# sleep

Rule #7

Sleep well, think well.

IT'S NOT THE MOST comfortable way to earn an entry in the Guinness Book of World Records, obtain an A on a high-school science-fair project, and meet a world-famous scientist. In 1965, 17-year-old Randy Gardner decided that his science-fair project would involve not sleeping for 11 straight days and observing what happened. To the astonishment of just about everyone, he accomplished the feat, setting a world record that year for sleep loss. The project attracted the attention of scientist William Dement, who was given permission to study what happened to the teenager's mind during the week and a half he was awake.

What happened to Randy's mind was extraordinary. To put it charitably, it started to malfunction. In short order, he became irritable, forgetful, nauseous, and, to no one's surprise, unbelievably tired. Five days into his experiment, Randy began to suffer from what could pass for Alzheimer's disease. He was actively hallucinating, severely disoriented, and paranoid. He thought a local radio host was out to get him because of his changes in memory. In the last four days of his experiment, he lost motor function, his fingers trembling and his speech slurred. Curiously, on the final day, he still was able to beat Dement at pinball, doing so 100 consecutive times.

Some unfortunate souls don't have the luxury of experimenting. They become suddenly—and permanently—incapable of ever going to sleep again. Fatal Familial Insomnia is one of the rarest human genetic disorders that exists, affecting only about 20 families worldwide. That rarity is a blessing, because the disease follows a course straight through mental-health hell. In middle to late adulthood, the person begins to experience fevers, tremors, and profuse sweating. As the insomnia becomes permanent, these symptoms are accompanied by increasingly uncontrollable muscular jerks and tics. The person soon experiences crushing feelings of depression and anxiety. He or she becomes psychotic. Finally, mercifully, the patient slips into a coma and dies.

So we know bad things happen when we don't get any sleep. But, considering that sleep occupies a walloping one-third of our time on the planet, it is incredible to contemplate that we still don't know *why* we need to sleep. Not that there haven't been clues. One strong hint came about 10 years ago, from a group of researchers who left a bunch of wires stuck inside a rat's brain. The rat had just learned to negotiate a maze when it decided to take a nap. The recording device was still attached to those wires, and it was still on. But to understand how this relates to the purpose of sleep, let's look at what the brain is doing while we sleep.

## you call this rest?

If you ever get a chance to listen in on a living brain while it is slumbering, you'll have to get over your disbelief. The brain does not appear to be asleep at all. Rather, it is almost unbelievably active during "rest," with legions of neurons crackling electrical commands to one another in constantly shifting patterns—displaying greater rhythmical activity during sleep, actually, than when it is wide awake.



The only time you can observe a real resting period for the brain (where the amount of energy consumed is less than during a similar awake period) is in the deepest parts of what is called non-REM sleep. But that takes up only about 20 percent of the total sleep cycle, which is why researchers early on began to disabuse themselves of the notion that the reason we rest is so that we can rest. When the brain is asleep, the brain is not resting at all.

Even so, most people report that sleep is powerfully restorative, and they point to the fact that if they don't get enough sleep, they don't think as well. That is measurably true, as we shall see shortly. And so we find ourselves in a quandary: Given the amount of energy the brain is using, it seems impossible that you could receive anything approaching mental rest and restoration during sleep.

Even if the brain doesn't behave itself bioenergetically, other parts of the body do rest during sleep, in something like a human version of micro-hibernation. That introduces a second puzzle: Sleep makes us exquisitely vulnerable to predators. Indeed, deliberately going off to dreamland unprotected in the middle of a bunch of hostile hunters (such as leopards, our evolutionary roommates in eastern Africa) seems like a behavior dreamed up by our worst enemies. There must be something terribly important we need to accomplish during sleep if we are willing to take such risks in order to get it. Exactly what is it that is so darned important?

The scientist who studied sleepless Randy Gardner made a substantial early contribution to answering such questions. Often called the father of sleep research, Dement is a white-haired man with a broad smile who at this writing is in his late 70s. He says pithy things about our slumbering habits, such as "Dreaming permits each and every one of us to be quietly and safely insane every night of our lives."

