JOURNAL OF CHEMICAL EDUCATION

Commentary

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Book and Media Recommendations: *What If?*; *The Lifecycle of Software Objects*; *Sapiens: A Brief History of Humankind*; and *Gulp: Adventures on the Alimentary Canal*

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ABSTRACT: Four books are reviewed: *What If?* by Randall Munroe, *The Lifecycle of Software Objects*, by Ted Chiang, *Sapiens: A Brief History of Humankind* by Yval Noah Harari, and *Gulp*, by Mary Roach.

KEYWORDS: *General Public, Interdisciplinary/Multidisciplinary, Humor/Puzzles/Games, History/Philosophy, Public Understanding/Outreach, Forensic Chemistry, Professional Development*

From hypothetical scenarios with mind-boggling answers, to the evolution of humans and software, and culminating in a journey through the digestive system, these four books will provide the reader with a range of questions and ideas about science to consider over the summer.

WHAT IF?

Students often have a predilection for dangerous and dramatic hypothetical queries. What if I drank this hydrochloric acid? What if I put this in the Bunsen burner? Randall Munroe, who worked at NASA before creating the enormously popular webcomic xkcd,[1] shares their predilection. His book *What If?*[2] draws from and expands upon material from his blog by the same name, where Munroe crafts answers to hypothetical questions such as "How high can a human throw something?"

Munroe navigates the questions with charming stick-figure illustrations and self-referential humor, arriving at outlandish and often perilous conclusions. The explanations themselves are highly satisfying, requiring the application of physics, chemistry, biology, mathematics, sociology, and other branches of science to support Munroe's predictions for the various scenarios. For example, one question ponders the existence of a mole (as in Avogadro's number) of moles (as in the small subterranean mammal). To answer, he begins by addressing the aspects of mass and volume, but then considers microbiology, geochemisty, and the possibility of human colonization of space in his answer. In drawing from so many different domains, he eschews the "spherical cow in a vacuum", demonstrating that science does not operate apart from context. Munroe has a talent for identifying the salient features of a phenomenon and drawing appropriate analogies to explain scientific concepts. However, I did notice a few inaccuracies in the text, such as the inclusion of ammonia in a list of chemical elements.

Science educators, aware of the difficulty of trying to communicate a sense of how big or how small a measurement is, will appreciate Munroe's use of pop-culture and humor to bring measurements to life. For example, in answering "What place on Earth would allow you to freefall the longest by jumping off it?", Munroe concludes that the duration of that fall would be 26 s, which he puts into perspective by describing it as the amount of time required for a flawless play-through of Super Mario World 1−1. (Other cultural references include: Felix Baumgartner, *Jurassic Park*, Beyoncé, *Lion King*, Wagner, Spinal Tap, and the requisite Tolkien and *Star Wars*.) This ability to provide perspective is especially important for some of the extreme, bordering on absurd scenarios that surpass a human scale of observation.

Although I derived great pleasure from reading this book, I could see the utility of *What If?* in the science classroom: using it to entice students disinterested in nonfiction reading, or to illustrate how to employ Fermi estimation, or even as inspiration for assignments where students solve similar hypothetical problems.

THE LIFECYCLE OF SOFTWARE OBJECTS

Ted Chiang's science fiction novella, *The Lifecycle of Software Objects*[3] (Figure 1), reminded me of the Tamagotchi craze of the 1990s. The simulation game required players to feed, play with, and clean up after a virtual pet. Chiang's story follows the

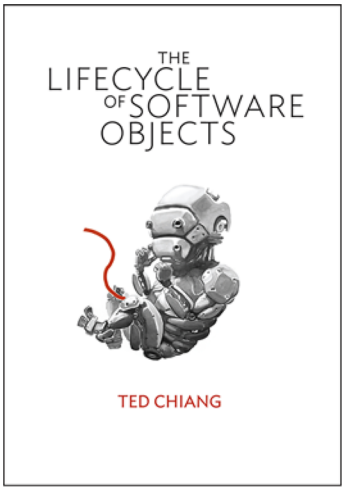

Figure 1. *The Lifecycle of Software Objects*[3] cover image provided by Subterranean and reproduced with permission.

Published: June 11, 2015

DOI: 10.1021/acs.jchemed.5b00235
J. Chem. Educ. 2015, 92, 1143−1145

rise and fall of another, albeit more sophisticated, virtual pet, the digient.

Digients, designed with the capacity to learn and acquire language, could be interacted with via a virtual world. Protagonist Ana Alvarado's job was to train these "digients" to explore their potential for learning and help guide further software development. She continued to supervise the first-generation digients as the product became available to the masses. The popularity of interacting with digients in the virtual world soon led to the production of prosthetic bodies so that humans could interact with digients in their own analog world.

The third-person omniscient narration in present tense allows concise expository passages and even briefer dialogue among the characters. Chiang was frugal with words, but the austere prose did not detract from the story. Rather, it enhanced Chiang's ability to depict the action across years at a time. This allowed him to explore what happened when the popularity of digients waned. Like raising a real living being, digients needed sustained, long-term interaction to avoid "going feral". Once the novelty wore off and the onerous responsibility became evident, society largely abandoned the software.

This is the heart of Chiang's story: Ana and other stalwart digient owners faced crippling shifts in technology and a society that could not comprehend their devotion to their digient companions. Chiang's human characters encountered several classic ethical dilemmas of artificial intelligence. What rights do digients have? When, if ever, should the human owners permit the digients to make choices about their own futures? What is the range of relationships that humans could and should have with digients? Do humans have a moral obligation to protect digients from suffering, neglect, or low self-actualization? When, if ever, is it acceptable to clone digients? As the digients' futures look progressively bleaker, choices the humans once considered immoral began to look less repugnant.

