This was substantially updated in light of experience this past Summer teaching a 10 week ‘Practice of Science’ course with undergrad researchers at the University of Washington. We read a set of articles on a topic and met for lunch each Monday for discussion.

I’ve focused below on things I’ve found useful, with a modest tilt toward print resources and some of the more obscure or older (but still useful!) resources to complement the burgeoning tide of web-accessible resources. Among these, the most useful is the ‘Ten simple rules’ collection at PLoS Computational Biology: https://collections.plos.org/collection/ten-simple-rules/

Consider the starred (*) articles as essential reading early in your career (or now, if they’re new to you). Sample the remainder as time, interest and need—or need of diversion—dictate. Enjoy, and send on your suggestions for including in our next update! We acknowledge all accepted additions!

1. Getting Started - Choice of problem and direction


Dyson, F.J. (2012) Is science driven mostly by ideas or by tools? Science 338:1426-1427. On the enduring tension between ideas and tools, and how both are needed to effectively drive science.


2. Getting Stuff Done


*Fisher, D. (2003). The Henry Kunkel Legacy: through the eyes of his last graduate student. Lupus 12:172-174. (an engaging, informal look at Henry Kunkel and his essence as a mentor with a message: the creative spark for your science must come from you; smart people will always see an interesting angle on any solid result; and the way to build a big, interesting and potentially important story is that first small, solid experimental result. So get started!).


Bliss, E.C. (1976) Getting Things Done. Bantam Books, New York. (73 short chapters with a few amusing little drawings on how to tackle daily life. Got me to throw out all the other time management books I bought, but was procrastinating about reading!).


3. Essential Skills I - Reading


Biomedical Literature, Praeger, New York (very useful, if somewhat dated – I’ve taken his advice to contact authors with legitimate questions – they are often flattered and helpful!).


Carl Zimmer: ‘How you should read coronavirus studies, or any science paper’. This short piece from June 2020 in the NY Times was written for general readers, but core advice well-taken: https://www.nytimes.com/article/how-to-read-a-science-study-coronavirus.html


Medawar, P. (1963) Is the scientific paper a fraud? This was a BBC radio address by the redoubtable Medawar, gently reminding the audience of the gap between the mess that's day-to-day science and the finished product, the pristine, logical sequence we eventually publish to tell our stories. Republished in Medawar's collection of essays 'The Threat and the Glory - Reflections on Science and Scientists' Harper-Collins.

Gladwell, M. (2002) The social life of paper. New Yorker 25 March issue. (The real skinny on paper, and why it’s so useful: paper is a remarkably efficient and versatile, low cost, low tech but ‘high-touch’ crutch to support the life of the mind. This article starts with air traffic controllers, who use small scraps of paper to track and clear even very busy flight schedules. Available free at the author's website: www.gladwell.com).

Jabr, F. (2013) Why the brain prefers paper. Scientific American Nov 2013, pp.49-53. This is a great article to use to start arguments, especially across generational lines, and a good complement to Gladwell’s article above. Less important than how you read is that you do read, and regularly. Twitter’s going to carry you only so far in life…but this cultural invention power trio (language, written language and print on paper) has good prospects to carry us well into the 21st century...

Fawcett, P.J. (1978) Personal filing systems revisited. Ear Nose & Throat J. 57:82-89 (an unlikely place for a small gem enunciating some timeless principles for organizing your life that carry well into the age of interweb-accessible information overload).

4. Essential Skills II – Writing (the first skill you need to get a lot better at…).


Whitesides, G.M. (2004) Whitesides’ Group: writing a paper. Advanced Materials 16: 1375-1377. George Whitesides got so fed up with lab members bringing him half-baked drafts of manuscripts that he wrote this short ‘guide’ for lab members emphasizing what manuscripts are and how to build them, before they came to him seeking advice!


Albert, T. (2012) ‘Tips on preparing your manuscript’ BiomedCentral. Tim taught scientific writing for many years and distilled his wisdom in a great short 1 pager that, alas, is no longer available online. His website is still up and active however (see: [https://www.timalbert.co.uk/writing-tips/](https://www.timalbert.co.uk/writing-tips/)) and I have a copy of the original 1 pager if interested – drop me a note…


Some style guides that may help…and a few on typography


Williams, R.(∼1990 on) *The PC (or Mac) is not a Typewriter* series. Peachpit Press, Berkeley. (very useful older series providing a painless introduction to typography and how to use any word processor/graphics program to produce words/figures that look good and are a pleasure to read. Word processing programs paradoxically institutionalize lots of typographical mistakes and errors—e.g., this series will convince you never to ‘fully justify’ anything again! Use these to spot and correct the more egregious mistakes or achieve special effects. Little 'how-tos' that make the difference!

