The 5 Elements of Effective Thinking

Edward B. Burger
Michael Starbird

"*The 5 Elements* is an enormously insightful examination of what constitutes effective thinkin Everyone will find something of value in it."

—Morton O. Schapiro, president of Northwestern University

"I highly recommend this book for instructors who care more about their students than test score for students who care more about learning than their GPA, for leaders of society and masters of th universe who care more about serving the public good than increasing their profit margin, and f artists who constantly remind us of the human condition. *The 5 Elements of Effective Thinki* provides comfort in a world that has lost its equilibrium."

—Christopher J. Campisano, director of Princeton University's Program in Teacher Preparation

"Edward Burger and Michael Starbird became renowned scholars and educators by demonstratin that mathematical expertise is within the reach of the general population and not confined to tho with the 'right' aptitude. With the publication of this remarkably wise and useful book, they exten their pedagogical principles to the general realm of practical affairs and the entire range academic endeavor. Regardless of the reader's background, *The 5 Elements* offers highly applicab and original lessons on how to think."

—John W. Chandler, president emeritus of Hamilton College and Williams College

"So this is how Newton stood on the shoulders of giants! Burger and Starbird outline the bas methods of genius—so that ordinary people, too, can see further than others."

—Robert W. Kustra, president of Boise State University

"I spectacularly love this book. It made the greatest impact on me a book possibly could because hold these ideas in such high regard and they landed in my hands at the perfect time. M overarching response to *The 5 Elements of Effective Thinking* is pure delight, great appreciation, an confidence in myself and in what lies ahead."

—Kyle C., undergraduate mathematics major

"This book took me on an emotional rollercoaster, made clear some biases I have toward mysel and helped me to see the world in a new way."

—Elle V., undergraduate biology major

"There are a lot of great things about this book. It is filled with many wonderful quotes, wit humor, fun exercises, historical and personal examples, and stuff that really gets you thinking. also found myself quietly laughing out loud in the library several times. I have alread recommended this book to people who want to take a different approach to thinking. I was ver fortunate, and sometimes I think, destined, to receive this book on the first day of college."

—Luis H., undergraduate history major

"While reading *The 5 Elements*, I learned more about how I should think, study, and understan than during any other experience in my life. Every chapter resonated so well with me that I a already changing the way I go through my classes, homework, and life."

—Nirav S., undergraduate mechanical engineering major

“This book is captivating because it changes the average thoughts of learning by teaching new on
and highlighting them through examples of current students and historic geniuses. The book shov
that geniuses are average people with different ways of thinking and learning. I found this ne
insight inspiring.”

—Lauren L., undergraduate psychology major

“When I picked up this book to read for a class, I was dreading it. After the first few pages,
couldn’t put it down. I’ve always had an idea of what I’ve needed to do in order to become a bett
student, but this material was laid out in a way that was not only inspirational, but fun to read. Th
basics of learning, understanding, and creating are all within this text.”

—Scott G., undergraduate civil engineering major

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Thinking Makes the Difference

I think, therefore I am.

—René Descartes

The root of success in everything, from academics to business to leadership to personal relationshi and everything else, is thinking—whether it's thinking disguised as intuition or as good values or decision making or problem solving or creativity, it's all thinking.

So it is not a surprise that thinking more effectively is the key to success for students, professional business leaders, artists, writers, politicians, and all of us living our everyday lives. Doing anythi better requires *effective thinking*—that is, coming up with more imaginative ideas, facing complicat problems, finding new ways to solve them, becoming aware of hidden possibilities, and then taki action.

What *is* a surprise is that the basic methods for thinking more clearly, more innovatively, mo effectively are fundamentally the same in all areas of life—in school, in business, in the arts, personal life, in sports, in everything. The other surprise is that those methods of effective thinki can be described, taught, and learned. They are not inborn gifts of a special few. They are not esoteric that only geniuses can master them. All of us can learn them and use them, and that is wh this book is about.

We, the authors, did not begin our careers with the goal of discovering strategies of effecti thinking. We began our careers teaching the abstract ideas of mathematics. But over the years w came to realize that what actually makes a difference are a few habits of thinking that people c apply in everyday life—methods that are not mathematical at all. This book offers thought-provoki ways to provoke thought. These strategies have inspired many people in all walks of life to becom more successful, and we hope that you too will create success through effective thinking.

Elements of Effective Thinking, Learning, and Creating

I know quite certainly that I myself have no special talent. Curiosity, obsession and dogged endurance, combined with self-criticism, have brought me to my ideas.

—Albert Einstein

A wondrously romantic belief is that brilliant students are born brilliant and brilliant thinke magically produce brilliant ideas: *A*+, the star student aces the exam; *click*, Edison invents t lightbulb; *liftoff*, the Wright brothers soar into the sky; *abracadabra*, J. K. Rowling apparates Har Potter; *yea*, the Founding Fathers resolve the Bill of Rights; *whoosh*, Ralph Lauren turns heads o fashion's runways; *eureka*, Einstein teases his hair and relativity falls out. We can all marvel at thes fanciful visions of leaps of genius, but we should not be fooled into believing that they're realit Brilliant students and brilliant innovators create their own victories by practicing habits of thinki that inevitably carry them step-by-step to works of greatness. No leaps are involved—a few bas strategies of thought can lead to effective learning, understanding, and innovation. More importantl *you* yourself can master and apply those strategies. This book presents practical, proven methods effective thinking and creativity that lead to inevitable success in life.

We, the authors, are teachers. We have taught hundreds of thousands of students and adults how t think more effectively. Countless times we have encountered individuals with potential and watche the drama of life's transformation unfold—or not. Anne and Adam struggle with ideas, understand th basics, learn from mistakes, ask questions—and thrive. Fiona and Frank, with the same native tale start at the same place, but they memorize without understanding, fear error, avoid uncertainty—a do not succeed. This book is about what makes the difference.