Chiang wove all of these issues into a compact story without seeming heavy-handed or didactic. More incredibly, he was able to include poignant scenes that left me feeling a range of emotions as I followed the plight of the digients and their owners. The only disappointment was in the ending; Chiang sidestepped a firm conclusion and left room for the reader's imagination to continue the story. Regardless, I was captivated by the story in *The Lifecycle of Software Objects* and look forward to reading more by Chiang in the future.

SAPIENS: A BRIEF HISTORY OF HUMANKIND

I spent much of my early life (when I was not feeding my Tamagotchi) in perennial wait for the next installment of Jean Auel's Earth's Children series, so I was eager to read Yval Noah Harari's *Sapiens: A Brief History of Humankind*[4] (Figure 2). I looked forward to a description of the crucial shifts that occurred to bring *Homo sapiens* from hunter-gatherers to today's city dwellers, grounded in up-to-date research. It also had great reviews, a 4.5-star rating and it was on Amazon's Best Book of the Month list when I selected it. The first part of the book did not disappoint; I was captivated by the descriptions of how early humans interacted with prehistoric Earth. Harari describes how humans gained dominion over other species, ascribing this achievement to the "cognitive revolution". The second part of the book describes the "agricultural revolution", as humans abandoned their nomadic lifestyles and settled into farming communities. This was followed by the "scientific revolution".

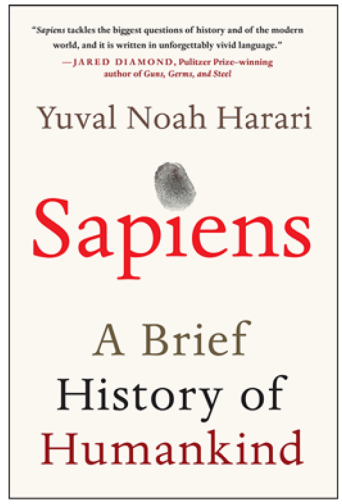

Figure 2. *Sapiens: A Brief History of Humankind*[4] cover image provided by Harper and reproduced with permission.

In the first part, Harari presents conflicting theories and weighs in with his own voice as to which seems best supported by the available evidence. Each chapter ends with questions and cliffhangers, spurring the reader forward into the next. As the human story progresses, there are fewer citations and more statements that left me scratching my head. For example, Harari describes China as accepting the culture of "former Western overlords". Another story Harari relates is about Neil Armstrong and Buzz Aldrin carrying a Native American tribal message with them to the moon. A quick Google search revealed this account was first relayed by Johnny Carson in his *Tonight Show* monologue.[5] Later in the book, he contrasted the ancient remedy for chapped hands—rubbing them with olive oil—to the modern solution that the scientific revolution has provided us, listing the chemical names for the ingredients in hand cream. However, the first five ingredients listed after water are present in olive oil! This type of rhetoric only serves to promote chemophobia and mistrust of science, and seems more appropriate for a blog touting the latest "natural" remedy for measles.

After reviewing our progress in the context of these revolutions, Hariri offers his comments on whether we, as individuals, are happier since they have occurred, and makes predictions about how science and technology will propel the continued evolution of *Homo sapiens*. However, the undocumented claims and nonsequiturs of *Sapiens: A Brief History of Humankind* interrupted my journey through the text like speed bumps in a residential neighborhood. I reached the end, but because Hariri had lost nearly all credibility at that point, his conclusions bounced off me like a stone off a windshield.

GULP: ADVENTURES ON THE ALIMENTARY CANAL

In contrast, the bizarre stories and experiments in *Gulp: Adventures on the Alimentary Canal*[6] are thoroughly cited. Author Mary Roach has done her homework for this book, including hiring a translator so she could access a 1891 article written in German about a patient whose stomach had ruptured, and the subsequent experiments performed on cadavers in order to investigate the organ's capacity. Thoroughly researched does not at all imply this is a stuffy or academic tome. Instead, this book links anecdotes and

DOI: 10.1021/acs.jchemed.5b00235
J. Chem. Educ. 2015, 92, 1143−1145

adventures loosely related to the topic at hand, bolstering them with descriptions of research and her personal conversations with scientists. Roach breaks down the sterile and impersonal stereotype of science by profiling many of the researchers whose work she described. Several less likely characters included in the book's cast are Elvis Presley's physician, a prison inmate, and a French Canadian trapper.

Although taste, chewing, nutrient absorption, and elimination are commonplace activities, Roach makes them seem exotic as she explores these topics through pet food manufacturing, nutritional fads from a century ago, a plausible reason for the origin of fire-breathing dragon myths, and many more unexpected contexts. I could see the possibility of Roach as a guest author for Randall Munroe's blog, answering fantastic questions like: How much flatulence would it take to poison a person? How much food would it take to burst a person's stomach? How many years could a person survive with a bullet wound that permits a direct view into his stomach? I hate to give anything away, but the answer to all of these is "More than you would guess."

Roach does not take herself too seriously, peppering her text with quips and puns *ad nauseam*. (As a fan of tasteless puns, I cannot complain.) If you are looking to learn about the biology and chemistry behind nutrition and digestion, this book will not sate your appetite. If you get queasy reading graphic descriptions of bodily functions and anatomy, some of these chapters will be tough to swallow. But if you want to be surprised and amused, and learn along the way, *Gulp* will satisfy.

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Notes

The authors declare no competing financial interest.

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