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I said, "Why should a pyramid
Stand always dully on its base?
I'll change it! Let the top be hid,
The bottom take the apex-place!"
And as I bade they did.

The people flocked in, scores on scores,
To see it balance on its tip.
They praised me with the praise that bores,
My godlike mind on every lip.
—Until it fell, of course.

And then they took my body out
From my crushed palace, mad with rage,
—Well, half the town was wrecked, no doubt—
Their crazy anger to assuage
By dragging it about.

The end? Foul birds defile my skull.
The new king's praises fill the land.
He clings to precept, simple, dull;
His pyramids on bases stand.
But—Lord, how usual!

Stephen Vincent Benét,
"The Innovator (A Pharaoh Speaks)" (1918)

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Singh, Kuldeep. **2013**. *Linear Algebra: Step by Step.* Oxford, U.K.: Oxford University Press. **Best linear algebra textbook (tie).**

Strang, Gilbert. **2016**. *Introduction to Linear Algebra.* 5th ed. Wellesley-Cambridge Press. Classic textbook on linear algebra that discusses many methods and applications.

Strang, Gilbert. **2006**. *Linear Algebra and Its Applications.* 4th ed. Boston: Cengage. Classic textbook on linear algebra that discusses many methods and applications.

Group Theory

Dresselhaus, Mildred, Gene Dresselhaus, and Ado Jorio. **2008**. *Group Theory: Application to the Physics of Condensed Matter.* Berlin: Springer. Provides more information on the applications of group theory in solid state physics.

Hamermesh, Morton. **1989**. *Group Theory and Its Application to Physical Problems.* Dover, reprinted. **Best group theory textbook.**

Tung, Wu-Ki. **1985**. *Group Theory in Physics.* Singapore: World Scientific. Provides more infor-

mation on the applications of group theory in particle physics.

General Physics

Bayman, Benjamin F., and Morton **Hamermesh**. **1986**. *A Review of Undergraduate Physics.* New York: Wiley.

Benenson, Walter, John W. Harris, Horst Stöcker, and Holger Lutz. **2006**. *Handbook of Physics.* 2nd ed. Berlin: Springer.

Cohen, E. Richard, David R. Lide, and George L. Trigg, eds. **2003**. *AIP Physics Desk Reference.* 3rd ed. Berlin: Springer.

Feynman, Richard P., Ralph B. Leighton, and M. L. Sands. **2011**. *The Feynman Lectures on Physics: The New Millennium Edition.* 3 vols. Basic Books. These lecture notes are famous for their clarity, creativity, and wide scope. They cover classical mechanics thoroughly but also have major sections on other areas of physics.

Hewitt, Paul G. **2014**. *Conceptual Physics.* 12th ed. New York: Pearson. **Best middle school physics textbook.**

Menzel, Donald H. **1960**. *Fundamental Formulas of Physics.* 2 vols. Dover.

Young, Hugh D., and Roger A. **Freedman**. **2019**. *University Physics with Modern Physics.* 15th ed. New York: Pearson. **Best high school or first university physics textbook.**

Experimental Physics

Dunlap, R. A. **1988**. *Experimental Physics: Modern Methods.* Oxford, U.K.: Oxford University Press.

Melissinos, Adrian C., and Jim **Napolitano**. **2003**. *Experiments in Modern Physics.* 2nd ed. Academic Press.

Moore, John H., Christopher C. Davis, and Michael A. Coplan. **2009**. *Building Scientific Apparatus.* 4th ed. Cambridge, U.K.: Cambridge University Press.

Classical Mechanics

Barger, Vernon, and Martin **Olsson**. **1994**. *Classical Mechanics: A Modern Perspective.* 2nd ed. New York: McGraw-Hill.

Fetter, Alexander L., and John Dirk **Walecka**. **2003**. *Theoretical Mechanics of Particles and Continua.* Dover.

Goldstein, Herbert, John L. Safko, and Charles P. Poole, Jr. **2001**. *Classical Mechanics.* 3rd ed. New York: Pearson.

Landau, L. D., and E. M. **Lifshitz**. **1976**. *Mechanics.* 3rd ed. Butterworth-Heinemann.

Morin, David. **2008**. *Introduction to Classical Mechanics: With Problems and Solutions.* Cambridge, U.K.: Cambridge University Press. **Best classical mechanics textbook.**

Electromagnetism

Griffiths, David J. **2012**. *Introduction to Electrodynamics.* 4th ed. Addison-Wesley. **Best electromagnetism textbook.**

Jackson, John David. **1998**. *Classical Electrodynamics.* 3rd ed. New York: Wiley. Excellent coverage of more advanced topics, and great reference book for scientists who have previously studied electromagnetism.

Landau, L. D., and E. M. **Lifshitz**. **1980**. *The Classical Theory of Fields.* 4th ed. Butterworth-Heinemann.

Landau, L. D., E. M. Lifshitz, and L. P. Pitaevskii. **1984**. *Electrodynamics of Continuous Media.* 2nd ed. Butterworth-Heinemann. Excellent coverage of more advanced topics, and great reference books for scientists who have previously studied electromagnetism.

Purcell, Edward M., and David J. **Morin**. **2013**. *Electricity and Magnetism.* 3rd ed. Cambridge, U.K.: Cambridge University Press. Good electromagnetism textbook.

Zangwill, Andrew. **2012**. *Modern Electrodynamics.* Cambridge, U.K.: Cambridge University Press. Excellent coverage of more advanced topics, and great reference book for scientists who have previously studied electromagnetism.

Statistical Physics

Kittel, Charles, and Herbert **Kroemer**. **1980**. *Thermal Physics.* 2nd ed. New York: W. H. Freeman. **Best statistical physics textbook (tie).**

Landau, L. D., and E. M. **Lifshitz**. **1980**. *Statistical Physics Part 1.* 3rd ed. New York: Pergamon Press.

Lifshitz, E. M., and L. P. **Pitaevskii**. **1980**. *Statistical Physics Part 2.* New York: Pergamon Press.

Lifshitz, E. M., and L. P. **Pitaevskii**. **1981**. *Physical Kinetics.* New York: Pergamon Press. These three volumes in the Landau and Lifshitz series and cover statistical physics and thermodynamics as seen by the brightest Russian theoretical physicists and go far, far beyond the topics treated in other statistical physics textbooks.

Reif, F. **1965**. *Fundamentals of Statistical and Thermal Physics.* New York: McGraw-Hill. Less readable than Kittel/Kroemer and Schroeder, but provides great coverage and is highly regarded.

Schroeder, Daniel V. **2000**. *An Introduction to Thermal Physics.* San Francisco: Addison Wesley

Longman. **Best statistical physics textbook (tie).**

Zemanski, Mark W., and Richard H. **Dittman**. **1981**. *Heat and Thermodynamics.* 6th ed. New York: McGraw-Hill. Avoid the 7th edition—it has lots of mistakes. Does a fairly good job bridging statistical physics and engineering thermodynamics.

Nonrelativistic Quantum Physics

Bohm, David. **1989**. *Quantum Theory.* 2nd ed. Dover.

Bohm, David, and Basil J. **Hiley**. **1995**. *The Undivided Universe: An Ontological Interpretation of Quantum Theory.* Routledge.

Eisberg, Robert, and Robert **Resnick**. **1985**. *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles.* 2nd ed. New York: Wiley. A good introductory book, with very broad overviews and good physical explanations but little mathematical detail.

Griffiths, David J., and Darrell F. **Schroeter**. **2018**. *Introduction to Quantum Mechanics.* 3rd ed. Cambridge University Press. **Best nonrelativistic quantum physics textbook (tie).**

Krane, Kenneth. **2012**. *Modern Physics.* 3rd ed. New York: Wiley. Another good introductory book, also with broad overviews and good physical explanations, and somewhat more mathematical detail than Eisberg and Resnick.

Landau, L. D., and E. M. **Lifshitz**. **1977**. *Quantum Mechanics (Non-relativistic Theory).* 3rd ed. Pergamon. The best advanced quantum book. Terse and much more fond of pure mathematics than physical explanations, but it is clearly a product of genius and contains things you will not find elsewhere.

Levine, Ira N. **2013**. *Quantum Chemistry.* 7th ed. Prentice-Hall. Contains much more information on molecules than quantum textbooks written by physicists do.

Liboff, Richard L. **2002**. *Introductory Quantum Mechanics.* 4th ed. Addison Wesley. **Best nonrelativistic quantum physics textbook (tie).**

Messiah, Albert. **2014**. *Quantum Mechanics.* Single-volume reprint of 2-volume original. Dover. Perhaps the most comprehensive quantum textbook, and cheap too!

