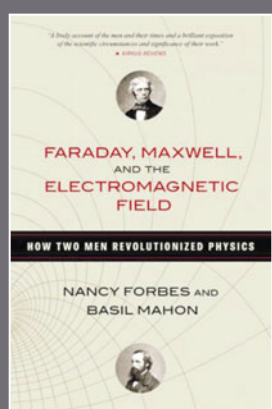




Ebook reads for the materials researcher



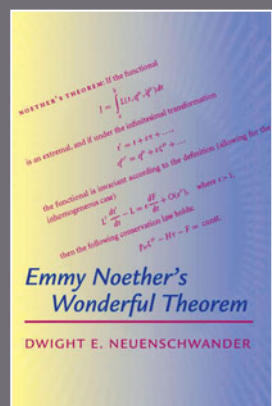
I spend a significant amount of my spare time in reading. Almost all of the books that I read are in ebook form. I only buy a paper book when I absolutely must have it immediately and it's unavailable as an ebook. I use the Kindle app on my iPad for technical books because of the color graphics and equations. I use my Kindle device for fiction and other non-technical books. All of the following books that I'm recommending are available in ebook form.



Faraday, Maxwell, and the Electromagnetic Field: How Two Men Revolutionized Physics, by Nancy Forbes and Basil Mahon, published by Prometheus Books in 2014, is far more than just a biography of Faraday and Maxwell. The theme of the book is the story of how the idea of electric and magnetic fields triumphed over physical objections involving rejection of action at a distance. The main protagonists are Michael Faraday and James Clerk Maxwell, two of

the giants in the development of our understanding of electricity and magnetism. The book describes how Faraday rose from poverty to become one of the most respected scientists in the world. An apprenticeship with Humphry Davy propelled Faraday forward. At that time studies in electricity and magnetism were an arcane art. Faraday used a deeply methodological approach to experiments to gain critical insights into the field. However, his knowledge of mathematics and formalism was greatly lacking. Maxwell was able to use his knowledge of

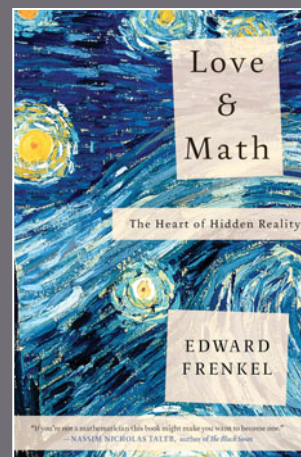
mathematics to develop the equations that bear his name that unified electricity and magnetism, but these results were driven by the detailed experimental results obtained by Faraday. Humphry Davy, Heinrich Hetz, Charles Augustin Coulomb, Luigi Galvani, Alessandro Volta, Oliver Heaviside, and others played important roles in the lives of Faraday and Maxwell, and are given credit for their roles in the development of these and other ideas.



Emmy Noether's Wonderful Theorem, by Dwight E. Neuenschwander, published by The Johns Hopkins University Press in 2011, combines a very readable biography of Emmy Noether with an exposition of work related to the theorem in the calculus of variations that bears her name, which has had major implications for many areas of modern science. The book details her struggles through an era that did not for the most part allow women a place in the halls of academia as well as during the rise of the Nazi party in Germany. In spite of those obstacles, she was able to complete a course of study at the University of Erlangen and pass the exams that allowed her to obtain the equivalent of a bachelor's degree. She then studied at the University of Göttingen, obtaining a doctoral degree under Paul A. Gordon. She returned to Göttingen later at the invitation of David Hilbert and Felix Klein, but had to lecture under Hilbert's name because women were not allowed on university faculty in Germany at that time. She fled to the United States because of the rise of Nazism, but died at a relatively young age following what was thought to be routine surgery. The book discusses extremal functionals, invariant functionals, the invariance of fields, gauge invariance, and other elements of this important area of mathematics and physics.

Love & Math: The Heart of Hidden Reality, by Edward Frenkel, is a book that I both love and hate. It was published by Basic Books in 2013. I love this book because it is very readable and it introduced me to ideas in mathematics of which I was completely unaware. I hate this book because it

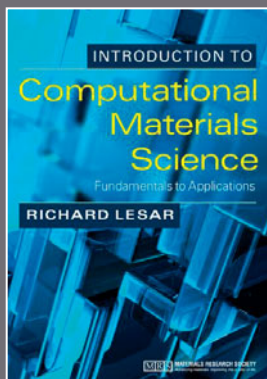
exposed to me how woefully ignorant I am about advanced mathematics. (It has also caused me to purchase a whole new set of books on advanced mathematics to try and fill that void!) The book is autobiographical and discusses the discrimination faced by the author as he attempted to attend the best institutions of higher learning in Russia, as well as his path to a successful career in mathematics. In terms of mathematics, the book discusses the Langlands Program (named after the mathematician Robert Langlands), which Frenkel describes as a community attempt to create a Grand Unified Theory of mathematics. The book shows connections between disparate elements across a broad range of





mathematics and connects some of those elements to problems in physics, including string theory. Despite the emphasis on mathematics, the book is very readable and enjoyable.