Dement studied many aspects of the human sleep cycle. What he began to uncover was this: "Sleeping" brains, like soldiers on a battlefield, are actually locked in vicious, biological combat. The conflict involves a pitched battle between two powerful and opposing drives, each made of legions of brain cells and biochemicals with very different agendas. Though localized in the head, the theater of operations for these armies engulfs every corner of the body. This fight is sometimes referred to as the "opponent process" model.

As Dement began to define these two opposing drives, he noticed some strange things about the war they were waging. First, these forces are not engaged just during the night, while we sleep, but also during the day, while we are awake. Second, they are doomed to a combat schedule in which each army sequentially wins one battle, then promptly loses the next battle, then quickly wins the next and so on, cycling through this win/loss column every day and every night. The third strange thing is that no one army ever claims final victory in this war. This incessant engagement results in the cyclical waking and sleeping experiences all humans encounter every day (and night) of our lives.

Dement was not working in isolation. His mentor, a gifted researcher named Nathaniel Kleitman, gave him many of his initial insights. If Dement can be considered the father of sleep research, Kleitman certainly could qualify as its grandfather. An intense Russian man with bushy eyebrows, Nathaniel Kleitman may be best noted for his willingness to experiment not only on himself but also on his children. When it appeared that a colleague of his had discovered Rapid Eye Movement (REM) sleep, Kleitman promptly volunteered his daughter for experimentation, and she just as promptly confirmed the finding. But one of the most interesting experiments of Kleitman's long career occurred in 1938, when he persuaded a colleague to join him 150 feet underground in Mammoth Cave in Kentucky for an entire month.

Free of sunlight and daily schedules, Kleitman could ask whether the routines of wakefulness and sleep cycled themselves automatically through the human body. His observations were mixed, but the experiment provided the first real hint that such an automatic



device did exist in our bodies. Indeed, we now know that the body possesses a series of internal clocks, all controlled by discrete regions in the brain, providing a regular rhythmic schedule to our waking and sleeping experiences. This is surprisingly similar to the buzzing of a wristwatch's internal quartz crystal. An area of the brain called the suprachiasmatic nucleus, part of that hypothalamus we discussed earlier, appears to contain just such a timing device. Of course, we have not been characterizing these pulsing rhythms as a benign wristwatch. We have been characterizing them as a violent war. One of Kleitman's and Dement's greatest contributions was to show that this nearly automatic rhythm occurs as a result of the continuous conflict between two opposing forces.

With the idea that such forces are under internal control, we can explore them in greater detail, beginning with a description of their names. One army is composed of neurons, hormones, and various other chemicals that do everything in their power to keep you awake. This army is called the circadian arousal system (often referred to simply as "process C"). If this army had its way, it would make you stay up all the time. Fortunately, it is opposed by an equally powerful army, also made of brain cells, hormones, and various chemicals. These combatants do everything in their power to put you to sleep. They are termed the homeostatic sleep drive ( "process S"). If this army had its way, you would go to sleep and never wake up.

It is a strange, even paradoxical, war. The longer one army controls the field, for example, the more likely it is to lose the battle. It's almost as if each army becomes exhausted from having its way and eventually waves a temporary white flag. Indeed, the longer you are awake (the victorious process C doing victory laps around your head), the greater the probability becomes that the circadian arousal system will eventually cede the field to its opponent. You then go to sleep. For most people, this act of capitulation comes after about 16 hours of active consciousness. This will occur even if you are living in a cave.

Conversely, the longer you are asleep (the triumphant process S now doing the heady victory laps), the greater the probability becomes that the homeostatic sleep drive will similarly cede the field to *its* opponent, which is, of course, the drive to keep you awake. The result of this surrender is that you wake up. For most people, the length of time prior to capitulation is about half of its opponent's, about eight hours of blissful sleep. And this also will occur even if you are living in a cave.