Relativistic Quantum Physics

Griffiths, David J. **2008**. *Introduction to Elementary Particles.* 2nd ed. New York: Wiley. **Best relativistic quantum physics textbook.** This book is an excellent model of what textbooks should be but rarely are—wonderfully readable in a clear and concise way, broad in scope yet full of numerous detailed practical examples, and founded on physical insight as well as equations. It reviews special relativity and nonrelativistic quantum mechanics, then goes on to cover spinless “toy” relativistic quantum theories, QED, weak interactions, and QCD. Its major weaknesses are that it does not show exactly where the Feynman rules come from, shies away from the scary math needed to take most QED calculations to their conclusion, and omits any discussion of quantum gravity.

Berestetskii, V. B., E. M. Lifshitz, and L. P. Pitaevskii. **1982**. *Quantum Electrodynamics.* 2nd ed. Pergamon Press. This book shares the characteristic strengths and weaknesses of the other texts in the Landau and Lifshitz series. It is terse yet exhaustive in its treatment of its chosen subject, and it contains many examples and insights that simply cannot be found elsewhere. On the other hand, it champions mathematics over physical explanations and uses a somewhat different notation than most Western textbooks. Considering the detail that the authors lavish on spin-0 model theories and spin-$\frac{1}{2}$ QED, it is very regrettable that they did not also address the weak interactions, QCD, and quantum gravity.

Kaku, Michio. **1993**. *Quantum Field Theory: A Modern Introduction.* Oxford, U.K.: Oxford University Press. This is essentially the only field theory book that covers all four fundamental forces, and it is actually fairly decent. Its coverage of the material is somewhat uneven; for example, it gives an amazingly clear and thorough presentation of QED renormalization, yet it presents only a brief overview of most of QCD. It includes useful introductions to more advanced (and speculative) field theories, including grand unified theories, supersymmetry, and superstrings. Be warned that superstring theory is Kaku's real passion, so you should take his enthusiasm for it with several grains of salt.

Chen, Bryan Gin-ge, David Derbes, David Griffiths, Brian Hill, Richard Sohn, and Yuan-Sen Ting, eds. **2018**. *Lectures of Sidney Coleman on Quantum Field Theory.* Singapore: World Scientific. Like Kaku, Coleman's lectures show the theory behind the theory, but they go into far more detail than Kaku's book, and they have great nerd jokes too.

Attempting to outdo the 10-volume Russian physics series by Landau and Lifshitz, Walter Greiner and other German physicists have written a zillion-volume physics series, with at least 10 volumes just on quantum physics. That seems a bit excessive, but the following volumes provide more thorough coverage of the fundamental forces than can be found in other field theory books that try to cover all the forces in one book. They calculate just about everything that can be calculated, and they show every single step (unlike Griffiths)—pages and pages and pages of them:

Greiner, Walter. **2000**. *Relativistic Quantum Mechanics: Wave Equations.* 3rd ed. Berlin: Springer.

Greiner, Walter, and Berndt **Müller**. **1994**. *Quantum Mechanics: Symmetries.* 2nd ed. Berlin: Springer.

Greiner, Walter, and Joachim **Reinhardt**. **2009**. *Quantum Electrodynamics.* 4th ed. Berlin: Springer.

Greiner, Walter, and Berndt **Müller**. **2009**. *Gauge Theory of Weak Interactions.* 4th ed. Berlin: Springer.

Greiner, Walter, Stefan Schramm, and Eckart Stein. **2007**. *Quantum Chromodynamics.* 3rd ed. Berlin: Springer.

Feynman, Richard P. **2018**. *Feynman Lectures on Gravitation.* Boca Raton, Florida: CRC Press. While not as clear and insightful as *The Feynman Lectures on Physics*, this book may serve as an introductory textbook on quantum gravity, especially since there aren't really any other books competing for that job. At least as important as Feyman's actual presentation, the book also contains extensive introductions and a bibliography covering major developments in quantum gravity since Feynman worked on the problem in the early 1960s.

Birrell, N. D., and P. C. W. **Davies**. **1982**. *Quantum Fields in Curved Space.* Cambridge U.K.: Cambridge University Press. This is yet another book which is recommended chiefly because of its lack of competitors. It does indeed describe how quantum field theory changes when it occurs in curved instead of flat spacetime. However, it devotes surprisingly little attention to unique physical effects which should result, and it does not spell out how curved spacetime affects the Feynman rules so that readers may work out physical effects themselves. Perhaps that is because little is actually known about those areas. Useful advances in understanding may have occurred since this book was written.

Penrose, Roger. **2004**. *The Road to Reality: A Complete Guide to the Laws of the Universe.*

Relativity

Taylor, Edwin F., and John A. **Wheeler**. **1966**. *Spacetime Physics.* 2nd ed. New York: W. H. Freeman. A very readable introduction to special relativity.

Epstein, Lewis C. **1985**. *Relativity Visualized.* Insight Press. A non-mathematical yet very physically insightful introduction to special and general relativity.

Kenyon, I. R. **1990**. *General Relativity.* Oxford, U.K.: Oxford University Press. This is probably the best introductory general relativity textbook—very concise without sacrificing much detail or scope, with shorter yet better explained derivations than most other general relativity books.

Taylor, Edwin F., and John A. **Wheeler**. **2000**. *Exploring Black Holes: Introduction to General Relativity.* New York: Addison Wesley Longman. A very readable if incomplete and idiosyncratic introduction to general relativity.

Wheeler, John A. **1990**. *A Journey into Gravity and Spacetime.* New York: Scientific American. A very simple introduction to general relativity with beautiful illustrations and virtually no equations.

Schutz, Bernard. **2003**. *Gravity from the Ground Up: An Introductory Guide to Gravity and General Relativity.* Cambridge University Press. This is another introductory book that avoids extensive math and gives fairly good explanations.

Misner, Charles W., Kip S. Thorne, and John A. Wheeler. **1973**. *Gravitation.* New York: W. H. Freeman. Often called the "Big Black Phone Book of Gravity," this textbook looks truly imposing, but it gives clearer and more physically intuitive pictures of general relativity theory than can be found in most other textbooks (which is not saying much). Other nice features are its presentations of multiple ways of looking at certain things (e.g. multiple, different derivations of Einstein's gravitational field equation) and its comprehensive nature (at least for its time; there have been a few new and possibly even useful ideas in general relativity theory since 1973).

These four books are longer than Kenyon, shorter than Misner, Thorne, and Wheeler, and more up-to-date than the latter. They are roughly comparable to each other, although sometimes one will have better coverage on a particular topic than the others:

Carroll, Sean. **2003**. *Spacetime and Geometry: An Introduction to General Relativity.* Benjamin Cummings.

d'Inverno, Ray. **1992**. *Introducing Einstein's Relativity.* Oxford, U.K.: Oxford University Press.

Hartle, James B. **2003**. *Gravity: An Introduction to Einstein's General Relativity.* Benjamin Cummings. **Best general relativity textbook (tie).**

Ohanian, Hans C., and Remo **Ruffini**. **2013**. *Gravitation and Spacetime.* 3rd ed. Cambridge, U.K.: Cambridge University Press. **Best general relativity textbook (tie).**

General Nuclear Engineering

Shultis, J. Kenneth, and Richard E. **Faw**. **2016**. *Fundamentals of Nuclear Science and Engineering.* 3rd ed. Boca Raton, Florida: CRC Press. **Best single-volume book on nuclear engineering.**

Nuclear Physics

Blatt, John M., and Victor F. **Weisskopf**. **1952**. *Theoretical Nuclear Physics.* New York: Dover. An exhaustively detailed yet readable presentation of most aspects of nuclear physics. It only betrays its age in a few places, such as its discussions of the shell model and beta decay.

Brookhaven. **2019**. Nuclear Wallet Cards. Brookhaven National Laboratory. https://www.nndc.bnl.gov/wallet/wallet11.pdf

Brunelli, B., and **Leotta**, G. G., eds. **1987**. *Muon-Catalyzed Fusion and Fusion with Polarized Nuclei.* Plenum Press. A decent introduction to muon-catalyzed and spin-polarized fusion.

deShalit, Amos, and Herman **Feshbach**. **1974**. *Theoretical Nuclear Physics Volume I: Nuclear Structure.* New York: Wiley. Volume II: Herman Feshbach. 1992. *Theoretical Nuclear Physics: Nuclear Reactions.* New York: Wiley. These two volumes neglect many key topics (α decay, the deuteron, fission, fusion, etc.) despite their combined 1900-page length, and they thoroughly obfuscate other topics, particularly in the second volume. However, they do provide modern, detailed accounts of nuclear models, beta decay, and gamma decay. The first chapter is a helpful overview.

Knolls. **2010**. *Nuclides and Isotopes: Chart of the Nuclides.* 17th ed. Knolls Atomic Power Laboratory.

Krane, Kenneth S. **1988**. *Introductory Nuclear Physics.* New York: Wiley. **Best nuclear physics textbook.**

Segrè, Emilio. **1977**. *Nuclei and Particles.* 2nd ed. Reading, Massachusetts: Benjamin Cummings. Expanding on ca. 1950 lecture notes by his mentor Enrico Fermi, Segrè adopted Fermi's concise, physically intuitive style. The result is a phenomenal textbook, simultaneously very readable, scientifically detailed, and far-ranging. Sadly it is long out of print.