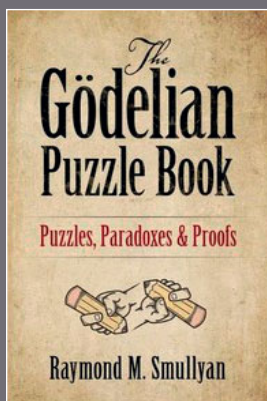
Recently, I have renewed my interest in modeling and simulation. To get an idea of what is going on in this area of materials research, I have begun to read two books: *Introduction to Computational Materials Science: Fundamentals to*



Applications by Richard LeSar and published by Cambridge University Press/Materials Research Society in 2013, as well as *Computational Materials Science* by June Gunn Lee, published by CRC Press in 2012. LeSar's book is aimed at upper level undergraduates with the goal to "introduce the basic methods used in the computational modeling of materials" including electronic structure meth-

ods, Monte Carlo methods, molecular dynamics, and other approaches to modeling and simulation. Lee's book is a more advanced text that deals with materials at the atomic and molecular level, using molecular dynamics, density functional theory, and first-principles methods. Both books are highly readable and engaging.

I have also become more interested recently in learning about magnetic materials, so I've started reading *Magnetic Materials: Fundamentals and Applications 2/e* by Nicola Spaldin, first published by Cambridge University Press in 2011. The book begins with a discussion of magnetic fields and magnetization, and the different types of magnetism; it discusses magnetic phenomena, and then device applications and novel materials. The book is highly readable and contains numerous figures that aid the reader.

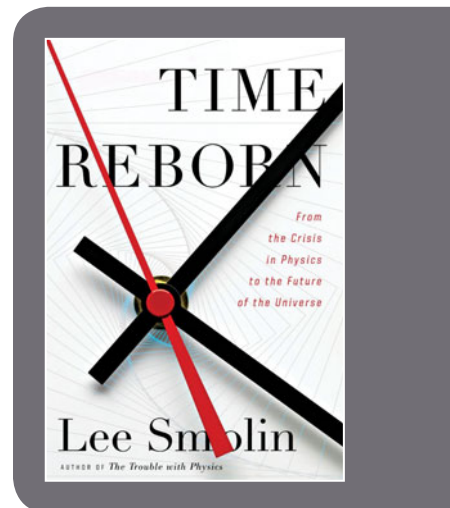


Beautiful Geometry by Eli Maor and Eugen Jost, published by Princeton University Press in 2014, is as much about the art of geometric form as it is about geometry. The mathematics is entertaining and the artwork is spectacular.

The Gödelian Puzzle Book: Puzzles, Paradoxes & Proofs by Raymond M. Smullyan, published by Dover Publications in 2013, is a book of recreational logic puzzles intended to illuminate ideas associated with Kurt Gödel's famous theorem,

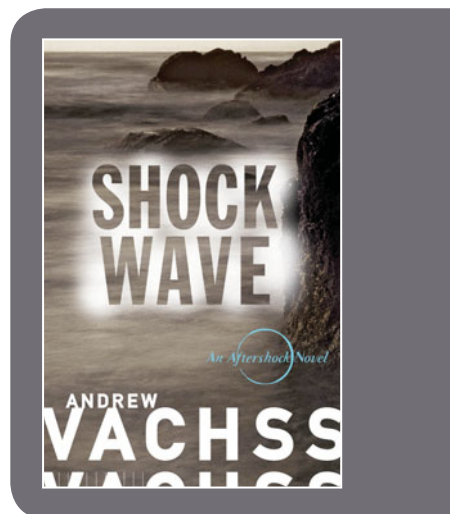
provability, undecidability, and the infinite. The puzzles and paradoxes presented are accompanied by proofs and solutions. One of the things that you will learn is that it is unwise to accept any wager from Smullyan.

Time Reborn: From the Crisis in Physics to the Future of the Universe, by Lee Smolin, published by Houghton Mifflin Harcourt in 2013, is an attempt to address the fundamental philosophical and physical question: What is time? Along the way to providing his answer to that question, Smolin addresses how our concepts of time affect our understanding of thermodynamics, quantum mechanics, cosmology, and other areas of science. Although you may not agree with Smolin's conclusions after reading the book, the book is provocative and well worth reading.



I have also been reading the science fiction novels in *The Expanse* series by James S.A. Corey, including *Leviathan's Wake*, *Caliban's War*, *Abaddon's Gate*, and *Cibola Burn*; *War to the Knife* by Peter Grant; *Skin Game*, *A Novel of the Dresden Files* by Jim Butcher; and *Barbarians at the Gates* by Christopher Nuttall. I often find that novels of science fiction and fantasy contain provocative ideas about materials science and science in general. In the adventure and mystery category, I have been reading *Wrecking Crew* by Nick Albert, *Shockwave: An Aftershock Novel* by Andrew Vachss, *The Keeper* by John Lescroart, and *The Watchman* by Adrian Magson. In the category of westerns, I have read *Adobe Walls* by Robert Vaughan and *Sundance* by David Fuller.

Shockwave: An Aftershock Novel by Andrew Vachss. The cover features a dark, moody landscape with a large wave crashing against a rocky shore.



In the category of westerns, I have read *Adobe Walls* by Robert Vaughan and *Sundance* by David Fuller.

If you read any of these books, I hope they give you as much enjoyment as they have given me. In closing, I must admit that I no longer browse in book stores because I feel guilty about browsing without any intention to buy from the bookseller since I only buy ebooks. I strongly prefer the reading experience of ebooks over the printed page, but I do miss browsing through new and used bookstores for good reads.

Steve Moss

Steve Moss