For more information on typography, the field once moribund until resurrected by digital fonts, see: “*Stop Stealing Sheep, and Learn How Type Works*" by Erik Spiekermann and E. M. Ginger. More detail can be found in Robert Bringhurst’s classic “*The Elements of Typographic Style*” an in-depth, workbook-style look at typesetting. Read Carolina de Bartolo’s “*Explorations in Typography*” (or just visit the book’s terrific website). And Ellen Lupton’s “Thinking With Type” (web link is: [http://www.thinkingwithtype.com/](http://www.thinkingwithtype.com/)) provides a good all-round introduction or self-teaching the basics. For all things typographic, see typographica.org
5. **Essential Skills III – Speaking (the second skill where you need to up your game...)**

McGovern, V. (2009) *The one-minute talk*. Let’s start small, with the even shorter version of the elevator pitch—master this shortest of short forms first, which you’ll use almost every day, then work up to the perfect short talk and hour lecture.

Emily Lakdawalla (2018) ‘Speak your science!’ A great guide to speaking, by an animated solar system expert/planetary scientist who delivers great advice for whatever length talk you’re slated to give. Her talk is in both written and video versions. Choose one...written: https://www.planetary.org/articles/0206-speak-your-science, or https://arizona.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=2d254148-7a7b-4a25-b76fa87e014e1772 (you may need to paste entire link into your browser...)


Calnan, J. and Barabas, A. (1981) *Speaking at Medical Meetings*, 2nd Ed. Heinemann, London. 184pp. (a wide range of useful advice covering many different aspects of speaking. Great figures and cartoons are all illuminated with apt quotes from Shakespeare and ends with a pithy ‘10 Commandments’ 1 pager...).

6. **Essential Skills IV – Poster presentations**


Maitreya’s Stream of Consciousness Poster Presentation Guide (2014 - unpublished). A very useful guide to poster presentations created by my Genome Sciences colleague Maitreya Dunham - everyone should write her to encourage her to update and publish this!

Sam Hertig’s detailed video guide to poster prep (2016). You can find this via the following link: go.nature.com/2aetlrc See also the related good article by Chris Woolston (2016) Lead the poster parade. *Nature* 536:115-117.

**ABRCMS Judging Rubric - Poster and Oral Presentations** (2019) ASM-ABRCMS. Very useful scoring sheet to help keep you on the straight-and-narrow when developing and presenting posters or short talks.

7. **Essential Skills V – Graphics and imaging**

Tufte, E.D. (1983/2001) *The Visual Display of Quantitative Information*. 1st/2nd Editions. Graphics Press, Cheshire, CT. 197pp. Let’s start with the ‘Bible’… the most useful and inspiring guide to graphical excellence in theory and practice. After reading this you’ll never look at a multicolor, overproduced 3D Powerpoint slide again without weeping at the lost opportunity to accurately and economically convey information! See also Tufte’s 3 sequels, the most recent of which, *Beautiful Information*, includes the full text of his take-no-prisoner’s shred of Powerpoint. All 4 books are stunningly produced, equally useful and enjoyable to read or thumb through. Tufte also teaches a course that includes all of the books in the registration fee).


UAB’s Online Learning Tool for Research Integrity and Image Processing (2008 on). This can be found at: [https://ori.hhs.gov/education/products/RIandImages/default.html](https://ori.hhs.gov/education/products/RIandImages/default.html) and includes very useful guidelines for image processing best practices.


Buriak, J., ed. (2014) Titles and Table of Contents Images: The Candy Store Analogy. *Chemistry of Materials* 26 (3), 1289–1290. These two articles cover the latest high-stakes graphical image format, the Table of Contents image.


8. Essential Skills VI – Collaboration


Twyla Tharp and Jesse Kornbluth (2009) *The Collaborative Habit: Life Lessons for Working Together*. Interesting statement on the importance and mechanics of collaboration from one of the giants of 20\textsuperscript{th} century American modern dance. This book aims to be a practical guide and is made all the more interesting by focusing on generalizable lessons.


Haddock, S.H.D. and Dunn, C.W. (2011) *Practical Computing for Biologists*. Sinauer Associates, Sunderland, MA. Includes a plethora of topics in readily accessible form that are becoming increasingly important: familiarity with text manipulation and command line resources, programming (the appropriately focus on Python), computer graphics, remote access and building simple electronic devices using Arduino. A great way to dip your toe in on any of these topics.