Education does not stop with the end of your formal schooling. Even if your formal school days a long past, you are still a student and, hopefully, will always be one. You can choose to learn habits o thought that will help you to meet the ongoing challenges of life—personal, professional, and societa

Imagine Marie Curie, Albert Einstein, and William Shakespeare as students. Today we know the as famous geniuses, but when they were in school, they didn't walk around wearing a "FUTURE GENIU button. Instead, they just looked at the world differently by applying habits of mind that allowed the to discover and create new and profound ideas. While we can celebrate famous geniuses and l inspired by their remarkable stories, this book is about *you*—a real person with strengths a weaknesses—not a mythologized hero. Look down at your shirt—if you don't see a "FUTURE GENIU button, then you too have the potential to innovate. Creativity is not a matter of magical inspiratio This book describes habits that will automatically cause *you* to regularly produce new knowledge a insight. Remember: Extraordinary people are just ordinary people who are thinking differently—a that could be you.

Ordinary students can attain extraordinary heights. Mark was one of our mathematics studen whose work at the beginning of the semester was truly dismal. He was so lost that his homewo assignments were neither right nor wrong—they were simply nonsense. He merely recycled ma terms that he wrote down during class discussions without even knowing their meaning. It was as if h were writing a poem in a language that he himself did not understand. Although he was genuine dedicated, Mark appeared to be the textbook example of a *lost cause*.

By the end of the semester, however, Mark had transformed himself into a different person—person who was able to think about mathematics in clever and imaginative ways. As the term came a close, he devised a creative and correct solution to a difficult, long-standing challenge that no on else in the class was able to resolve. At some point during the semester, Mark had the epiphany tha mathematics had meaning and that he could make sense of it. He returned to the most basic ideas the subject—ideas that he had seen years before but never truly grasped. He floundered when h viewed learning as memorizing techniques and repeating words. He succeeded when he sought understand fundamental ideas deeply. With his new mind-set, building up a solid understanding of th subject was relatively easy, and his success in the class was inevitable.

The principles of understanding the unknown and finding creative insights that transformed Mark life can be taught, learned, and applied broadly across disciplines and professions. We have seen thes methods of thinking transform otherwise ordinary people into innovative leaders, authors, artist financial gurus, teachers, film producers, scientists, and, in a number of cases, multimillionaires.

> **Education is what survives when what has been learned has been forgotten.**
>
> **—B. F. Skinner**

Given that we, the authors, are professors, it is not surprising that many stories in this book tak place in classroom settings. However, we have also taught tens of thousands of lifelong learners. S when we offer illustrations from our school experiences, we hope that you will view them literally you are in the classroom (as either a student or a teacher), or metaphorically if you now find yourse outside the ivy-covered walls of the academy. When Aesop wrote "The Tortoise and the Hare," he wa not aiming exclusively at the turtle market. Throughout life we frequently face challenges analogou to taking tests, earning grades, and understanding course material. Instead of taking formal tests, w encounter daunting questions from employers or even family and friends; instead of earning grade we are judged in the workplace and in social settings; instead of understanding course material, w regularly need to master new skills and absorb new knowledge to keep up with a rapidly changin world. All our stories have direct relevance to you and your life.

Five elements of thinking and learning

The surprising fact is that just a few learnable strategies of thinking can make you more effective the classroom, the boardroom, and the living room. You can personally *choose* to become mo successful by adopting five learnable habits, which, in this book, we not only explain in detail but als make concrete and practical. Here in this section we briefly introduce those important habits to come

Understand deeply:

> Don't face complex issues head-on; first understand simple ideas deeply. Clear the clutter and expose what is really important. Be brutally honest about what you know and don't know. Then see what's missing, identify the gaps, and fill them in. Let go of bias, prejudice, and preconceived notions. There are degrees to understanding (it's not just a yes-or-no proposition) and you can always heighten yours. Rock-solid understanding is the foundation for success.

Make mistakes:

> Fail to succeed. Intentionally get it wrong to inevitably get it even more right. Mistakes are great teachers—they highlight unforeseen opportunities and holes in your understanding. They also show you which way to turn next, and they ignite your imagination.

Raise questions:

Constantly create questions to clarify and extend your understanding. What's the real question? Working on the wrong questions can waste a lifetime. Ideas are in the air—the right questions will bring them out and help you see connections that otherwise would have been invisible.

Follow the flow of ideas:

Look back to see where ideas came from and then look ahead to discover where those ideas may lead. A new idea is a beginning, not an end. Ideas are rare—milk them. Following the consequences of small ideas can result in big payoffs.

These four building blocks are basic elements for effective thinking, and we devised an easy wa for you to remember them. You only need to recall the classical elements that were once believed t be the essential parts of all nature and matter. Those elements, which predated Socrates and influenc Renaissance culture and thought, are Earth, Fire, Air, and Water. So to help trigger your memory an enable you to apply these techniques, we associate each classical element with one of our strategi for effective thinking, learning, and creating:

 Earth ↔ Understand deeply

 Fire ↔ Make mistakes

 Air ↔ Raise questions

 Water ↔ Follow the flow of ideas

By mastering these strategies, you can and will *change*. The classical elements of nature included fifth special element—the *quintessential element*—that was the changeless matter from which all th heavens were made. Ironically, here in our context of thinking and learning, the quintessential eleme is *change*.

 The Quintessential Element ↔ Change

Change:

The unchanging element is change—by mastering the first four elements, you can change the way you think and learn. You can always improve, grow, and extract more out of your education, yourself, and the way you live your life. Change is the universal constant that allows you to get the most out of living and learning.