Except for the unfortunate members of 20 or so families worldwide, Kleitman, Dement, and a host of other researchers were able to show that such dynamic tension is a normal—even critical—part of our daily lives. In fact, the circadian arousal system and the homeostatic sleep drive are locked in a daily warfare of victory and surrender so predictable, you can actually graph it. Stated formally, process S maintains the duration and intensity of sleep, while process C determines the tendency and timing of the need to go to sleep.

Now, this war between the two armies does not go unsupervised. Internal and external forces help regulate the conflict, defining for us both the amount of sleep we need and the amount of sleep we get. We will focus on two of the internal forces, chronotype and the nap zone. To understand how these work, we must leave the intricacies of battle for a moment and explore instead the life of newspaper cartoonists and advice columnists. Oh, and we will also talk about birds.

## lark or owl?

The late advice columnist Ann Landers would vehemently declare, "No one's going to call me until I'm ready!" and then take her phone off the hook between 1 and 10 a.m. Why? This was the time she normally went to sleep. The cartoonist Scott Adams, creator of the comic strip *Dilbert*, never would think of starting his day at 10 a.m. "I'm quite tuned into my rhythms," he has said. "I never try to do any creating past noon. ... I do the strip from 6 to 7 a.m." Here



we have two creative and well-accomplished professionals, one who starts working just as the other's workday is finished.

About 1 in 10 of us is like *Dilbert's* Adams. The scientific literature calls such people larks (more palatable than the proper term, "early chronotype"). In general, larks report being most alert around noon and feel most productive at work a few hours before they eat lunch. They don't need an alarm clock, because they invariably get up before the alarm rings—often before 6 a.m. Larks cheerfully report their favorite mealtime as breakfast and generally consume much less coffee than non-larks. Getting increasingly drowsy in the early evening, most larks go to bed (or want to go to bed) around 9 p.m.

Larks are the mortal enemy of the 2 in 10 humans who lie at the other extreme of the sleep spectrum: "late chronotypes," or owls. In general, owls report being most alert around 6 p.m., experiencing their most productive work times in the late evening. They rarely want to go to bed before 3 a.m. Owls invariably need an alarm clock to get them up in the morning, with extreme owls requiring multiple alarms to ensure arousal. Indeed, if owls had their druthers, most would not wake up much before 10 a.m. Not surprisingly, late chronotypes report their favorite mealtime as dinner, and they would drink gallons of coffee all day long to prop themselves up at work if given the opportunity. If it sounds to you as though owls do not sleep as well as larks in our society, you are right on the money. Indeed, late chronotypes usually accumulate a massive "sleep debt" as they go through life.

The behaviors of larks and owls are very specific. Researchers think these patterns are detectable in early childhood and burned into the genetic complexities of the brain that govern our sleep/wake cycle. At least one study shows that if Mom or Dad is a lark, half of their kids will be, too. Larks and owls cover only about 30 percent of the population. The rest of us are called hummingbirds. True to the idea of a continuum, some hummingbirds are more owlish, some are more larkish, and some are in between. To my knowledge, no birdish moniker has ever been applied to those people who seem to need only four or five hours of sleep. They instead are referred to as suffering from "healthy insomnia."

So how much sleep does a person need? Given all of our recent understanding about how and when we sleep, you might expect that scientists would come up with the answer fairly quickly. Indeed, they have. The answer is: We don't know. You did not read that wrong. After all of these centuries of experience with sleep, we still don't know how much of the stuff people actually need. Generalizations don't work: When you dig into the data on humans, what you find is not remarkable uniformity but remarkable individuality. To make matters worse, sleep schedules are unbelievably dynamic. They change with age. They change with gender. They change depending upon whether or not you are pregnant, and whether or not you are going through puberty. There are so many variables one must take into account that it almost feels as though you've asked the wrong question. So let's invert the query. How much sleep *don't* you need? In other words, what are the numbers that disrupt normal function? That turns out to be an important question, because it is possible to become dysfunctional with too much sleep *or* not enough. Whatever amount of sleep is right for you, when robbed of that (in either direction), bad things really do happen to your brain.

## napping in the free world

Given that sleep rhythms fight their battles 24 hours a day, researchers have studied the skirmishes occurring not only in the night but also in the day. One area of interest is the persistent need to take a nap, and to do so at very specific times of the day.