*R* has become a standard scientific statistical computing package, esp. in light of the large and growing library of extensions. There are myriad good introductory books, free on-line tutorials and guides that will get you started.


Bailey, N.T.J. (1995) *Statistical Methods in Biology*, 3rd Ed. Cambridge University Press, Cambridge. 255pp. (Everyone needs a ‘statistical crutch’ - this is mine: good introductions to simple concepts and their application, with a Summary on what approach or test to choose as a function of distribution, sample size and type of comparison. Needs to be used with software (e.g., R), and a biostatistician you can trust and work with).

Swinscow, TDV (200) *Statistics at Square One*. 9\textsuperscript{th} Ed. Revised by MJ Campbell. BMJ Press. (very
useful introductory text that first appeared as an articles series in the BMJ. Now available in print or on-line at the BMJ website: [http://www.bmj.com/collections/statsbk/](http://www.bmj.com/collections/statsbk/) - a great complement to Bailey).


10. Reproducibility and responsible conduct in science


11. Moving on – your career from nappies (well, maybe grad school) through retirement…


Barres, B.A. (2013) How to pick a graduate advisor. *Neuron* 80:275-279 (also available as a shorter and snappier 2017 YouTube video: [https://www.youtube.com/watch?v=THHkXpORUWo](https://www.youtube.com/watch?v=THHkXpORUWo)).

Ben Barres and Duncan Odum below give complementary perspectives on a critical career choice - where and who to work with. Barres is no longer with us, alas, but has an interesting backstory as a top-flight scientist who changed genders as a mid-career adult. See his just-published, posthumous ‘Autobiography of a Transgender Scientist.’


Two interesting perspectives on the vexing issue of choice of a lab are given in: Holden, C. ‘Eight attributes of highly successful postdocs’, and Vogel, G. ‘A day in the life of a topflight lab’ (Bob Langer’s lab at MIT), both in the 3 Sept 1999 issue of Science.

Lee, A., Dennis, C. and Campbell, P. (2007) *Nature’s* guide for mentors. *Nature* 447:791-797. Even though this is billed as a guide for mentors, it has a great deal to say about identifying good or great mentors and the important roles a mentor plays in one’s scientific career. Have a look!
series on-line: Science Magazine’s ‘Science Careers’ site is excellent - many interesting articles and series covering a wide range of career advice and having an excellent collection of on-line resources. See above for a relatively recent example on the need for risk-taking in science. My first stop, as there’s always something interesting here before diving into the web and science blogosphere.

series in-print: the ‘Sticky Wicket’ series in Journal of Cell Science is very entertaining, very funny and (usually!) anonymous, as was the previous, now apparently discontinued ‘Caveman’ series. What redeems this often-biting series is the skillful use of humor to address important topics in science and science or graduate training.


Barker, Kathy (2002,2005) At the Helm and At the Bench: Laboratory Navigator. Cold Spring Harbor Laboratory Press. (two useful guides, one now in 2nd edition, by Kathy Barker of ISB on setting up and running your lab. At the Helm is the more useful of the two for senior students, post-docs and new faculty).


Burroughs Wellcome/HHMI (2006) Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty. 2nd Edition (a 250 pp guide that can be requested free from HHMI or downloaded and printed from the HHMI website where you'll find additional resources: http://www.hhmi.org/grants/office/graduate/labmanagement.html. Includes excerpts from the Barker books noted below as well. Very useful advice and free to boot!). Note: HHMI also funded a series of 'Future Faculty Fellows' boot camps at many institutions. These provide 2 days of very practical talks, hand-on advice and materials. If available to you, sign up both for the resources and opportunity to compare notes with other trainees and faculty.

American Society for Cell Biology (2004) Career Advice for Life Scientists vols I-III. These books are soft bound and free as pdfs (search the title or see the ASCB website) and a great complement to HHMI above.

Lara Szewczak with Amy Gladfelter and Tony Hyman (2018) Take a deep breath and switch. Cell 174:1333-1336. How do you change your science and direction mid-stream? This free-ranging moderated discussion between two accomplished scientists covers many aspects of how science can and should evolve over the course of one’s career. The full version of the interview is available in the on-line version of this article.


you may never have heard of.

12. Style in Science/The Wellsprings of Creativity


See also the entertaining take in Peter Doherty’s ‘The Beginner’s Guide to Winning the Nobel Prize’, esp his Chapter 9 which is reprinted in Reginald Smith’s compendium Scientific Work and Creativity: Advice From the Masters noted below.