In any movie, play, or literary work, media scholars tell us how to determine who truly is the ma character of the story—it's the individual who, by the end, has changed the most. Your life is a exciting journey. When you embrace change, you put yourself front and center by intentionall deciding in which direction you wish your life's drama to unfold. In doing so, *you* become the hero your own life's adventure.

The chapters ahead unpack the previous sound-bite sentences by more fully describing our fiv elements of effective thinking. Exercises, action items, illustrations, and stories in each chapter tu

these elements into a practical way to vastly improve individuals and organizations.

The elements and exercises provide you with an intellectual GPS to help you navigate through lif We have seen countless inspirational examples of people who flourish well beyond their ow expectations. These stories feed our optimistic belief that we all are capable of living our lives f more successfully than we generally do. Our hope is that students will find these elemen transformative; instructors will use these lessons to enrich their classes; leaders of society, whether business, science, politics, or the arts, will employ these strategies to become more innovative; a lifelong learners will apply these principles to better live as ever-evolving students of the world.

How to Read this Book

Your challenge is to make these elements a part of your daily routine. We urge you to read this tiny book slowly and then reread it. In fact, we thought of literally repeating the entire text three times (making the book three times as long); however, our publisher refused to embrace our innovative idea. Instead we suggest three readings, as follows:

First read: Take it all in and don't mind the details—Throughout the text, we provide exercises where we invite you to pause, look back, contemplate, and experiment. However, during your first read-through, don't necessarily pause to attempt these exercises. Instead, get a global sense of the entire story we are telling.

Second read: Give it a test drive—Return to the beginning and slowly reread the book, this time stopping to think about and to apply the suggestions and exercises to your life.

Third read: Make it your own—You have now tried the exercises and reflected on the elements twice. In this third reading, work toward letting those methods become second nature.

We encourage you to revisit chapters again and again—different elements will resonate with you at different times. The more you absorb and practice these elements of thinking, the more you will get out of them.

At the end of this book you will find an invitation to share your own stories of effective thinking www.elementsofthinking.com. We look forward to hearing from you.

Understand Deeply

He never did a thing so very bad.
He don’t know why he isn’t quite as good
As anyone.
—From “The Death of the Hired Man” by Robert Frost

Silas felt the nervous excitement that all students feel as their professor returns graded exams. Wh Silas saw the red “58%” on the top of his test paper, he was frustrated, annoyed, and bewildered. really knew the stuff on the test. I just made a bunch of stupid little mistakes. I really knew it. Really And he really believed he knew it. Really. Sadly, such unpleasant surprises do not necessarily en after we receive our diplomas. Many people spend their entire careers confidently (and erroneousl thinking they know more and deserve more than their yearly evaluations, salaries, and success seem reflect.

Understanding is not a yes-or-no proposition; it’s not an on-or-off switch. Silas spent hou studying for his test. But he spent that time memorizing facts rather than building a de understanding. He would have earned a higher grade had he invested the same amount of tin mastering the fundamentals, identifying essential themes, attaching each idea to that core structur and, finally, imagining what surrounds or extends the material he was studying. Instead, Silas strategy was like that of a well-intentioned elementary school student who meticulously memoriz the mechanics of adding two-digit numbers but has no idea why the process works, and, as a resu finds adding three-digit numbers as alien as visiting another planet. Silas’s understanding was, at bes thin and fragile. Even tiny variations threw him, because he viewed his job as pinning down a certa number of isolated facts rather than understanding the meaning and connections of the ideas.

When you learn anything, go for depth and make it rock solid. If you learn a piece of music for th piano, then, instead of just memorizing finger movements, learn to hear each note and understand th structure of the piece. Ask yourself, “Can I play the notes of the right hand while just humming th notes of the left hand?” If you study the Civil War, rather than memorizing some highlights—Lincol was president; Lee was a general; slavery played a role—you can try to understand the backgroun competing forces, and evolving social values that ignited the bloody conflict. When you mak political decisions, instead of focusing on a candidate’s good looks and fifteen-second sound bite you can objectively learn about the issues and develop your own reasoned opinions.

You *can* understand anything better than you currently do. Setting a higher standard for yourself f what you mean by *understanding* can revolutionize how you perceive the world. The following ste illustrate why a deep understanding is essential to a solid foundation for future thinking and learning

Understand simple things deeply

The most fundamental ideas in any subject can be understood with ever-increasing depth. Profession tennis players watch the ball; mathematicians understand a nuanced notion of number; successf

students continue to improve their mastery of the concepts from previous chapters and courses as the move toward the more advanced material on the horizon; successful people regularly focus on the co purpose of their profession or life. True experts continually deepen their mastery of the basics.

Trumpeting understanding through a note-worthy lesson. Tony Plog is an internationally acclaime trumpet virtuoso, composer, and teacher. A few years ago we had the opportunity to observe hi conducting a master class for accomplished soloists. During the class, each student played a portion his or her selected virtuosic piece. They played wonderfully. Tony listened politely and always starte his comments, "Very good, very good. That is a challenging piece, isn't it?" As expected, h proceeded to give the students advice about how the piece could be played more beautifully, offerin suggestions about physical technique and musicality. No surprise. But then he shifted gears.

He asked the students to play a very easy warm-up exercise that any beginning trumpet play might be given. They played the handful of simple notes, which sounded childish compared to th dramatically fast, high notes from the earlier, more sophisticated pieces. After they played the simp phrase, Tony, for the first time during the lesson, picked up the trumpet. He played that same phras but when he played it, it was not childish. It was exquisite. Each note was a rich, delightful sound. H gave the small phrase a delicate shape, revealing a flowing sense of dynamics that enabled us to he meaning in those simple notes. The students' attempts did not come close—the contrast wa astounding. The fundamental difference between the true master and the talented students clear occurred at a far more basic level than in the intricacies of complex pieces. Tony explained th mastering an efficient, nuanced performance of simple pieces allows one to play spectacular difficult pieces with greater control and artistry.