Wagemans, Cyriel. **1991**. *The Nuclear Fission Process.* Boca Raton, Florida: CRC Press. This reference and those it cites are good for filling the gaps in nuclear physics textbooks regarding fission reactions.

Nuclear Fuel

Benedict, Manson, Thomas H. Pigford, and Hans Wolfgang Levi. **1981**. *Nuclear Chemical Engineering.* 2nd ed. New York: McGraw-Hill. **Best (and only?) textbook on fission fuel enrichment, processing, and disposal.**

Fission Reactors

Cacuci, Dan Gabriel. **2010**. *Handbook of Nuclear Engineering.* 5 vols. Berlin: Springer.

Glasstone, Samuel, and Alexander **Sesonske**. **1981**. *Nuclear Reactor Engineering.* 3rd ed. New York: Van Nostrand Reinhold.

Glasstone, Samuel, and Alexander **Sesonske**. **1994**. *Nuclear Reactor Engineering.* 4th ed. 2 vols. New York: Chapman & Hall. These editions of Glasstone Sesonske each contain a fair amount of material that is not in the other. This is a very clear and readable textbook which presents a modern view of virtually all aspects of fission reactors. Glasstone wrote a zillion different nuclear reactor textbooks with various titles, co-authors, and edition numbers. All of them are quite riveting.

Lamarsh, John R., and Anthony J. **Baratta**. **2017**. *Introduction to Nuclear Engineering.* 4th ed. New York: Pearson. **Best fission reactor textbook.**

Weinberg, Alvin M., and Eugene P. **Wigner**. **1958**. *The Physical Theory of Neutron Chain Reactors.* Chicago: University of Chicago Press. This classic book presents some of the heavier-duty mathematical techniques which are necessary for detailed analysis of realistic reactors.

Zerriffi, Hisham, and Annie **Makhijani**. **2000**. *The Nuclear Alchemy Gamble.* Institute for Energy and Environmental Research. www.ieer.org/reports/transm/report.pdf Although this report is skeptical of the practicality of transmutation for fission reactor waste products, it gives a fairly good overview of transmutation approaches and the waste isotopes for which transmutation would be most useful.

Plasma Physics and Fusion

Chen, Frances F. **2018**. *Introduction to Plasma Physics and Controlled Fusion.* 3rd ed., corrected. Berlin: Springer. **Best plasma physics textbook.**

Freidberg, Jeffrey, ed. **2010**. *Research Needs for Fusion-Fission Hybrid Systems.* U.S. Department of Energy. www.er.doe.gov/ofes/FESAC/March_2010/Hybrid%20Report%20Final%20v4.pdf

Freidberg, Jeffrey P. **2014**. *Ideal MHD.* 2nd ed. Cambridge, U.K.: Cambridge University Press. This authoritative textbook on magnetohydrodynamics provides detailed analysis of the equilibrium and stability of a number of cylindrical and toroidal plasma systems.

Glasstone, Samuel, and Ralph H. **Lovberg**. **1960**. *Controlled Thermonuclear Reactions.* Van Nostrand.

Helander, Per, and Dieter J. **Sigmar**. **2002**. *Collisional Transport in Magnetized Plasmas.* Cambridge, U.K.: Cambridge University Press. This textbook is a detailed treatment of an area of plasma physics that is slighted in most other textbooks.

Leontovich, Mikhail A., ed. **1965–**. *Reviews of Plasma Physics.* New York: Consultants Bureau. This series of Russian books covers various topics in plasma physics that are not adequately treated in standard textbooks. The articles on transport by S. I. Braginskii (Vol. 1) and D. V. Sivukhin (Vol. 4) are particularly noteworthy.

Miyamoto, Kenro. **2016**. *Plasma Physics for Controlled Fusion.* 2nd ed. Berlin: Springer. No other book provides as many details about as many aspects of plasma physics and fusion. However, the wholesale regurgitation (without digestion) of complicated derivations from the literature and the lack of an organized approach to carefully introduce successive concepts make this book more of a reference work than an educational textbook.

Rose, David J., and Melville **Clark**, Jr. **1961**. *Plasmas and Controlled Fusion.* Cambridge, Massachusetts: MIT Press. Even though parts of Glasstone & Lovberg and Rose & Clark are now somewhat out of date, these books do what more modern texts fail to do: give an orderly, unified presentation of the physics and engineering required to create a fusion reactor. The books are excellent and have much in common, yet they are complementary. Glasstone & Lovberg presents wonderful physical intuition but sometimes fails to back it up with a proper mathematical derivation, and on the other hand Rose & Clark sometimes makes the math more complicated than necessary.

Nuclear Weapons

Atzeni, Stefano, and Jürgen **Meyer-Ter-Vehn**. **2004**. *The Physics of Inertial Fusion: Beam Plasma Interaction, Hydrodynamics, Hot Dense Matter.* Oxford, U.K.: Oxford University Press.

Coster-Mullen, John. **2012**. *Atom Bombs: The Top Secret Inside Story of Little Boy and Fat Man.* Self-published.

Fortov, Vladimir E. **2016**. *Extreme States of Matter: High Energy Density Physics.* 2nd ed. Berlin: Springer.

Glasstone, Samuel, and Philip J. **Dolan**. **1977**. *The Effects of Nuclear Weapons.* 3rd ed. Washington, D.C.: U.S. Government Printing Office. True to the title, the book focuses on weapons effects and shies away from weapons designs.

Gsponer, André, and Jean-Pierre **Hurni**. **2009**. *The Physical Principles of Thermonuclear Explosives, Inertial Confinement Fusion, and the Quest for Fourth Generation Nuclear Weapons.* Geneva: Independent Scientific Research Institute. Discusses the physics of inertial confinement fusion, nuclear bombs, and speculative designs for miniaturized nuclear weapons.

http://isri.ch/wiki/_media/publications:ag-09-01.pdf
https://cryptome.org/2014/06/wmd-4th-gen-quest.pdf

Hansen, Chuck. **1988**. *U.S. Nuclear Weapons.* New York: Orion. Compiles a massive amount of information on the history of nuclear weapons and some information on their physics.

Hansen, Chuck. **2007**. *Swords of Armageddon.* 2nd ed. CD-ROM. www.uscoldwar.com Compiles a massive amount of information on the history of nuclear weapons and some information on their physics.

Lindl, J. D. **1998**. *Inertial Confinement Fusion.* Berlin: Springer. This is the official bible of declassified information on the U.S. inertial confinement fusion program.

Paine, C. E., M. McKinzie, and T. B. Cochran. **2000**. *When Peer Review Fails.* Natural Resources Defense Council. This critique of how the U.S. inertial confinement fusion program has been run contains some good points and useful numbers.

Pondrom, Lee G. **2018**. *The Soviet Atomic Project: How the Soviet Union Obtained the Atomic Bomb.* Singapore: World Scientific.

Reed, Bruce Cameron. **2015**. *The Physics of the Manhattan Project.* 3rd ed. Berlin: Springer.

Reed, Bruce Cameron. **2019**. *The History and Science of the Manhattan Project.* 2nd ed. Berlin: Springer.

Serber, Robert. **1992**. *The Los Alamos Primer: The First Lectures on How to Build an Atomic Bomb.* Berkeley, California: University of California Press. A brief, unclassified introduction to fission bomb physics which is also fascinating for historical reasons.

Sublette, Carey. **2020**. *The Nuclear Weapon Archive/Nuclear Weapons Frequently Asked Questions.* http://nuclearweaponarchive.org **The only unclassified "textbook" on the physics of nuclear weapons designs.**

Teller, Edward, Wilson K. Talley, Gary H. Higgins, and Gerald W. Johnson. **1968**. *The Constructive Uses of Nuclear Explosives.* New York: McGraw-Hill.

Winterberg, Friedwardt. **1981**. *The Physical Principles of Thermonuclear Explosive Devices.* New York: Fusion Energy Foundation.

Winterberg, Friedwardt. **2010**. *The Release of Thermonuclear Energy by Inertial Confinement: Ways Towards Ignition.* Singapore: World Scientific.

Particle Accelerators

Chao, Alexander Wu, Karl Hubert Mess, Maury Tigner, and Frank Zimmermann. **2013**. *Handbook of Accelerator Physics and Engineering.* 2nd ed. Singapore: World Scientific. **Best particle accelerator textbook.**

Conte, Mario, and William W. **MacKay**. **2008**. *An Introduction to the Physics of Particle Accel-*

erators. 2nd ed. Singapore: World Scientific.

Humphries, Stanley, Jr. **1986**. *Principles of Charged Particle Acceleration.* New York: Wiley. (Reprinted by Dover, 2012.)