Holton, G. (1978) Fermi’s group and the recapture of Italy’s place in physics, Chapter 5 in The Scientific Imagination: Case Studies. Cambridge University Press, Cambridge. 382pp. (Fermi was the last great physicist to be equally adept and accomplished as a theoretician and experimentalist. A good account of Fermi’s work habits is given in Platt, J.R. (1962) The Excitement of Science, Houghton-Mifflin, Boston, Chs. 7 and 8).


Smith, R., Editor (2012) Scientific Work and Creativity: Advice From the Masters. Citizen Scientist League, Clearwater, FL. Great compendium of 29 chapters including many excerpts from famous books and scientists. My thanks to the Editor, Reginald Smith, for bringing this to my attention.


Tharp, T. (2003) The Creative Habit: Learn It and Use It for Life. Simon and Schuster, 243pp. (very interesting statement on creativity and the conditions that foster creative thinking from one of the giants of 20th century American modern dance. This book aims to be a practical guide and is made all the more interesting by where it’s coming from and by focusing on what promotes creativity across a wide range of disciplines).

13. The Larger World, and a few just for fun...

Note: this bibliography touches almost none of the current focus on issues of diversity, equity and inclusion. This does not reflect in any way upon the importance of these critical though still emerging community issues. Let me know what you’ve found the most useful resources on these important topics in science, and we’ll generate a separate section for them next cycle…

Fiona Watt’s series of interviews with prominent women in science ran in the Journal of Cell Science from 2003. Almost all address or illuminate issues women face and feel more often than men (sexism, exclusivity, demands of family and children), and often provide trenchant advice. She

Simone, J.V. (1999) Understanding academic medical centers: Simone’s maxims. *Clin. Cancer Research* 5:2281-2285. Joe Simone is a senior academic physician who’s held leadership roles at several cancer centers, most recently in Utah. After having heard his ‘maxims’ quoted so many times as wisdom of a sage, I was happy to find that they’d been captured for posterity, amusement and use. Topics include institutional realities, leadership, recruiting, job changing and success.

Peter Cook’s Oxford website. Peter runs the Nuclear Structure and Function Research Group at the Dunn School of Pathology at the University of Oxford. His long-standing interest in teaching and better-communicating is on display in his ‘Resources’ page that includes up-to-date material and live links to many very useful resources. See: http://users.path.ox.ac.uk/~pcook/w1/resources.htm

Medawar, P. (1982/1990) *Pluto’s Republic* and *The Threat and the Glory*, Oxford U.P. and Harper Collins. (Medawar and Thomas (see below) were two of the most engaging and elegant stylists writing science in any century. Both are models of high intelligence, clarity and enthusiasm in presenting science and medicine to the public).

Thomas, L. (1974/79) *Lives of a Cell* and *The Medusa and the Snail*. Viking Press. (see note above. The first of these books was collected from a very unusual (for the time) column Thomas wrote for the *New England Journal of Medicine* entitled ‘Notes of a Biology Watcher’).

Sabertooth the lab head (2001) A memo to graduate students and post-docs. *J Cell Science* 114:2547-48. A tongue-in-cheek contribution to JCS’s entertaining StickeyWicket/Caveman series reminding you—again—that you are the chief agent of your success or failure in science. The first sentence gives you the flavor: 'I'm sorry to be unhelpful, but I am not your mother!'


Feynman, R.P. (1985) *Surely You’re Joking, Mr. Feynman!: Adventures of a Curious Character*. W.W. Norton, New York. 350pp. (Feynman's autobiography in the form of a collection of great stories he told his drumming buddy and fellow physicist Ralph Leighton. A gentle reminder that life and science are supposed to be fun).


Dyson, F.J. (1988 on) *Infinite In All Directions*. Perennial/Harper & Row, New York. (these and subsequent lectures in *From Eros to Gaia* (1992), *Imagined Worlds* (1997),and *The Sun, The Genome and The Internet* (1999) are great fun to read for Dyson’s intellectual breadth and adventurousness, and his exemplary prose. All in paperback with his reissued autobiography. Alas, a giant no longer with us, except in spirit...).


In the same vein is the recently published ‘*Why People Believe Weird Things*’ by Michael Shermer (WH Freeman, 1997 and recently updated). Shermer has also written the ‘Skeptic’ column for *Scientific American*. Look around - you’ll have no trouble finding local examples...of people believing weird and worse!