The lesson was simple. The master teacher suggested that the advanced students focus more of the time on practicing simple pieces intensely—learning to perform them with technical efficiency an beautiful elegance. Deep work on simple, basic ideas helps to build true virtuosity—not just in mus but in everything.

What is deep understanding? How can you realize when you don't know something deeply? When th advanced trumpet students played the simple phrase, they played every note and it sounded good them. Before hearing the contrast between their renditions and the true virtuoso's performance, th students might not have realized that it was possible to play that phrase far, far better.

In everything you do, refine your skills and knowledge about fundamental concepts and simp cases. Once is never enough. As you revisit fundamentals, you will find new insights. It may appe that returning to basics is a step backward and requires additional time and effort; however, b building on firm foundations you will soon see your true abilities soar higher and faster.

▶ **A way to provoke effective thinking …**

Master the basics

Consider a skill you want to improve or a subject area that you wish to understand better. Spend five minutes writing down specific components of the skill or subject area that are basic to that theme. Your list will be a free-flowing stream of consciousness. Now pick one of the items on your list, and spend thirty minutes actively improving your mastery of it. See how working deeply on the basics makes it possible for you to hone your skill or deepen your knowledge at the higher levels you are trying to attain. Apply this exercise to other things you think you know or would like to know.

▶ Illustration: A student's response in trying to understand basic economics

Step 1: A brainstorming list of components: *Maximize profits; free markets; supply and demand; equilibrium of*

supply and demand. (Note that the student's list is neither organized nor complete, which is great.) Step 2: Improve understanding of "*equilibrium of supply and demand*": *First, I need to understand what the graphs of the supply and demand curves mean. The horizontal axis is the quantity and the vertical axis is the price; so I see why the demand graph curves down to the right and the supply graph curves up to the right. I think that equilibrium is the point of intersection of those two graphs. But if the quantity level is to the left of that intersection, then the price for demand is higher than the price for supply. I don't know what that means.* (Note that this student successfully identified a lack of understanding of a basic idea, namely, what the supply and demand graphs represent. He now knows what he should work on first. A firm understanding of that basic idea will allow him to progress further and faster in the future.)

The whole of science is merely a refinement of everyday thinking.

—Albert Einstein

A commonsense approach leads to the core. Many of the most complicated, subtle, and profou ideas arise from looking unmercifully clearly at simple, everyday experiences. Calculus is one of t most influential concepts in history. It has fundamentally changed the way we experience life today- a wide range of technological innovations, from space exploration to plasma TVs, computers, and ce phones, would not exist without calculus. And calculus is based on thinking deeply about simpl everyday motion—like an apple falling from a tree.

In 1665, England suffered an epidemic of bubonic plague. Cambridge University was closed to ste the dreaded disease's spread, so Isaac Newton and the other students were sent home. Newton spe the next two years on his aunt's farm, during which time he formulated the fundamental ideas calculus and the laws of physics. The famous story about Newton sitting under an apple tree when a apple fell on his head, giving him the idea of universal gravitation and calculus, may be almo literally true. Thinking about the speed of a falling apple can generate the idea of the *derivative*—t profound extension of the basic notion that speed equals distance divided by time. Thinking about ho far the apple would fall if you knew its speed at each instant leads to the idea of the *integral*—t abstraction that distance equals speed multiplied by time.

The grandest, most cosmic ideas, such as how the planets move, arise from thinking deeply about a apple beaning Newton. Newton described the universe—the behavior of the sun, planets, and dista stars—using the same laws that describe everyday occurrences like apples falling from trees. Th simple and familiar hold the secrets of the complex and unknown. The depth with which you mast the basics influences how well you understand everything you learn after that.

Today, when math teachers are asked what makes calculus so difficult to teach, most reply, "M students don't know the basic mathematics that they saw in the eighth or ninth grade." One secret mastering calculus is to truly master basic algebra. In any class, when preparing for your next exa make sure you can earn a 100% on all the previous exams—if you can't, then you're not ready for t test looming in your future. Instructors should also embrace this fundamental reality and help the students have a firmer grasp of the basics that preceded the material currently being explored.

To learn any subject well and to create ideas beyond those that have existed before, return to t basics repeatedly. When you look back after learning a complicated subject, the basics seem f simpler; however, those simple basics are a moving target. As you learn more, the fundamenta become at once simpler but also subtler, deeper, more nuanced, and more meaningful. The trump virtuoso found limitless beauty in a simple exercise and, in turn, found deep insights into the mo

interesting difficult pieces.

A way to provoke effective thinking …

Ask: What do you know?

Do you or don't you truly know the basics? Consider a subject you think you know or a subject you are trying to master. Open up a blank document on your computer. Without referring to any outside sources, write a detailed outline of the fundamentals of the subject. Can you write a coherent, accurate, and comprehensive description of the foundations of the subject, or does your knowledge have gaps? Do you struggle to think of core examples? Do you fail to see the overall big picture that puts the pieces together? Now compare your effort to external sources (texts, Internet, experts, your boss). When you discover weaknesses in your own understanding of the basics, take action. Methodically learn the fundamentals. Thoroughly understand any gap you fill in as well as its surrounding territory. Make these new insights part of your base knowledge and connect them with the parts that you already understood. Repeat this exercise regularly as you learn more advanced aspects of the subject (and save your earlier attempts so that you can look back and see how far you've traveled). Every return to the basics will deepen your understanding of the entire subject.

Illustration: Voting

How well do you know the candidates running for office—their records, their positions? Write a list of issues that are important to you. Then list what you believe to be the positions of the candidates on each issue—their stated opinions, their voting records, and their other actions associated with the issue. Most voters will have inaccurate or only meager knowledge, particularly for candidates they don't support. Then look up the actual records and see the differences. Fleshing out your knowledge will lead to more informed decisions—on Election Day and beyond.