Humphries, Stanley, Jr. **1990**. *Charged Particle Beams.* New York: Wiley. (Reprinted by Dover, 2013.) Textbooks on particle accelerators are relatively scarce, but the two volumes by Humphries do a good job of covering particle acceleration, focusing, and beam maintenance.

Livingston, Milton S., and John P. **Blewett**. 1962. *Particle Accelerators.* New York: McGraw-Hill.

Nuclear Medicine

Knoll, Glenn F. **2000**. *Radiation Detection and Measurement.* 3rd ed. New York: Wiley. Radiation dosimetry and other aspects of radiation sensors.

Wagner, Henry N., Zsolt Szabo, and Julia W. Buchanan, eds. **1995**. *Principles of Nuclear Medicine.* 2nd ed. Saunders. Thorough coverage of diagnostic and therapeutic nuclear medicine as of when it was published. It is long overdue for an update or replacement by a comparable new textbook.

General Mechanical Engineering

Lindeburg, Michael R. **1992**. *Engineer-In-Training Reference Manual.* 8th ed. Belmont, California: Professional Publications. Useful summaries of subjects in mechanical engineering, electrical engineering, and other areas.

Sadegh, Ali M., and William M. **Worek**. **2017**. *Marks' Standard Handbook for Mechanical Engineers.* 12th ed. New York: McGraw-Hill. The standard bible of practical information for mechanical engineering.

Statics and Dynamics

Beer, Ferdinand, E. Johnston, David Mazurek, Phillip Cornwell, and Brian Self. **2018**. *Vector Mechanics for Engineers: Statics Dynamics.* 12th ed. New York: McGraw-Hill. **Best textbook for engineering statics/dynamics.**

Mechanics of Materials

Beer, Ferdinand P., E. Russell Johnston, Jr., John T. DeWolf, and David F. Mazurek. **2011**. *Mechanics of Materials.* 6th ed. New York: McGraw-Hill. **Best mechanics of materials textbook (tie).**

Hibbeler, Russell C. **2010**. *Mechanics of Materials.* 8th ed. New York: Pearson. **Best mechanics of materials textbook (tie).**

Landau, L. D., and E. M. **Lifshitz**. **1986**. *Theory of Elasticity.* 3rd ed. New York: Pergamon Press.

This work covers the mechanics of materials as seen by the brightest Russian theoretical physicists. Depending on your perspective, the result is either the epitome of mathematical elegance or an unsurpassed mathematical nightmare.

Young, Warren C. **1989**. *Roark's Formulas for Stress & Strain.* 6th ed. New York: McGraw-Hill. Got a nasty case of stress, strain, or fatigue? Just look up the appropriate formula and plug in the numbers.

Fluid Mechanics

General textbooks on fluid mechanics:

White, Frank M. **2010**. *Fluid Mechanics.* 7th ed. New York: McGraw-Hill. **Best fluid mechanics textbook.**

White, Frank M. **2005**. *Viscous Fluid Flow.* 3rd ed. New York: McGraw-Hill. Supplements White's introductory textbook and offers thorough coverage of incompressible and compressible viscous fluid mechanics, mostly emphasizing analytical calculations and approximations instead of scary computer stuff.

Kundu, Pijush K., Ira M. Cohen, and David R. Dowling. **2011**. *Fluid Mechanics.* 5th ed. Amsterdam: Elsevier. A good complement to the books by White. It covers the same basic topics as those books, but then skips some of their advanced topics in favor of a completely different set of advanced topics, such as instabilities, geophysical fluid dynamics, and biofluid mechanics.

Landau, L. D., and E. M. **Lifshitz**. **1987**. *Fluid Mechanics.* 2nd ed. New York: Pergamon Press. Far more math than physical intuition, but amazingly rigorous and comprehensive. Once the authors blow through ordinary fluid mechanics and acoustics, they start on *really* advanced topics.

Acoustics and Shock Waves

Blackstock, David T. **2000**. *Fundamentals of Physical Acoustics.* New York: Wiley. **Best acoustics textbook (tie).**

Kinsler, Lawrence E., Austin R. Frey, Alan B. Coppens, and James V. Sanders. **1999**. *Fundamentals of Acoustics.* 4th ed. New York: Wiley. **Best acoustics textbook (tie).**

Pierce, Allan D. **2019**. *Acoustics: An Introduction to Its Physical Principles and Applications.* 3rd ed. Berlin: Springer. **Best acoustics textbook (tie).**

Zel'dovich, Ya. B., and Yu. R. **Raizer**. **2002**. *Physics of Shock Waves and High-Temperature Hydrodynamic Phenomena.* New York: Dover. A classic.

Sachdev, P. L. **2004**. *Shock Waves and Explosions.* Boca Raton, Florida: Chapman and Hall/CRC. Very mathematical, but one of the few books on the subject.

Krehl, Peter O. K. **2009**. *History of Shock Waves, Explosions and Impact: A Chronological and Biographical Reference.* Berlin: Springer.

Thermodynamics

Cengel, Yunus A., Michael A. Boles, and Mehmet Kanoglu. **2018**. *Thermodynamics: An Engineering Approach.* 9th ed. New York: McGraw-Hill. **Best thermodynamics textbook.** Ties into other mechanical engineering textbooks by Cengel.

Heywood, John. **1988**. *Internal Combustion Engine Fundamentals.* New York: McGraw-Hill. More compact and slightly more up-to-date than Taylor, and also widely used for internal combustion engine design.

Moran, Michael J., and Howard N. **Shapiro**. **2010**. *Fundamentals of Engineering Thermodynamics.* 7th ed. New York: Wiley. Another widely used textbook on engineering thermodynamics.

Sonntag, Richard E., and Claus **Borgnakke**. **2012**. *Fundamentals of Thermodynamics.* 8th ed. New York: Wiley. The third widely used textbook on engineering thermodynamics.

Taylor, Charles Fayette. **1985**. *The Internal Combustion Engine in Theory and Practice.* 2 vols., 2nd ed. Cambridge, Massachusetts: MIT Press. This book has been the two-volume bible of internal combustion engine design for decades.

Heat Transfer

Cengel, Yunus, and Afshin **Ghajar**. **2014**. *Heat and Mass Transfer: Fundamentals and Applications.* 5th ed. New York: McGraw-Hill.

Incropera, Frank P., David P. DeWitt, Theodore L. Bergman, and Adrienne S. Lavine. **2006**. *Fundamentals of Heat and Mass Transfer.* 6th ed. New York: Wiley.

Lienhard, John H. IV, and John H. **Lienhard** V. **2003**. *A Heat Transfer Textbook.* 5th ed. Dover. http://web.mit.edu/lienhard/www/ahtt.html.

Mills, A. F., and Carlos F. M. **Coimbra**. **2015**. *Basic Heat & Mass Transfer.* 3rd ed. Temporal Publishing. **Best heat transfer textbook.**

Rohsenow, Warren M., James P. Hartnett, Young I. Cho. **1998**. *Handbook of Heat Transfer.* 3rd ed. New York: McGraw-Hill.

General Aerospace Engineering

Agrawal, Brij N., and Max F. **Platzer**. 2018. *Standard Handbook for Aerospace Engineers.* 2nd ed. New York: McGraw-Hill. **Best single-volume book on aerospace engineering.**

Anderson, Jr., John D. **2015**. *Introduction to Flight.* 8th ed. New York: McGraw-Hill.

Anderson, Jr., John D. **1999**. *Aircraft Performance and Design.* New York: McGraw-Hill.

Aerodynamics

John D. Anderson Jr.'s textbooks on aerodynamics and related topics are wonderfully clear and organized and also discuss the pioneers of aerodynamics. They are significantly better than competing textbooks on aerodynamics, and they go into compressible fluid flow in far greater detail than fluid mechanics textbooks do. There is considerable overlap among Anderson's books, though, so you don't necessarily need to buy them all. If you can only buy one, get *Fundamentals of Aerodynamics*.

Anderson, Jr., John D. **2016**. *Fundamentals of Aerodynamics.* 6th ed. New York: McGraw-Hill. **Best aerodynamics textbook.**

Anderson, Jr., John D. **2020**. *Modern Compressible Flow with Historical Perspective.* 4th ed. New York: McGraw-Hill.

Anderson, Jr., John D. **2019**. *Hypersonic and High Temperature Gas Dynamics.* 3rd ed. Washington, D.C.: American Institute of Aeronautics and Astronautics.

Dorrance, William H. **1962**. *Viscous Hypersonic Flow: Theory of Reacting and Hypersonic Boundary Layers.* New York: McGraw-Hill. (Reprinted by Dover, 2017.) A forerunner of Anderson's more recent hypersonic textbook, and especially noteworthy for its theoretical derivation of the reference temperature for compressible viscous flow on pp. 134–140.