It must have taken some getting used to, if you were a staffer in the socially conservative early 1960s. Lyndon Baines Johnson, 36$^{th}$ president of the United States and leader of the free world, routinely closed the door to his office in the midafternoon and put on his pajamas. He then proceeded to take a 30-minute nap. Rising



refreshed, he would tell aides that such a nap gave him the stamina to work the long hours required of the U.S. commander-in-chief during the Cold War. Such presidential behavior might seem downright weird. But if you ask sleep researchers like William Dement, his response might surprise you: It was LBJ who was acting normally; the rest of us, who refuse to bring our pajamas to work, are the abnormal ones. And Dement has a fair amount of data to back him up.

LBJ was responding to something experienced by nearly everyone on the planet. It goes by many names—the midday yawn, the post-lunch dip, the afternoon "sleepies." We'll call it the nap zone, a period of time in the midafternoon when we experience transient sleepiness. It can be nearly impossible to get anything done during this time, and if you attempt to push through, which is what most of us do, you can spend much of your afternoon fighting a gnawing tiredness. It's a fight because the brain really wants to take a nap and doesn't care what its owner is doing. The concept of "siesta," institutionalized in many other cultures, may have come as an explicit reaction to the nap zone.

At first, scientists didn't believe the nap zone existed except as an artifact of sleep deprivation. That has changed. We now know that some people feel it more intensely than others. We know it is not related to a big lunch (although a big lunch, especially one loaded with carbs, can greatly increase its intensity). It appears, rather, to be a part of our evolutionary history. Some scientists think that a long sleep at night and a short nap during the midday represent human sleep behavior at its most natural.

When you chart the process S curve and process C curve, you can see that they flat-line in the same place—in the afternoon. Remember that these curves are plotting the progress of a war between two opposed groups of cells and biochemicals. The battle clearly has reached a climactic stalemate. An equal tension now exists between the two drives, which extracts a great deal of energy to maintain. Some researchers, though not all, think this equanimity in tension drives the nap zone. Regardless, the nap zone matters, because our brains don't work as well during it. If you are a public speaker, you already know it is darn near fatal to give a talk in the midafternoon. The nap zone also is literally fatal: More traffic accidents occur during it than at any other time of the day.

On the flip side, one NASA study showed that a 26-minute nap improved a pilot's performance by more than 34 percent. Another study showed that a 45-minute nap produced a similar boost in cognitive performance, lasting more than six hours. Still other researchers demonstrated that a 30-minute nap taken prior to staying up all night can prevent a significant loss of performance during that night.

If that's what a nap can do, imagine the benefits of a full night's sleep. Let's look at what can happen when we ignore these internal forces, and when we embrace them.

## go ahead, sleep on it

If central casting ever called you to suggest a character in history representing the archetypal brilliant-but-mad-looking scientist, Dimitri Ivanovich Mendeleyev might be in your top five list. Hairy and opinionated, Mendeleyev possessed the lurking countenance of a Rasputin, the haunting eyes of Peter the Great, and the moral flexibility of both. He once threatened to commit suicide if a young lady didn't marry him. She consented, which was quite illegal, because, unbeknownst to the poor girl, Mendeleyev was already married. This trespass kept him out of the Russian Academy of Sciences for a while, which in hindsight may have been a bit rash, as Mendeleyev single-handedly systematized the entire science of chemistry.

His Periodic Table of the Elements—a way of organizing every atom that had so far been discovered—was so prescient, it allowed room for all the elements yet to be found and even predicted some of their properties. But what's most extraordinary is this: Mendeleyev



says he first came up with the idea in his sleep. Contemplating the nature of the universe while playing solitaire one evening, he nodded off. When he awoke, he knew how all of the atoms in the universe were organized, and he promptly created his famous table. Interestingly, he organized the atoms in repeating groups of seven.

Mendeleyev is hardly the only scientist who has reported feelings of inspiration after having slept, of course. Is there something to the notion of "Let's sleep on it"? What's the relationship between ordinary sleep and extraordinary learning?