… Understand Deeply

When faced with a difficult challenge—don't do it! In a speech delivered to Congress on May 2 1961, John F. Kennedy challenged the country with the words "I believe that this nation shou commit itself to achieving the goal, before this decade is out, of landing a man on the Moon a returning him safely to the Earth." On May 26, the National Space Council didn't suit up an astronau Instead their first goal was to *hit* the moon—literally. And just over three years later, NAS successfully smashed Ranger 7 into the moon at an impact velocity of 5,861 miles per hour (after t unmanned spacecraft transmitted over four thousand photographs of the lunar surface). It took fifte ever-evolving iterations before the July 16, 1969, gentle moon landing and subsequent moon walk b the crew of the Apollo 11 spacecraft.

Great scientists, creative thinkers, and problem solvers do *not* solve hard problems head-on. Wh they are faced with a daunting question, they immediately and prudently admit defeat. They reali that there is no sense in wasting energy vainly grappling with complexity when, instead, they c productively grapple with simpler cases that will teach them how to deal with the complexity to com

> **If you can't solve a problem, then there is an easier problem you can't solve: find it.**
>
> **—George Polya**

When the going gets tough, creative problem solvers create an easier, simpler problem that they *c* solve. They resolve that easier issue thoroughly and then study that simple scenario with laser focu Those insights often point the way to a resolution of the original difficult problem.

Apply this mind-set to your work: when faced with a difficult issue or challenge, do something els

Focus entirely on solving a subproblem that you know you can successfully resolve. Be complete confident that the extraordinarily thorough work that you invest on the subproblem will later be t guide that allows you to navigate through the complexities of the larger issue. But don't jump to th more complex step while you're at work on the subissue. First just try to *hit* the moon … walking o its surface is for another day.

A way to provoke effective thinking …

Sweat the small stuff

Consider some complex issue in your studies or life. Instead of tackling it in its entirety, find one small element of it and solve that part completely. Understand the subissue and its solution backwards and forwards. Understand all its connections and implications. Consider this small piece from many points of view and in great detail. Choose a subproblem small enough that you can give it this level of attention. Only later should you consider how your efforts could help solve the larger issue.

Illustration: A student's response to this exercise applied to time management

Time management is too big an issue for me, so I'll just focus on getting my homework done. That's still too big a task, so let me just focus on starting my homework. I could commit ten minutes right after each lecture to review class notes and think about the homework assignment. Then five minutes before the next lecture I could review the notes from the previous lecture—great, but not always realistic. So to make it practical, when I return to my room for the night, I'll commit at least ten minutes to reviewing the class notes of the day and beginning the assigned homework. In fact, my problem is not just procrastination but focus. Ah ha! So for those ten minutes, I'll turn off my computer and cell phone and spend that short uninterrupted time knowing there will be no distractions. Without text messages and emails, those ten minutes will be qualitatively different from and better than thirty minutes of interrupted time. That weird serenity will bring me to a meditation-like, focused state of mind. And looking at the homework on the day it was assigned—when it's still fresh in my mind—is better than investing the same amount of time the day before the homework is due—when I'd have to spend time just remembering what was going on. Once I've made this little ten-minute practice a daily habit, I'll revisit the larger challenge of time management. (See how this exercise did its job—it brought out some important principles to consider when facing the daunting challenge of time management: the value of uninterrupted, focused time and the value of carving out small regular intervals of time when they will be most effective.)

… Understand Deeply

Clear the clutter—seek the essential

During most of history, when people thought of flight, they thought it was for the birds. And when w visualize flying birds, we see flapping wings. But, as anyone who has flown on an airplane will attes flapping is not the essence of flight. It's the gentle curve of the top of the wing that matters—the a traveling faster over that curved top creates lift. That curve is the essential feature that generates th lift for birds and the lift for planes. Ignoring the flapping is incredibly difficult, because it's the mo conspicuous, loudest, and most obvious feature of birds in flight. Aviation pioneers needed great focu to ignore the obvious flapping and find the subtle wing curve—the essence that enables us to soar.

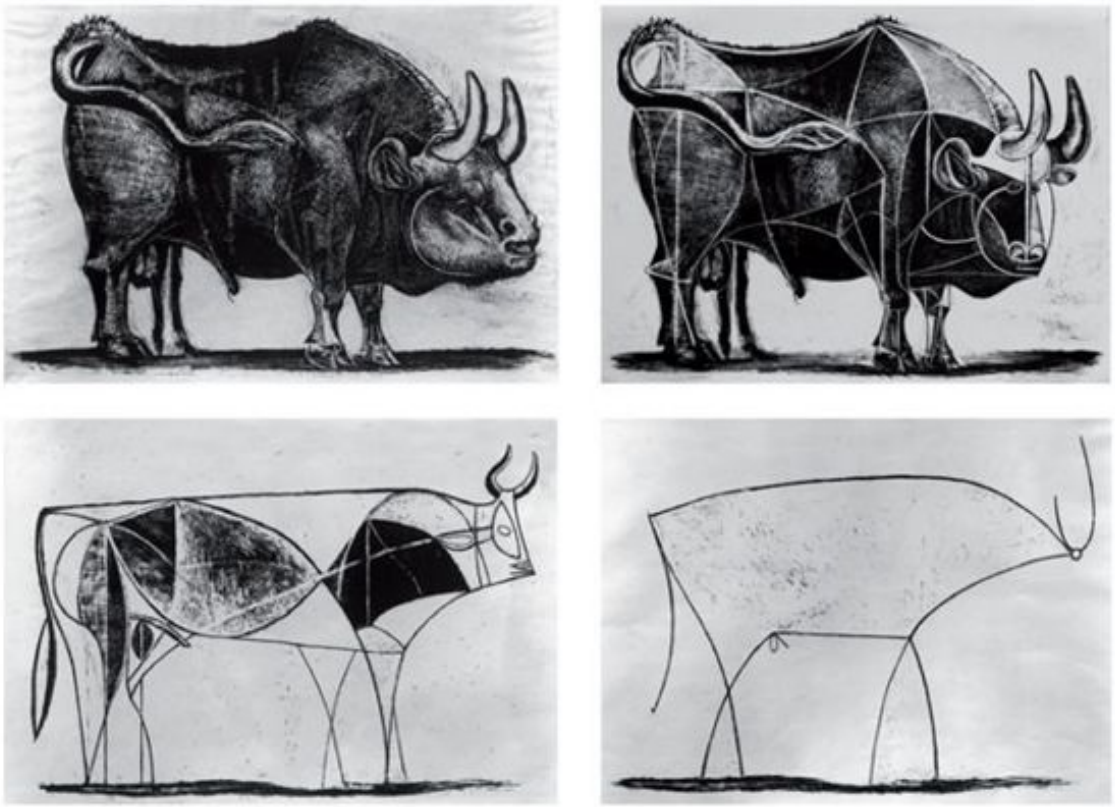
Uncover the essence. When faced with an issue that is complicated and multifaceted, attempt isolate the essential ingredients. The essence is not the whole issue. There is a further step understanding how the other features of the situation fit together; however, clearly identifying an isolating essential principles can guide you through the morass. The strategy of clearing the clutt and seeking the essential involves two steps:

