

Overview of *A Mind for Numbers: How to Excel at Math and Science (Even if You Flunked Algebra)* by Barbara Oakley¹

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Despite the explicit mention of “numbers,” “math,” and “science” in the title and of “teaching methods” in the biographical blurb, this book has nothing *directly* to do with any of those subjects. So if you expect to learn a mnemonic device for factoring polynomials, you will not learn it from Oakley’s book. On the other hand, the book *does* focus on the mind, or rather the brain, and provides copious information and practical applications to help readers develop habits of mind and behaviors that lead to successful learning not just in STEM fields but in any subject or skill.

As indicated in the “To the Reader” section, Oakley intends the book to appeal to a broad range of general readers, and, for the most part, she does a fine job of accommodating the needs of general readers. She uses plain language that anyone can understand, and when she does use specialized terms, she defines them and often includes an end note in case readers want additional information from primary sources. She has kept chapters relatively short, 20 pages or fewer, with Chapter 4 the longest at 31 pages. Each chapter is structured similarly, including short sections with topic headings and visuals and ending with a list of “Summing it Up” bullet points and a list of questions and/or activities titled “To Enhance Your Learning.” All chapters include quotations from students and professionals attesting to the effectiveness of the strategies Oakley describes, and each chapter ends with an extended vignette about the learning experiences of a specific professional in a STEM-related field.²

Below are brief summaries of each chapter.

Chapter 1: “Open the Door.” Oakley traces her academic and professional history from mathphobe to professor of engineering. By reviewing her personal journey from expert in Slavic languages to revamped STEM career path, Oakley shows that “the brain is designed to do extraordinary mental calculations” (6-7). She foreshadows subsequent chapters, including some findings from the field of neuroscience that readers can apply to expand their skills and creativity in STEM fields and beyond.

Chapter 2: “Easy Does It: Why Trying Too Hard Can Sometimes Be Part of the Problem.” The pitfalls of “trying too hard” are explained and illustrated through numerous examples. Oakley defines two primary modes of thinking—*focused* and *diffuse*—and shows how each is important for different types of learning and problem solving. She asserts that we must learn not only how to use each mode but also how and when to shift between these modes.

Chapter 3: “Learning is Creating: Lessons from Thomas Edison’s Frying Pan.” Oakley describes the mental habits of two creative giants—Thomas Edison and Salvador Dali—to support her claims about the successful uses of *focused* and *diffuse* modes of thinking. She also emphasizes the importance of *working memory* and *long-term memory* for creativity and problem solving, because these two forms of memory build multiple and novel connections that can lead to novel outcomes.

¹ New York: Tarcher/Penguin, 2014. Note: This review/summary is based on an uncorrected proof for limited distribution, which the publisher provided to members of CMU’s Teaching & Learning Collective (TLC) in preparation for Dr. Oakley’s visit to CMU on October 1, 2014. **Biographical blurb from back cover:** “Barbara Oakley is a professor of engineering at Oakland University in Rochester, Michigan. Concerned about the lack of a minority representation in engineering classrooms at inner-city schools in nearby Pontiac, Dr. Oakley introduced teaching methods that launched the school district to the top in math performance on statewide tests. Dr. Oakley’s previous books, *Evil Genes*, *Cold-Blooded Kindness*, and *Pathological Altruism* have been lauded by Joyce Carol Oates, Steven Pinker, and Pulitzer Prize winner Edward O. Wilson.”

² STEM is the commonly-accepted acronym for “science, technology, engineering, and math.”

Chapter 4: “Chunking and Avoiding Illusions of Competence: The Keys to Becoming an ‘Equation Whisperer’.” Oakley explains the process of *chunking* information and reveals common misconceptions about time-on-task versus active forms of reading and learning. She argues that making connections within and between information is more effective than passive rereading, overlearning, and rote memorization, strategies that frequently trick learners into believing they understand more of the material than they really do.

Chapter 5: “Preventing Procrastination: Enlisting Your Habits (“Zombies”) as Helpers.” Oakley labels procrastination as a “keystone bad habit” (86) and, therefore, a particularly threatening *zombie*. Habitual procrastination sabotages the neural foundations needed to succeed, especially but not exclusively in STEM subjects. Oakley provides a roadmap for identifying and avoiding addictive behaviors that thwart productive learning.