Helicopters

Leishman, J. Gordon. **2006**. *Principles of Helicopter Aerodynamics.* 2nd ed. Cambridge, U.K.: Cambridge University Press. **Best helicopter textbook.**

Aircraft Propulsion and Gas Turbines

Farokhi, Saeed. **2014**. *Aircraft Propulsion.* 2nd ed. New York: Wiley. **Best aircraft propulsion textbook.**

Hill, Philip, and Carl **Peterson**. **1991**. *Mechanics and Thermodynamics of Propulsion.* 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall. Older but still a great textbook on aircraft propulsion, with less extensive yet still useful coverage of rocket propulsion too.

Kerrebrock, Jack L. **1992**. *Aircraft Engines and Gas Turbines.* 2nd ed. Cambridge, Massachusetts: MIT Press. An insightful textbook by a specialist in the field.

Rolls-Royce. **1996**. *The Jet Engine.* 5th ed. Derby, U.K.: Rolls-Royce. If Golden Books created a bedtime story book for aircraft engine mechanics, this would be it. Amazing illustrations!

Rocket Propulsion

Huggett, Clayton, C. E. Bartley, and Mark M. Mills. **1960**. *Solid Propellant Rockets.* Princeton, New Jersey: Princeton University Press.

Huzel, Dieter K., and David H. **Huang**. **1992**. *Modern Engineering for Design of Liquid-Propellant Rocket Engines.* Washington, D.C.: American Institute of Aeronautics and Astronautics. Much more narrowly focused than Sutton, but it does into more detail on what it does cover.

Sutton, George P., and Oscar **Biblarz**. **2016**. *Rocket Propulsion Elements.* 9th ed. New York: Wiley. **Best rocket propulsion textbook.** Also try Hill and Peterson.

Astrodynamics

Bate, Roger R., Donald D. Mueller, Jerry E. White, William W. Saylor. **2020**. *Fundamentals of Astrodynamics.* 2nd ed. Mineola, New York: Dover.

Battin, Richard H. **1999**. *An Introduction to the Mathematics and Methods of Astrodynamics.* 2nd ed. New York: AIAA.

Hankey, Wilbur. **1988**. *Re-Entry Aerodynamics.* Washington, D.C.: American Institute of Aeronautics and Astronautics. The best and most recent book on reentry heat transfer, which isn't saying much. You also need to translate the calculations from units such as BTUs per slug per fortnight into real units.

Vallado, David A., and James **Wertz**. **2013**. *Fundamentals of Astrodynamics and Applications.* 4th ed. Hawthorne, California: Microcosm Press.

Wiesel, William E. **2010**. *Spaceflight Dynamics.* 3rd ed. Beavercreek, Ohio: Aphelion Press. **Best textbook on astrodynamics and reentry.**

Control Systems

Kabamba, Pierre T., and Anouck R. **Girard**. 2014. *Fundamentals of Aerospace Navigation and Guidance.* Cambridge, U.K.: Cambridge University Press. **Best control systems textbook.**

Nise, Norman S. **2020**. *Control Systems Engineering.* 8th ed. New York: Wiley.

Ogata, Katsuhiko. **2010**. *Modern Control Engineering.* 5th ed. Prentice Hall.

Siouris, George M. **2004**. *Missile Guidance and Control Systems.* Berlin: Springer.

General Electrical Engineering

Santoso, Surya, and H. Wayne **Beaty**. **2018**. *Standard Handbook for Electrical Engineers.* 17th ed. New York: McGraw-Hill.

Applied Electromagnetism

Bradley, David. **1994**. *Basic Electrical Power and Machines.* London: Chapman & Hall.

Melvin, William L., and James A. **Scheer**, eds. **2012**. *Principles of Modern Radar: Advanced Techniques.* Edison, New Jersey: Scitech Publishing.

Melvin, William L., and James A. **Scheer**, eds. **2013**. *Principles of Modern Radar: Radar Applications.* Edison, New Jersey: Scitech Publishing.

Richards, Mark A., James A. Scheer, and William A. Holm, eds. **2010**. *Principles of Modern Radar: Basic Principles.* Edison, New Jersey: Scitech Publishing.

Shen, Liang Chi, and Jin Au **Kong**. **1995**. *Applied Electromagnetism.* 3rd ed. Boston: Cengage.

Staelin, David H., Ann W. Morgenthaler, and Jin Au Kong. **1993**. *Electromagnetic Waves.* New York: Pearson.

Optics and Lasers

Born, Max, and Emil **Wolf**. **2019**. *Principles of Optics.* 7th ed. Cambridge, U.K.: Cambridge University Press.

Hecht, Eugene. **2015**. *Optics.* 5th ed. New York: Pearson.

Meschede, Dieter. **2017**. *Optics, Light and Lasers: The Practical Approach to Modern Aspects of Photonics and Laser Physics.* 3rd ed. New York: Wiley.

Milonni, Peter W., and Joseph H. **Eberly**. **2010**. *Laser Physics.* New York: Wiley.

Silfvast, William T. **2004**. *Laser Fundamentals.* 2nd ed. Cambridge, U.K.: Cambridge University Press.

Svelto, Orazio. **2010**. *Principles of Lasers.* 5th ed. Berlin: Springer.

Yariv, Amnon. **1989**. *Quantum Electronics.* 3rd ed. New York: Wiley.

Solid State Physics

Ashcroft, Neal W., and N. D. **Mermin**. **1976**. *Solid State Physics.* Philadelphia: Saunders College. This introductory-to-intermediate level textbook is not as easy to read as Kittel's book, but it covers some topics which are not treated in that book.

Dresselhaus, Mildred, Gene Dresselhaus, Stephen B. Cronin, and Antonio Gomes Souza Filho. **2018**. *Solid State Properties: From Bulk to Nano.* Berlin: Springer. This book is based on notes from courses that Mildred Dresselhaus taught for decades at MIT. They cover a wide range of topics in solid state physics and include quite a bit of information that is not available elsewhere.

Kittel, Charles. **2004**. *Introduction to Solid State Physics.* 8th ed. New York: Wiley. Far and away the best introductory solid state physics book. In fact, it is one of the best written textbooks the author has ever seen on any subject.

Simon, Steven H. **2013**. *The Oxford Solid State Basics.* Oxford, U.K.: Oxford University Press.

Tinkham, Michael. **1996**. *Introduction to Superconductivity.* 2nd ed. New York: McGraw-Hill.

(2004 reprint by Dover.)

Semiconductor Devices

Howe, Roger T., and Charles G. **Sodini**. **1996**. *Microelectronics: An Integrated Approach.* New York: Pearson.

Neamen, Donald A. **2011**. *Semiconductor Physics and Devices: Basic Principles.* 4th ed. New York: McGraw-Hill.

Pierret, Robert F. **1996**. *Semiconductor Device Fundamentals.* 2nd ed. (Includes Vols. 1-4 bound together.) Boston: Pearson.
You also need this: Jaeger, Richard C. 2001. *Introduction to Microelectronic Fabrication.* 2nd ed. (Vol. 5.) Boston: Pearson.
And this: Pierret, Robert F. 2002. *Advanced Semiconductor Fundamentals.* 2nd ed. (Vol. 6.) Boston: Pearson.

Sze, Simon M., Yiming Li, and Kwok K. Ng. **2021**. *Physics of Semiconductor Devices.* 4th ed. New York: Wiley.

Circuits

Agarwal, Anant, and Jeffrey H. **Lang**. **2005**. *Foundations of Analog and Digital Electronic Circuits.* Amsterdam: Elsevier. **Best circuits textbook (tie).** Shows how to take an existing circuit and construct simple but remarkably accurate mathematical models of how that circuit behaves. It has much less information about how to design circuits from scratch, so it is nicely complemented by Horowitz and Hill.

Horowitz, Paul, and Winfield **Hill**. **2015**. *The Art of Electronics.* 3rd ed. Cambridge, U.K.: Cambridge University Press. **Best circuits textbook (tie).** Gives a wonderfully intuitive feel for electronic circuits, and teaching you how to design or find the right circuit for a particular job. It has less information about mathematical analysis of circuits. Thus this book is nicely complemented by Agarwal and Lang.
Make sure you also watch the deleted scenes: Horowitz, Paul, and Winfield Hill. 2020. *The Art of Electronics: The X Chapters.* Cambridge, U.K.: Cambridge University Press.
And also buy the accompanying lab manual: Hayes, Thomas C., and Paul Horowitz. 2016. *Learning the Art of Electronics.* 3rd ed. Cambridge, U.K.: Cambridge University Press.

Neamen, Donald. **2009**. *Microelectronics Circuit Analysis and Design.* 4th ed. New York: McGraw-Hill.