Step One: Identify and ignore all distracting features to isolate the essential core.

Step Two: Analyze that central issue and apply those insights to the larger whole.

Desperately seeking Waldo. In a series of children's picture books by Martin Handford calle *Where's Waldo?*, each page contains a large image completely overrun with hundreds of little cartoo figures entangled together. One of the characters is Waldo, who wears a distinctive red-and-whit striped shirt and round glasses. Waldo would be easy to find if it were not for the hundreds of oth figures on the page. Children enjoy finding Waldo amid the clutter. If the non-Waldo figures wer removed, locating Waldo would be trivial (and boring). The challenge comes from the clutter. If yo literally clear the clutter from your desk, the remaining items are easy to find. But not only ca clearing the clutter expose those things that you know are there; it can reveal the otherwise invisib essence of the situation.

Many real questions are surrounded and obscured by history, context, and adornments. Within th cloud of vaguely related, interacting influences, you need to pluck out the central themes. Often yo may be surprised that after you pare down a complex issue to its essentials, the essentials are muc clearer and easier to face. Ignoring things is difficult. Often the peripheral clutter is blinking an clanging and trying madly to draw your attention away from what is really going on. B systematically ignoring one distraction after another, you can turn your attention to more centr (often initially invisible) themes. After you clear the clutter, what remains will clarify understandin and open the door to creating new ideas. Remember, you may not be able to see everything, but yo can certainly ignore most things.



Pablo Picasso, *The Bull* (plates III, IV, VIII, and IX, 1945–46). © 2012 Estate of Pablo Picasso / Artists Rights Society (ARS), New York. Photos of plates III, VIII, and XI: Erich Lessing / Art Resource, NY. Photo of plate IV: Cameraphoto Arte, Venice / Art Resource, NY

There is no abstract art. You must always start with something. Afterward you can

remove all traces of reality.

—Pablo Picasso

Picasso's work—just plain bull. In 1945–1946, Pablo Picasso produced a powerful series of drawin of bulls. When you arrange his bulls in order of detail, the most detailed is a realistic drawing of bull. All the features are there. Then, in a series of eighteen drawings, Picasso step-by-step simplifi the previous image. The shading of the hide vanishes. The details of the muscles disappear. Th texture is gone. The three-dimensionality evaporates. By the eighteenth bull, we see a line drawing— simple image consisting of ten curves and two ovals. But those twelve marks distill the essence of th bull—its strength and masculinity. The clutter is gone; the essence remains. This final image was th only one in the series that Picasso entitled *The Bull*. By systematically cutting away peripheral par (being careful not to turn the bull into a cow), we force ourselves to appreciate what's important.

▶ **A way to provoke effective thinking …**

Uncover one essential

Consider a subject you wish to understand, and clear the clutter until you have isolated one essential ingredient. Each complicated issue has several possible core ideas. You are not seeking "the" essential idea; you are seeking just one—consider a subject and pare it down to one theme.

In fact, you might perform this exercise on yourself. What do you view as essential elements of you? Isolating those elements can give a great deal of focus to life decisions.

▶ Illustration: Parenting

Bringing up children requires making many decisions on a daily basis. Getting advice about every scenario is impractical. Instead, identify one or two essential goals and use them to guide your actions. For example, one goal may be to raise children to become independent thinkers who take personal responsibility for life decisions. That goal would influence your decision if your children repeatedly fail to complete homework assignments. Do you embrace the easier, short-term solution of finishing their homework; or do you take the more difficult approach of encouraging your children to learn for themselves? Having essential goals in mind makes daily decisions clearer. Whether or not you are a parent, this same perspective can help everyone—teachers, students, professionals, businesspeople, and even politicians—make daily decisions that aim toward long-term goals rather than toward short-term goals that may be diversions.

… Understand Deeply ◀

Once you have isolated the essential, you have armed yourself with a solid center upon which build and embellish. The core is not the whole issue, but it is a lodestar that can guide you throug turbulent storms and complications. What's core? What's fluff? Find what's at the center and wor out from there. You can confidently center yourself.

See what's there

You (and everyone else) have prejudices.

Admit it already and move forward from there.