Chapter 6: “Zombies Everywhere: Digging Deeper to Understand the Habit of Procrastination.” Building positive mental habits is Oakley’s focus here. Four main components of habits are reviewed: rewarding short periods of productivity, nurturing the diffuse-thinking mode, engaging in mental contrasting, and avoiding multi-tasking that interrupts the learning process. Oakley argues that successful learners tend to focus on process over product.

Chapter 7: “Chunking Versus Choking: How to Increase Your Expertise and Reduce Anxiety.” Oakley provides opportunities here for readers to practice the study habits and learning strategies introduced previously. She prioritizes the mental storage of concepts over rote memorization and provides seven steps for building powerful *chunks* of process-based learning. She also emphasizes that learners gain expertise through active learning and mentally expanding their collection of problem-solution patterns.

Chapter 8: “Tools, Tips, and Tricks.” Acknowledging that it is normal for learners to have some negative feelings about beginning their work, Oakley explains that by managing those feelings and completing a type of behavioral self-analysis, learners can develop personalized productivity tools as well as a positive anticipation toward their work. She provides strategies designed to organize behavior and free up working memory for better problem solving. She also emphasizes the need to include healthy leisure time in the workday. Students and teachers may find especially useful the list of best apps and online support programs for keeping on task.

Chapter 9: “Procrastination Zombie Wrap-Up.” This is the culminating chapter about procrastination. Oakley notes that the neural framework needed for math and science performance languishes under stressful, binge-learning conditions. In contrast, the learning strategies of pausing and reflecting are more effective.

Chapter 10: “Enhancing Your Memory.” Oakley describes strategies for improving one’s visuospatial memory, i.e., by creating analogies, such as visual images, jingles, or the “memory palace.”

Chapter 11: “More Memory Tips.” Oakley expands on the previous chapter, focusing on the effectiveness of learners’ creating visual metaphors, spaced repetition, meaningful groups, and narratives. She also notes that, with respect to some kinds of learning, the kinesthetic element of writing by hand offers some advantages over writing by computer. She ends the chapter with a few more “memory tricks.”

Chapter 12: “Learning to Appreciate Your Talent.” Oakley shifts her focus to the role of intuition in learning and urges readers not to underestimate its value. She emphasizes that what we know isn’t as important as how we think.

Chapter 13: “Sculpting Your Brain.” This chapter is a mini-case study of Ramón y Cajal, the Nobel-Prize-winning “father of modern neuroscience” (194). Oakley’s purpose is to illustrate how strategies

she describes in previous chapters—especially *chunking* and creating *analogies*—are reflected by and account for Cajal’s intellectual development.

Chapter 14: “Developing the Mind’s Eye through Equation Poems.” We finally reach a chapter that focuses on mathematics, specifically on how to read mathematical symbols and understand the stories told by equations. As Oakley notes, “There are hidden meanings in equations, just as there are in poetry” (203). Oakley explains two strategies for finding and understanding those hidden meanings: by simplifying and personifying the object of study and by recognizing when and how to transfer to a new context something learned previously in a different context.

Chapter 15: “Renaissance Learning.” The primary focus of this chapter is the value of independent learning, but it also acknowledges the value of effective teachers. Oakley ends with a caveat for readers about “intellectual snipers,” i.e., “those who criticize or attempt to undermine any effort or achievement you make” (218).

Chapter 16: Avoiding Overconfidence: The Power of Teamwork.” In contrast to the previous chapter, which emphasized independent learning, this chapter promotes the advantages of collaborative. Oakley argues collaborative learning can help learners avoid overconfidence. As long as group members feel free to disagree with the group’s status quo, study teams can provide useful checks and balances to members’ individual learning, and Oakley explains how.

Chapter 17: “Test Taking.” Rather than focusing on test-taking as a mode of assessment, Oakley focuses on its role as “an extraordinarily powerful learning experience” (238). Students and teachers will find most useful the “Test Preparation Checklist” (240-41). Oakley also describes the “hard-start—jump-to-easy” technique of test-taking and addresses strategies for harnessing test-taking anxiety.

Chapter 18: “Unlock Your Potential.” The final chapter summarizes the previous chapters, culminating in two lists: “10 Rules of Good Studying” and “10 Rules of Bad Studying.” Both can be adapted easily to accommodate learning in any field or discipline.