Signal Processing

Haykin, Simon, and Barry **Van Veen**. **2003**. *Signals and Systems.* 2nd ed. New York: Wiley. **Best signal processing textbook (tie).**

Karu, Z. Z. **1995**. *Signals and Systems Made Ridiculously Simple.* Cambridge, Massachusetts: ZiZi Press. This book gives amazingly clear and concise explanations and examples of Fourier and Laplace transforms, focusing on their applications in systems theory. www.zizipress.com

Oppenheim, Alan V., Alan S. Willsky, and S. Hamid Nawab. **1996**. *Signals and Systems.* 2nd ed. New York: Pearson. **Best signal processing textbook (tie).**

Computer Architecture

Patterson, David A., and John L. **Hennessy**. **2020**. *Computer Organization and Design: The Hardware/Software Interface.* 6th ed. Amsterdam: Elsevier. **Best computer architecture textbook.**

General Earth Science

Glencoe. **2017**. *Glencoe Earth & Space iScience.* New York: McGraw-Hill. **Best middle school textbook on earth and space science.**

Tarbuck, Edward J., and Frederick K. **Lutgens**. **2017**. *Earth Science.* 15th ed. New York: Pearson. **Best high school or first university textbook on earth and space science.**

Geophysics

Fowler, C. M. R. **2004**. *The Solid Earth: An Introduction to Global Geophysics.* 2nd ed. Cambridge, U.K.: Cambridge University Press. **Best geophysics textbook.**

Stacey, Frank D., and Paul M. **Davis**. **2008**. *Physics of the Earth.* 4th ed. Cambridge, U.K.: Cambridge University Press.

Turcotte, Donald, and Gerald **Schubert**. **2014**. *Geodynamics.* 3rd ed. Cambridge, U.K.: Cambridge University Press.

Physical Geology

Fossen, Haakon. **2016**. *Structural Geology.* 2nd ed. Cambridge, U.K.: Cambridge University Press.

Plummer, Charles C., Diane H. Carlson, and Lisa Hammersley. **2018**. *Physical Geology.* 16th ed. New York: McGraw-Hill. **Best physical geology textbook.**

Rocks and Minerals

Klein, Cornelis, and Anthony **Philpotts**. **2016**. *Earth Materials: Introduction to Mineralogy and Petrology.* 2nd ed. Cambridge, U.K.: Cambridge University Press. **Best textbook on rocks and minerals.**

Pellant, Chris. **2002**. *Rocks and Minerals.* London: DK.

Prinz, Martin, George Harlow, and Joseph Peters. **1978**. *Simon & Schuster's Guide to Rocks and Minerals.* New York: Simon & Schuster.

Paleontology

Benton, Michael J. **2014**. *Vertebrate Palaeontology.* 4th ed. New York: Wiley.

Benton, Michael J., and David A. T. **Harper**. **2020**. *Introduction to Paleobiology and the Fossil Record.* 2nd ed. New York: Wiley. **Best paleontology textbook.**

Cleal, Christopher J., and Barry A. **Thomas**. **2019**. *Introduction to Plant Fossils.* 2nd ed. Cambridge, U.K.: Cambridge University Press.

Walker, Cyril, and David **Ward**. **2002**. *Fossils.* London: DK.

Marine Science

Garrison, Tom S. **2015**. *Oceanography: An Invitation to Marine Science.* 9th ed. Boston: Cengage. **Best marine science textbook (tie).**

Miller, G. Tyler, and Scott **Spoolman**. **2018**. *Environmental Science.* 16th ed. Boston: Cengage.

Townsend, David W. **2012**. *Oceanography and Marine Biology: An Introduction to Marine Science.* Oxford, U.K.: Sinauer. **Best marine science textbook (tie).**

Trujillo, Alan P., and Harold V. **Thurman**. **2019**. *Essentials of Oceanography.* 13th ed. New York: Pearson. **Best marine science textbook (tie).**

Atmospheric Science

Ahrens, C. Donald, and Robert **Henson**. **2018**. *Meteorology Today: An Introduction to Weather, Climate and the Environment.* 12th ed. Boston: Cengage. **Best atmospheric science textbook (tie).**

Barry, Roger G., and Richard J. **Chorley**. **2009**. *Atmosphere, Weather and Climate.* 9th ed. Abingdon, U.K.: Routledge.

Holloway, Ann M., and Richard P. **Wayne**. **2010**. *Atmospheric Chemistry.* London: Royal Society of Chemistry.

Salby, Murry L. **2012**. *Physics of the Atmosphere and Climate.* 2nd ed. Cambridge, U.K.: Cambridge University Press.

Vasquez, Tim. **2015**. *Weather Analysis & Forecasting Handbook, Color Edition.* Weather Graphics

Technologies.

Wallace, John M. **2006**. *Atmospheric Science: An Introductory Survey.* 2nd ed. Amsterdam: Elsevier. **Best atmospheric science textbook (tie).**

General Space Science

Bennett, Jeffery, Megan Donahue, Nicholas Schneider, and Mark Voit. **2019**. *The Cosmic Perspective.* 9th ed. New York: Pearson. **Best general textbook on space science (tie).**

Carroll, Bradley W., and Dale A. **Ostlie**. **2006**. *An Introduction to Modern Astrophysics.* 2nd ed. Boston: Addison-Wesley.

Chaisson, Eric, and Steve **McMillan**. **2017**. *Astronomy Today.* 9th ed. New York: Pearson. **Best general textbook on space science (tie).**

Unsöld, Albrecht, and Bodo **Baschek**. **2001**. *The New Cosmos: An Introduction to Astronomy and Astrophysics.* 5th ed. Berlin: Springer.

Astronomical Tools and Methods

Birney, D. Scott, Guillermo Gonzalez, and David Oesper. **2006**. *Observational Astronomy.* 2nd ed. Cambridge, U.K.: Cambridge University Press. **Best textbook on astronomical tools and methods (tie).**

Chromey, Frederick R. **2016**. *To Measure the Sky: An Introduction to Observational Astronomy.* 2nd ed. Cambridge, U.K.: Cambridge University Press. **Best textbook on astronomical tools and methods (tie).**

Solar System and Planetary Science

Encrenaz, Thérèse, Jean-Pierre Bibring, M. Blanc, Maria-Antonietta Barucci, Francoise Roques, Philippe Zarka. **2013**. *The Solar System.* 3rd ed. Berlin: Springer. **Best planetary science textbook (tie).**

Lissauer, Jack J., and Imke **de Pater**. **2019**. *Fundamental Planetary Science: Physics, Chemistry and Habitability.* Cambridge, U.K.: Cambridge University Press. **Best planetary science textbook (tie).**

Stellar Physics

Clayton, Donald D. **1983**. *Principles of Stellar Evolution and Nucleosynthesis.* Chicago: University of Chicago Press. While nuclear physics texts say alarmingly little about fusion reactions, this stellar physics text describes them in a fair amount of detail.

Hansen, Carl J., Steven D Kawaler, and Virginia Trimble. **2004**. *Stellar Interiors: Physical Prin-*

ciples, Structure, and Evolution. 2nd ed. Berlin: Springer.

Kippenhahn, Rudolf, Alfred Weigert, and Achim Weiss. **2012**. *Stellar Structure and Evolution.* 2nd ed. Berlin: Springer. This text is more up-to-date and complete than Schwarzschild, though not as well-written. **Best stellar physics textbook.**

Schwarzschild, Martin. **1958**. *Structure and Evolution of the Stars.* Mineola, New York: Dover. Although it is rather old, this book covers most of the physics of stars and is wonderfully clear and concise, so it makes an excellent introduction to stellar physics.

Shapiro, Stuart L., and Saul A. **Teukolsky**. **1983**. *Black Holes, White Dwarfs, and Neutron Stars.* New York: Wiley. Explains how general relativity affects stellar structure and stellar evolution, and discusses stellar collapse to white dwarfs, neutron stars, and black holes.

Interstellar Space and Galaxies

Cosmology

Bernstein, Jeremy. **1995**. *An Introduction to Cosmology.* Englewood Cliffs, New Jersey: Prentice Hall. A highly readable introduction to cosmology, unfortunately now out of print.

Dodelson, Scott, and Fabian **Schmidt**. **2020**. *Modern Cosmology.* 2nd ed. Academic Press. **Best cosmology textbook (tie).**

Kolb, Edward W., and Michael S. **Turner**. **1994**. *The Early Universe.* Reading, Massachusetts: Addison Wesley. Kolb and Turner is less up-to-date than Dodelson and Schmidt is more up-to-date, but it contains useful material and explanations that are not in Dodelson and Schmidt.

Liddle, Andrew. **2015**. *An Introduction to Modern Cosmology.* 3rd ed. New York: Wiley. **Best cosmology textbook (tie).**

Meadows, A.J. **2007**. *The Future of the Universe.* Berlin: Springer. Whereas other cosmology books mainly consider the past of the universe, this one considers the future of the universe, based on our current physical understanding.