Mountains of data demonstrate that a healthy sleep can indeed boost learning significantly, in certain types of tasks. These results generate a great deal of interest among sleep scientists and, unsurprisingly, no small amount of controversy. How should we define learning, they debate; exactly what is improvement? But there are many examples of the phenomenon. One study stands out in particular.

Students were given a series of math problems and prepped with a method to solve them. The students weren't told there was also an easier, "shortcut" way to solve the problems, potentially discoverable while doing the exercise. The question was: Is there any way to jumpstart, even speed up, their insights? Can you get them to put this other method on their radar screens? The answer was yes, *if you allow them to sleep on it.* If you let 12 hours pass after the initial training and ask the students to do more problems, about 20 percent will have discovered the shortcut. But, if in that 12 hours you also allow eight or so hours of regular sleep, that figure triples to about 60 percent. No matter how many times the experiment is run, the sleep group consistently outperforms the non-sleep group about 3 to 1.

Sleep has been shown to enhance tasks that involve visual texture discrimination, motor adaptations, and motor sequencing. The type of learning that appears to be most sensitive to sleep improvement is that which involves learning a procedure. Simply disrupt the night's sleep at specific stages and retest in the morning, and you eliminate any overnight learning improvement. Clearly, for specific types of intellectual skill, sleep can be a great friend to learning.

## sleep loss = brain drain

It won't surprise you, then, that lack of sleep hurts learning. In fact, a highly successful student can be set up for a precipitous academic fall, just by adjusting the number of hours she sleeps. Take an A student used to scoring in the top 10 percent of virtually anything she does. One study showed that if she gets just under seven hours of sleep on weekdays, and about 40 minutes more on weekends, she will begin to score in the bottom 9 percent of non-sleep-deprived individuals. Cumulative losses during the week add up to cumulative deficits during the weekend—and, if not paid for, that sleep debt will be carried into the next week.

Another study followed soldiers responsible for operating complex military hardware. One night's loss of sleep resulted in about a 30 percent loss in overall cognitive skill, with a subsequent drop in performance. Bump that to two nights' loss, and the figure becomes 60 percent. Other studies extended these findings. When sleep was restricted to six hours or less per night for just five nights, for example, cognitive performance matched that of a person suffering from 48 hours of continual sleep deprivation.

More recent research has begun to shed light on other functions that do not at first blush seem associated with sleep. When people become sleep-deprived, for example, their ability to utilize the food they are consuming falls by about one-third. The ability to make insulin and to extract energy from the brain's favorite dessert, glucose, begins to fail miserably. At the same time, you find a marked need to have more of it, because the body's stress hormone levels begin to rise in an increasingly deregulated fashion. If you keep up the behavior, you appear to accelerate parts of the aging process. For example, if healthy 30-year-olds are sleep-deprived for six days (averaging, in this study, about four hours of sleep per night), parts of



their body chemistry soon revert to that of a 60-year-old. And if they are allowed to recover, it will take them almost a week to get back to their 30-year-old systems.

The bottom line is that sleep loss means mind loss. Sleep loss cripples thinking, in just about every way you can measure thinking. Sleep loss hurts attention, executive function, immediate memory, working memory, mood, quantitative skills, logical reasoning ability, general math knowledge. Eventually, sleep loss affects manual dexterity, including fine motor control (except, perhaps, for pinball) and even gross motor movements, such as the ability to walk on a treadmill.

When you look at all of the data combined, a consistency emerges: Sleep is rather intimately involved in learning. It is observable with large amounts of sleep; it is observable with small amounts of sleep; it is observable all the time. Of course, explaining exactly *how* sleep improves performance has not been as easy as demonstrating the fact *that* it improves performance. Given the importance of the issue to the Brain Rule, let's try anyway.

Consider the following true story of a successfully married, incredibly detail-oriented accountant. Even though dead asleep, he regularly gives financial reports to his wife all night long. Many of these reports come from the day's activities. (Incidentally, if his wife wakes him up—which is often, because his financial broadcasts are loud—the accountant becomes amorous and wants to have sex.) Are we all organizing our previous experiences while we sleep? Could this not only explain all of the other data we have been discussing, but also finally give us a reason why we sleep?