—Two anonymous authors (of this book)

We, the authors, have a passion for art, but sadly our enthusiasm far exceeds our talent. Some yea ago while I (BURGER) was visiting Denison University in Ohio, I met a studio art professor and th had a chance to ask an expert about painting. I simply asked the artist, "Tell me one insight in painting." The artist, a bit surprised by the out-of-the-blue request, thought for several moments a then responded, "Shadows are the color of the sky." I didn't really believe him at first. Like mo people, I thought shadows were gray or black, but if you look closely, you will see that indee shadows in the great outdoors do have color—albeit subtle and muted.

This artistic insight struck me as meaningful beyond just looking at shadows. It showed somethi about seeing, about seeing what is actually there rather than what seems to be there. I had se shadows every day of my life, but I was wrong about what they really look like. Those colorf shadows gave me a whole new view of the world—a fresh perspective that transcends the art painting.

Whenever you "see" an issue or "understand" a concept, be conscious of the lens through whi you're viewing the subject. You should assume you're introducing bias. The challenge remains t identify and let go of that bias or the assumptions you bring, and actively work to see and understa the subject anew.

Whether it be physical characteristics of what you see, emotional aspects of what you feel, conceptual underpinnings of what you understand, acknowledging and then letting go of bias a prejudice can lead you to see what's truly there and (often more importantly) to discover what missing.

Two experiences from two art classes. Studying art can help us see the real world more clearly. He we recount two brief tales about our own challenges as art history students.

While an undergraduate at Pomona College, I (STARBIRD) found myself in the back row of medieval art history course taught by a truly refined scholar who was very old. Students believed th the secret to her nearly infinite knowledge of Gothic cathedrals was that she'd actually been prese when they were built. One day in class, the ancient professor showed a slide of a medieval paintin and asked, "Mr. Starbird, what do you see in this painting?"

Of course nothing profound came to mind. The picture just seemed strange—the body parts we distorted and the bright gold halos looked like the arches at McDonald's, which made my stoma growl. But I knew that art was supposed to have "meaning," so I tried to imitate the art analysis tha had heard, and replied, "I think the halo of light represents the circle of life—emerging from t darkness of the primeval void, arcing into a shining glory, and descending again to the abyss eternity." Without missing a beat, the dignified professor retorted, "Cut the bull and tell us what yo see." Not the reaction I expected.

The second incident occurred many years later when the other author (BURGER), as a professo decided to sit in on a popular introductory art history course at Williams College. The art profess was brilliantly theatrical and the lectures were riveting. Early in the term, the professor projected a image of a monk, his back to the viewer, standing on the shore, looking off into a blue sea and a enormous sky. The professor asked the class, "What do you see?" The darkened auditorium was silen We looked and looked and thought and thought as hard as possible to unearth the hidden meaning, bu came up with nothing—we must have missed it. With dramatic exasperation she answered her ow question, "It's a painting of a monk! His back is to us! He is standing near the shore! There's a blu sea and enormous sky!" Hmm … why didn't we see it? So as not to bias us, she'd posed the questio without revealing the artist or title of the work. In fact, it was Caspar David Friedrich's *The Monk*

the Sea (1808–1810).

To better understand your world, consciously acknowledge what you *actually* see—no matter ho mundane or obvious—rather than guess at what you think you are supposed to see. Saying what yo actually see forces you to become conscious of what is there and also what is missing. If you see then say it; if you don't see it, then don't claim to see it.

Being honest and accurate about what you actually know and don't know forces you to identify an fill gaps in your understanding. It is at the interface between what you actually know and what yo don't yet know that true learning and growth occur.

▶ **A way to provoke effective thinking …**

Say it like you see it

Homework assignments, tests, and job-related assessments ask you what you know. Unfortunately, partial credit or social pressure often encourages you to pretend to know a bit more than you actually do. So in the privacy of your own room look at assignments or possible test questions and write down the weaknesses as well as the strengths of what you know and don't know. Deliberately avoid glossing over any gaps or vagueness. Instead boldly assert what is tepid or missing in your understanding. Now take the action of filling in the gaps. Identifying and admitting your own uncertainties is an enormous step toward solid understanding.

▶ Illustration: Communication

If you are writing an essay, read literally what you have written—not what you intended to communicate. Pretend you don't know the argument you are making and read your actual words. What's confusing and what's missing? If you think you know an idea but can't express it clearly, then this process has identified a gap or vagueness in your understanding. After you admit and address those weaknesses, your exposition will be clearer and more directed to the actual audience. When delivering an address or making a presentation, apply this same process of deliberately listening to the actual words you are speaking rather than what you imagine you are saying.

… Understand Deeply ◀

What everybody believes is not always what's actually true. Commonly held opinions are frequent just plain false. Often we are persuaded by authority and repetition rather than by evidence and realit This tendency to accept what surrounds us makes it difficult to separate what we really know fro what we just believe we know. To illustrate this distinction, let's consider the downfall of gravity.

Around 340 BCE, Aristotle asserted that objects fall at a rate proportional to their weight. In oth words, he thought that heavier objects fall faster than lighter ones. People accepted this assertion f two reasons: (1) it sounded reasonable; and (2) Aristotle said it. The combination of reasonablene and authority is a recipe for entrenched bias. People accepted Aristotle's description of falling bodi for nearly two thousand years. Finally, during the sixteenth and seventeenth centuries, people slow moved from relying on authority to relying on evidence. As often happens in the recounting of histor the reality of incremental progress is replaced by a myth about an instant change in perspective.

In this case, a myth about Galileo condenses an evolving shift in perspective into a single decisiv experiment supposedly (but not actually) conducted by Galileo himself. As legend has it, in 158 Galileo challenged Aristotle's theory about falling bodies by climbing up to the top of the Leanin Tower of Pisa lugging an iron cannon ball and a less weighty wooden ball of equal size. Hopefull after warning passersby below, he simultaneously dropped both balls, and, much to the surprise many (especially the unsuspecting promenaders who did not hear the warning), the two balls crash to the ground at the same instant, thus demonstrating that heavier bodies do *not* fall faster. In fac

except for air resistance, bodies fall at the same rate regardless of their weight. The real myth, the and now, is that people would instantly rely on evidence rather than authority.