General Chemistry

Brown, Theodore L., H. Eugene LeMay, Jr., Bruce E. Bursten, Catherine J. Murphy, Patrick M. Woodward, and Matthew W. Stoltzfus. **2017**. *Chemistry: The Central Science.* 14th ed. New York: Pearson. **Best high school or first university chemistry textbook.**

Wilbraham, Antony C., Dennis D. Staley, Michael S. Matta, and Edward L. Waterman. **2017**. *Pearson Chemistry.* New York: Pearson. **Best middle school chemistry textbook.**

Chemistry Laboratory Methods

Singh, Mono M., Ronald M. Pike, and Zvi Szafran. **1995**. *Microscale & Selected Macroscale Experiments for General & Advanced General Chemistry: An Innovative Approach.* New York: Wiley.

Zubrick, James W. **2020**. *The Organic Chem Lab Survival Manual: A Student's Guide to Techniques.* 11th ed. New York: Wiley. **Best chemistry lab textbook.**

Organic Chemistry

Carey, Francis A., Robert M. Giuliano, Neil T. Allison, and Susan L. Bane. **2019**. *Organic Chemistry.* 11th ed. New York: McGraw-Hill. **Best organic chemistry textbook (tie).**

Carey, Francis A., and Richard J. **Sundberg**. **2008**.
Advanced Organic Chemistry. Part A: Structure and Mechanisms. 5th ed. Berlin: Springer.
Advanced Organic Chemistry. Part B: Reaction and Synthesis. 5th ed. Berlin: Springer.

Clayden, Jonathan, Nick Greeves, and Stuart Warren. **2012**. *Organic Chemistry.* 2nd ed. Oxford, U.K.: Oxford University Press. **Best organic chemistry textbook (tie).**

Klein, David R. **2016**. *Organic Chemistry.* 3rd ed. New York: Wiley. **Best organic chemistry textbook (tie).**

Straumanis, Andrei. **2009**. *Organic Chemistry: A Guided Inquiry.* 2nd ed. Belmont, California: Brooks/Cole. Also the accompanying *Student Solutions Manual.* Good teaching workbook to learn by basics by working your way through someone much shorter than a standard organic chemistry textbook.

Inorganic Chemistry

Cotton, F. Albert, Geoffrey Wilkinson, Carlos A. Murillo, and Manfred Bochmann. **1999**. *Advanced Inorganic Chemistry.* 6th ed. New York: Wiley.

Greenwood, N. N., and A. **Earnshaw**. **1997**. *Chemistry of the Elements.* 2nd ed. Oxford, U.K.: Butterworth-Heinemann. **Best inorganic chemistry textbook (tie).**

Housecroft, Catherine, and Alan G. **Sharpe**. **2018**. *Inorganic Chemistry.* 5th ed. New York: Pearson. **Best inorganic chemistry textbook (tie).**

Physical Chemistry

Atkins, Peter, Julio de Paula, and James Keeler. **2018**. *Atkins' Physical Chemistry.* 11th ed. Oxford, U.K.: Oxford University Press. **Best physical chemistry textbook (tie).**

McQuarrie, Donald A., and John D. **Simon**. **1997**. *Physical Chemistry: A Molecular Approach.* Sausalito, California: University Science Books. **Best physical chemistry textbook (tie).**

Analytical Chemistry

Harris, Daniel C., and Charles A. **Lucy**. **2019**. *Quantitative Chemical Analysis.* 10th ed. New York: W. H. Freeman. **Best analytical chemistry textbook (tie).**

Skoog, Douglas A., Donald M. West, F. James Holler, and Stanley R. Crouch. **2013**. *Fundamentals of Analytical Chemistry.* 9th ed. Boston: Cengage. **Best analytical chemistry textbook (tie).**

Chemical Engineering

Green, Don W., and Marylee Z. **Southard**. **2018**. *Perry's Chemical Engineers' Handbook.* 9th ed. New York: McGraw-Hill. **Best single-volume book on chemical engineering.**

General Materials Science

Callister, William D., Jr., and David G. **Rethwisch**. **2017**. *Materials Science and Engineering: An Introduction.* 10th ed. New York: Wiley. **Best first textbook on materials science.** Gives a simple overview of strength of materials, then delves into the properties of metals, polymers, ceramics, and other specific materials.

Strength of Materials

Dowling, Norman E., Stephen L. Kampe, and Milo V. Kral. **2018**. *Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue.* 5th ed. New York: Pearson. **Best strength of materials textbook.** Bridges the gap between mechanics of materials and materials science. Considers various stresses and strains but also provides a detailed examination of other materials properties, such as dislocations, plasticity, hardness, brittleness, etc.

Polymers

Coleman, Michael M., and Paul C. **Painter**. **1998**. *Fundamentals of Polymer Science: An Introductory Text.* 2nd ed. Boca Raton, Florida: CRC Press. **Best polymer textbook.**

Hiemenz, Paul C., and Timothy P. **Lodge**. **2007**. *Polymer Chemistry.* 2nd ed. Boca Raton, Florida: CRC Press.

Metals

Abbaschian, Reza, Lara Abbaschian, and Robert E. Reed-Hill. **2008**. *Physical Metallurgy Principles.* 4th ed. Boston: Cengage. **Best metallurgy textbook.**

Shewmon, Paul G. **1969**. *Transformations in Metals.* New York: McGraw-Hill.

Ceramics

Carter, C. Barry, and M. Grant **Norton**. **2013**. *Ceramic Materials: Science and Engineering.* 2nd ed. Berlin: Springer. **Best ceramics textbook.**

Kingery, W. David, H. K. Bowen, and Donald R. Uhlmann. **1976**. *Introduction to Ceramics.* 2nd ed. New York: Wiley.

Glass

Shelby, James, E. **2021**. *Introduction to Glass Science and Technology.* 3rd ed. London: Royal Society of Chemistry. **Best glass textbook.**

Varshneya, Arun K., and John C. **Mauro**. **2019**. *Fundamentals of Inorganic Glasses.* 3rd ed. Amsterdam: Elsevier.

Composites

Clyne, T. W., and D. **Hull**. **2019**. *An Introduction to Composite Materials.* 3rd ed. Cambridge, UK: Cambridge University Press. **Best composites textbook.**

Gibson, Ronald F. **2016**. *Principles of Composite Material Mechanics.* 4th ed. Boca Raton, Florida: CRC Press.

General Biology

Miller, Kenneth R., and Joseph S. **Levine**. **2018**. *Biology.* New York: Pearson. **Best middle school biology textbook.**

Urry, Lisa A., Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, and Rebecca Orr. **2020**. *Campbell Biology.* 12th ed. New York: Pearson. **Best high school or first university biology textbook.**

Biology Laboratory Methods

Barker, Kathy. **2004**. *At the Bench: A Laboratory Navigator.* 2nd ed. Cold Spring Harbor Laboratory Press. This is the best general introduction to biology lab methods, including common techniques for microbiology.

Gallagher, Sean R., and Emily A. **Wiley**, eds. **2012**. *Current Protocols: Essential Laboratory Techniques.* 2nd ed. Current Protocols. This is probably the best single-volume collection of major biology lab methods, including techniques for microbiology.

Biochemistry

Berg, Jeremy M., John L. Tymoczko, Gregory J. Gatto, Jr., and Lubert Stryer. **2019**. *Biochemistry.* 9th ed. New York: W. H. Freeman. Good biochemistry textbook.

Ferrier, Denise R. **2017**. *Lippincott Illustrated Reviews: Biochemistry.* 7th ed. New York: LWW. **Best biochemistry textbook.** This is by far the best introductory textbook on biochemistry, with explanations that are incredibly clear and concise, and illustrations that are amazingly helpful and numerous. This book is aimed at medical school students, so it mentions a number of connections to human diseases, but does not include photosynthesis or much on fermentation.

Koolman, Jan, and Klaus Heinrich **Roehm**. **2012**. *Color Atlas of Biochemistry.* 3rd ed. Stuttgart: Thieme. Graphically shows the "wiring diagrams" of major biochemical pathways.

Michal, Gerhard, and Dietmar **Schomburg**, eds. **2012**. *Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology.* 2nd ed. Wiley. Graphically shows the "wiring diagrams" of major biochemical pathways.

Nelson, David L., and Michael M. **Cox**. **2017**. *Lehninger Principles of Biochemistry.* 7th ed. New York: W. H. Freeman. Good biochemistry textbook.

Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. **2016**. *Fundamentals of Biochemistry.* 5th ed. New York: Wiley. Good biochemistry textbook.

Molecular Biology

Clark, David P., and Lonnie D. **Russell**. **2010**. *Molecular Biology Made Simple and Fun.* 4th ed. Cache River Press. A very offbeat and entertaining yet accurate introduction to molecular biology, great for middle school and high school.

