately call the women and men in white coats) will recognize the passionate and irreverent voices of her subjects. ("Most of the time," one of them tells her, "when you get an amazing, counterintuitive result, it means you screwed up the experiment.") Thankfully, she does not try to render something called "the scientific method" (a phrase that never passes the lips of a real scientist) but conveys the idea that science is just the attempt to understand the world with a special effort to ensuring that the things you say about it are true.

The remaining chapters cover probability, large and small numbers, physics, chemistry, evolutionary and molecular biology, geology and astronomy. Though the material is up-to-date, Angier stays clear of cutting-edge discoveries and in-house controversies. She also wisely avoids the dreary peace-and-ecology sermon with which so many scientists feel they must conclude their popular books.

Every author of a book on science faces the challenge of how to enliven material that is not part of people's day-to-day concerns. The solutions include the detective story, the suspenseful race to a discovery, the profile of a colorful practitioner, the reportage of a raging controversy and the use of a hook from history, art or current affairs. The lure that Angier deploys is verbal ornamentation: her prose is a blooming, buzzing profusion of puns, rhymes, wordplay, wisecracks and Erma-Bombeckian quips about the indignities of everyday life. Angier's language is always clever, and sometimes witty, but "The Canon" would have been better served if her Inner Editor had cut the verbal gimmickry by a factor of three. It's not just the groaners, like "Einstein made the pi wider," or the clutter, like "So now, at last, I come to the muscle of the matter, or is it the gristle, or the wishbone, the skin and pope's nose?" The deeper problem is a misapplication of the power of the verbal analogy in scientific exposition.

A good analogy does not just invoke some chance resemblance between the thing being explained and the thing introduced to explain it. It capitalizes on a deep similarity between the principles that govern the two

things. When Richard Dawkins, discussing the evolution of aggressive standoffs between animals in "The Selfish Gene," wanted to explain that any signal of a wavering will should be disfavored by natural selection, he wrote, "The poker face would evolve." Dawkins intends the poker face not simply as a metaphor that conveys a visual image (say, like the one a writer might use to depict a sphinx), but as an allusion to a deeper principle, an allusion that allows one to understand the phenomenon. Just as a poker player actively tries to hide his reactions, natural selection may select against features of an organism that would otherwise divulge its internal state. And just as it would do no good for the poker player to lie about his hand (because the other players would learn to ignore the lie), selection would not favor an animal giving a false signal about its intentions (because its adversaries would evolve to ignore the signal). Moreover, the analogy allows one to make a prediction: that just as an adversary in poker will develop increasingly sensitive radar for any twitch or body language that leaks through — the "tell" — animals may evolve increasingly sensitive radar for any tells in their rivals. A good analogy helps you think: the more you ponder it, the better you understand the phenomenon.

But all too often in Angier's writing, the similarity is sound-deep: the more you ponder the allusion, the worse you understand the phenomenon. For example, in explaining the atomic nucleus, she writes, "Many of the more familiar elements have pretty much the same number of protons and neutrons in their hub: carbon the egg carton, with six of one, half dozen of the other; nitrogen like a 1960s cocktail, Seven and Seven; oxygen an aria of paired octaves of protons and neutrons." This is showing off at the expense of communication. Spatial arrangements (like eggs in a carton), mixed ingredients (like those of a cocktail) and harmonically related frequencies (like those of an octave) are all potentially relevant to the structure of matter (and indeed are relevant to closely related topics in physics and chemistry), so Angier forces readers to pause and determine that these images should be ignored here. Not only do readers have to work to clear away the verbal overgrowth, but a substantial proportion of them will be misled and will take the flourishes literally. (Trust me: I've graded exams.)

Still, "The Canon" is never dull or obscure, and despite the distracting wordplay, most of Angier's explanations are anything but superficial. She conveys the real substance of field after field, without distortion or dumbing down, and often her sensual descriptions (of the interior of a cell, a star or the Earth, for instance) leave the reader with images both vivid and useful. "The Canon" is an excellent introduction (or refresher) to the beautiful basics of science, and I hope it is widely read. It could make the country smarter.

Steven Pinker is Johnstone professor of psychology at Harvard University. His seventh book, "The Stuff of Thought: Language as a Window Into Human Nature," will be published in September.