How can people, for thousands of years, believe false assertions that are easily disproved? Answe Individuals tend to accept ideas if people they know or respect state or believe those ideas. You nee to be very clear about the foundations of your opinions. If you believe something only because anoth person—even a professor—told you it was so, then you should not view your understanding as roc solid. The Galileo story illustrates the healthy attitude that evidence settles a question, no matter wh says the opposite. Search for evidence and don't be satisfied until you know the why.

> **It's not what you don't know that gets you in trouble.**
>
> **It's what you do know that ain't so.**
>
> **—Will Rogers *or* Mark Twain *or* someone else**

How do you know? Becoming aware of the basis of your opinions or beliefs is an important ste toward a better understanding of yourself and your world. Regularly consider your opinions, belief and knowledge, and subject them to the "How do I know?" test. What is the evidence that yo understanding is based upon? Become aware of the sources of your opinions. If your sources a shaky, then you might want to be more open-minded to the possibility that your opinion or knowledg might be incorrect. Regularly find cases in which you need to rethink your views.

Opening our minds to counterintuitive ideas can be the key to discovering novel solutions an building deeper understanding, but how can we take advantage of those opportunities? Certainly w are not intentionally closed-minded. So how can we break free of our unintended closed-mindedne and see the world with less bias?

First, we can simply try out alternative ideas hypothetically and temporarily. In other words, don say, "Okay, I'll change my opinions on health care right now." Instead, say, "For the next day (or eve the next twenty minutes), I'll pretend my opinions are the opposite of what I normally believe (eve though I know it's nonsense), and see where those new beliefs take me." This strategy allows you t explore ideas without having to overcome deeply ingrained moral or institutional prejudices. Eve following ideas that you know are wrong can be illuminating. Because in following the consequenc of those "wrong" ideas, you might be led to better understand why your original belief is indee correct, or you might be led to new and unexpected insights that run counter to your original beliefs.

The twentieth-century physicist Niels Bohr used this process while trying to lead a group scientists to understand quantum mechanics. Quantum mechanics is a bizarre description fundamental particles in physics. Its assertions about the nature of nature are strange and run count to our intuition about the universe. So in trying to decide whether quantum mechanics might be correct description of our physical world, Bohr employed a practice of spending one day assumin that quantum mechanics was true and following the implications of that perspective, and the spending the next day assuming that quantum mechanics was false and following the consequences that view. By alternating his views, he was able to explore each alternative more objectivel (Incidentally, he eventually decided that quantum mechanics was a better description than th alternative theory of the day.)

▶ **A way to provoke effective thinking …**

Try on alternatives and size up the fit

Take some opinion that you hold that other people (those who clearly are wrong) do not hold. Every other hour accept your own current opinion and think about its implications, and on the alternate hours accept the alternative opinion and see where that leads. Try not to be judgmental. Don't resist the alternative views. You are not committing to any change. This exercise has the goal of understanding alternatives more realistically. As a result, you might change an opinion, but more likely you will simply have a better understanding of why the alternative views make sense to others. If an hour is too long a time period, try the challenge in fifteen-minute intervals.

Illustration: Sit next to the other side

Attend a meeting or dinner sponsored by a group that has a point of view different from your own. If you're a student and a Republican, attend a Young Democrats Club event. If you're an atheist, attend a Christian Fellowship meeting. You might feel a bit uncomfortable at first, but avoid letting yourself instantly think of refutations. Instead, listen and try to empathize and see a new point of view—and perhaps make a new connection.

… Understand Deeply

See what's missing

Forcing yourself to see what's actually in front of you rather than what you believe you should see is difficult task. However, an even greater challenge is to see what's missing. One of the most profoun ways to see the world more clearly is to look deliberately for the gaps—the *negative space*, as it called in the art world; that is, the space surrounding the objects or issues of interest. In our daily ar intellectual experiences there are gaps of many sorts. If you're studying some body of material, as yourself to identify those concepts that you truly do not fully understand. Those concepts may, in fac be ideas that you were supposed to have mastered in an earlier class or at an earlier point in your lif Don't despair. Honestly admitting those gaps in knowledge and understanding is the first importa step in attempting to fill them. Of course, a harder question is this: How can you see what's tru invisible?

Add the adjective and uncover the gaps. Let's return to a time in which photographs were not living color. During that period, people referred to pictures as "photographs" rather than "black-an white photographs" as we do today. The possibility of color did not exist, so it was unnecessary insert the adjective "black-and-white." However, suppose we *did* include the phrase "black-and-whit *before* the existence of color photography. By highlighting that reality, we become conscious current limitations and thus open our minds to new possibilities and potential opportunities.

World War I was given that name only after we were deeply embattled in World War II. Before tha horrific period of the 1940s, World War I was simply called "The Great War" or, even worse, "Th War to End All Wars." What if we had called it "World War I" back in 1918? Such a label might hav made the possibility of a second worldwide conflict a greater reality for governments and individual and might have led to better international policy decisions. We become conscious of issues when w explicitly identify and articulate them.

In 1937, Sylvan Goldman, a small grocery store owner, wanted to better understand his shoppers. describing the buying ability of a customer, he may have thought, "A person can buy only what he she can carry." Armed with this insight and his desire to enable his customers to buy more, M Goldman took some wooden folding chairs, and affixed wheels to their legs and a basket to their seat Goldman invented the shopping cart. Not only did the cash start rolling in, but this innovation also l the way for department, retail, electronic, and home-improvement stores of the future to move lo