Cox, Michael M., Jennifer A. Doudna, and Michael O'Donnell. **2015**. *Molecular Biology: Principles and Practice.* 2nd ed. New York: W. H. Freeman. **Best molecular biology textbook (tie).**

Krebs, Jocelyn E., Elliott S. Goldstein, and Stephen T. Kilpatrick. **2017**. *Lewin's Genes XII.* Burlington, Massachusetts: Jones & Bartlett. Not as well written than when Lewin himself wrote the editions, but still filled with lots of useful details. **Best molecular biology textbook (tie).**

Watson, James D., Amy A. Caudy, Richard M. Myers, and Jan A. Witkowski. **2007**. *Recombinant DNA.* 3rd ed. Cold Spring Harbor. Beautifully illustrated, *Scientific-American*-level introduction to natural molecular biology pathways and technological methods for using them.

Watson, James D., Tania A. Baker, Stephen P. Bell, Alexander A.F. Gann, Michael Levine, and Richard M. Losick. **2013**. *Molecular Biology of the Gene.* 7th ed. Benjamin Cummings. **Best molecular biology textbook (tie).**

Genetics

Griffiths, Anthony J. F., John Doebley, Catherine Peichel, and David A. Wassarman. **2020**. *Introduction to Genetic Analysis.* 12th ed. New York: W. H. Freeman. **Best genetics textbook (tie).**

Klug, William, Michael Cummings, Charlotte Spencer, Michael Palladino, Darrell Killian. **2019**.

Concepts of Genetics. 12th ed. New York: Pearson. Good coverage of hereditary patterns of genetics. **Best genetics textbook (tie).**

Passarge, Eberhard. **2017**. *Color Atlas of Genetics.* 5th ed. Stuttgart: Thieme.

Cell Biology

Alberts, Bruce, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. **2014**. *Molecular Biology of the Cell.* 6th ed. Garland. **Best cell biology textbook (tie).** Also provides good overviews of molecular biology, biochemistry, and other related topics.

Freshney, R. Ian. **2016**. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.* 7th ed. Wiley-Blackwell. The authoritative book on growing mammalian cells in the lab.

Lodish, Harvey, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Kelsey C. Martin, and Michael Yaffe. **2021**. *Molecular Cell Biology.* 9th ed. New York: W. H. Freeman. **Best cell biology textbook (tie).** Also provides good overviews of molecular biology, biochemistry, and other related topics.

Pawlina, Wojciech. **2018**. *Histology: A Text and Atlas: With Correlated Cell and Molecular Biology.* 8th ed. New York: LWW. Authored by Michael H. Ross for its earlier editions, this is the best book on histology, showing how different types of human cells and tissues look under the microscope and describing why they look that way.

Microbiology

Bennett, John E., Raphael Dolin, and Martin J. Blaser. **2019**. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases.* 2 vols., 9th ed. Amsterdam: Elsevier. Exhaustive two-volume bible covering all categories of infectious microorganisms.

Cornelissen, Cynthia Nau, and Marcia Metzgar Hobbs. **2019**. *Lippincott Illustrated Reviews: Microbiology.* 4th ed. New York: LWW. Good summary of microbiology.

Engleberg, N. Cary, Victor DiRita, and Terence S. Dermody. **2012**. *Schaechter's Mechanisms of Microbial Disease.* 5th ed. New York: LWW. **Best microbiology textbook (tie).** More emphasis on the human pathology that can be caused by each microorganism.

Gladwin, Mark, William Trattler, and C. Scott Mahan. **2018**. *Clinical Microbiology Made Ridiculously Simple.* 7th ed. Medmaster. Very concise but filled with helpful lists and mnemonics.

Knipe, David M., and Peter M. **Howley**, eds. **2013**. *Fields Virology.* 6th ed. New York: LWW. Exhaustive two-volume bible focusing on viruses and prions.

Madigan, Michael T., Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, and David A. Stahl. **2017**. *Brock Biology of Microorganisms.* 15th ed. New York: Pearson. **Best microbiology textbook (tie).** Clearly written and well illustrated introductory textbook covering the different categories of microorganisms.

Willey, Joanne, Kathleen Sandman, and Dorothy Wood. **2019**. *Prescott's Microbiology.* 11th ed. New York: McGraw-Hill. Another good introductory textbook on microorganisms.

Books on microbiology laboratory techniques:

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About the Author

Abe: "...the Todd family from Kentucky. Very high-grade people. They spell their name with two D's–which is pretty impressive when you consider that one was enough for God."

Mentor: "Well, Abe—just bear in mind that there are always two professions open to people who fail at everything else: there's school-teaching, and there's politics."

Abe: "Then I'll choose school-teaching. You go into politics, and you may get elected."

Robert Sherwood, *Abe Lincoln in Illinois* (1937),
Act 2, Scene 4, and Act 1, Scene 1

Through reading about famous scientists, Todd Rider was inspired from an early age to pursue a career in scientific innovation, ultimately winning the Grand Prize at the 1986 International Science and Engineering Fair and filing his first patent application at age 17. He studied at MIT and Harvard 1986–1995, covering electrical engineering, nuclear engineering, mechanical and aerospace engineering, physics, biomedicine, chemistry, applied mathematics, and other areas, and received his Ph.D. in 1995. He headed the DNA sequencing program at the startup biotechnology company Aeiveos 1995–1996, became Senior Staff Scientist at MIT Lincoln Laboratory 1997–2013, and served as senior Laboratory Technical Staff at Draper Laboratory 2013–2015. In 2015 he founded the RIDER (Revolutionary Innovation, Discovery, Education, and Research) Institute.

During his career, Dr. Rider has invented a much more efficient rocket staging system and worked on antimatter rocket engine approaches; developed and tested methods of coherently combining multiple laser beams into a more powerful laser beam; discovered fundamental limitations on controlled fusion reactors; invented and demonstrated the CANARY rapid pathogen identifier; invented and developed the DRACO and PANACEA broad-spectrum antiviral therapeutics; written *Forgotten Creators* to study the accomplishments and the methods of German-speaking scientists of the past; and conducted research in various other areas. He has also worked to improve kindergarten through twelfth grade (K–12) science education, creating and running the MIT Science on Saturday program, writing educational guides for *Science News* magazine, judging state and national science fairs and competitions, and conducting presentations and hands-on lab activities on a wide range of science topics in K–12 classrooms in over 100 schools. Dr. Rider and his projects have been featured in *Science*, *Nature Biotechnology*, *Time*, *Scientific American*, *Technology Review*, *National Geographic*, *Der Spiegel*, the *New York Times*, *NBC Nightly News*, BBC, ZDF, Discovery Channel, and numerous other outlets. An inveterate acronym engineer, he has dubbed the work summarized in this book as the Search for New and Applicable Research Keys.

Abstract

One person who conceives a revolutionary scientific idea or creation—and can find the resources to demonstrate it—can change the world, as shown by countless examples from the past. This book is addressed to those who would like to become revolutionary innovators or creators, as well as to others who are in positions to help them. It offers advice and perspective for future creators, whether they are in elementary school, the middle of their scientific career, or somewhere in between.

Chapter 1 explains powerful methods for finding and analyzing both the most important revolutionary scientific problems and the most suitable innovative solutions to those problems. In top-down systems analysis, one methodically considers all possible categories and subcategories of problems of interest, and then all possible categories and subcategories of solutions to specific ones of those problems, in order to identify and focus on the most promising solutions for the most important problems. Top-down systems analysis is strongly complemented by bottom-up brainstorming, in which one seeks inspiration for specific problems, solutions, principles, constraints, etc. that will test, correct, refine, and fill out the categories and subcategories.

To inspire and guide future creators, this book uses these methods to break down and analyze all currently foreseeable future creations (with references to relevant previous research and suggestions for potential future work):

Chapter 2: Creations in Biology & Physiology
Chapter 3: Creations in Chemistry & Materials
Chapter 4: Creations in Earth & Space Sciences
Chapter 5: Creations in Mathematics & Physics
Chapter 6: Creations That Improve Humans
Chapter 7: Creations for Travel & Expansion
Chapter 8: Creations That Improve Resources
Chapter 9: Creations That Aid Nonhumans
Chapter 10: Revolutionary Innovation Itself
Chapter 11: Creations That Are Harmful

As discussed in Chapter 12, the road to creation, from initially having a revolutionary idea to actually realizing that idea, is usually very long and filled with many obstacles. Whereas the previous chapters dealt with the scientific difficulties and some methods to overcome them, this chapter discusses some of the common non-scientific obstacles (financial, political, cultural, personal, etc.).

Appendices cover a few research areas in more detail, to provide useful pointers to future creators interested in those areas, and illustrative examples even to future creators interested in other areas:

Appendix A: Innovations to Improve Moral Behavior
Appendix B: Innovations to Address Infectious Diseases
Appendix C: Innovations in Advanced Space Propulsion
Appendix D: Innovations in Unconventional Physics Applications
Appendix E: Innovations in Nuclear Energy

The Bibliography lists key references for general knowledge in each field and for some important previous research on several specific topics.

In the midst of the word he was trying to say,
In the midst of his laughter and glee,
He had softly and suddenly vanished away–
For the Snark was a Boojum, you see.

Lewis Carroll, *The Hunting of the Snark* (1876)