To answer these questions, we must return to our story of the hapless rat who, 10 years ago, was unfortunate to have fallen asleep with a bunch of wires stuck inside his brain. The "wires" are electrodes placed near individual neurons. Hook these electrodes up to a recording device, and you can eavesdrop on the brain while it is talking to itself, something like a CIA phone tap, listening to the individual chatter of neurons as they process information. Even in a tiny rat's brain, it is not unusual these days to listen in on up to 500 neurons at once. So what are they all saying? If you listen in while the rat is acquiring new information, like learning to navigate a maze, you soon will detect something extraordinary. A very discrete "maze-specific" pattern of electrical stimulation begins to emerge. Working something like the old Morse code, a series of neurons begin to crackle in a specifically timed sequence during the learning. Afterward, the rat will always fire off that pattern whenever it travels through the maze. It appears to be an electrical representation of the rat's new maze-navigating thought patterns (at least, as many as 500 electrodes can detect).

When the rat goes to sleep, it begins to *replay the maze-pattern sequence*. The animal's brain replays what it learned while it slumbers, reminiscent of our accountant. Always executing the pattern in a specific stage of sleep, the rat repeats it over and over again—and much faster than during the day. The rate is so furious, the sequence is replayed thousands of times. If a nasty graduate student decides to wake up the rat during this stage, called slow-wave sleep, something equally extraordinary is observed. The rat has trouble remembering the maze the next day. Quite literally, the rat seems to be consolidating the day's learning the night *after* that learning occurred, and an interruption of that sleep disrupts the learning cycle.

This naturally caused researchers to ask whether the same was true for humans. The answer? Not only do we do such processing, but we do it in a far more complex fashion. Like the rat, humans appear to replay certain daily learning experiences at night, during the slow-wave phase. But unlike the rat, more emotionally charged memories appear to replay at a different stage in the sleep cycle.

These findings represent a bombshell of an idea: Some kind of offline processing is occurring at night. Is it possible that the reason we need to sleep is simply to shut off the exterior world for a while,



allowing us to divert more attentional resources to our cognitive interiors? Is it possible that the reason we need to sleep is so that we can learn?

It sounds compelling, but of course the real world of research is much messier. Many findings appear to complicate, if not fully contradict, the idea of offline processing. For example, brain-damaged individuals who lack the ability to sleep in the slow-wave phase nonetheless have normal, even improved, memory. So do individuals whose REM sleep is suppressed by antidepressant medications. Exactly how to reconcile these data with the previous findings is a subject of intense scientific debate. What's always needed is more research—but not just at the lab bench.

## ideas

What if businesses and schools took the sleep needs of their employees and students seriously? What would a modern office building look like? What would a school look like? These are not idle questions. The effects of sleep deprivation are thought to cost U.S. businesses more than $100 billion a year. I have a few ideas ripe for real-world research.

### *Match chronotypes*

A number of behavioral tests can discriminate larks from owls from hummingbirds fairly easily. And given advances in genetic research, you may in the future need only a blood test to characterize your process C/process S graphs. The bottom line is, we can determine the hours when a person is likely to experience his or her major productivity peaks.

Here's an obvious idea: What if we began to match chronotypes to work schedules? Twenty percent of the workforce is already at sub-optimal productivity in the current 9-to-5 model. What if we created several work schedules, based on the chronotypes of the employees? We might gain more productivity and a greater quality of life for those unfortunate employees who otherwise are doomed to carry a permanent sleep debt. We might get more productive use out of our buildings if they remained open instead of lying dormant half the night. A business of the future will need to become involved in some aspect of its employees' sleep schedules.

We could do the same in education. Teachers are just as likely to be late chronotypes as their students. Why not put them together? Would you increase the competencies of the teacher? The students? Free of the nagging consequences of their sleep debts, their educational experiences might become more robust simply because each was more fully capable of mobilizing his God-given IQ.

Variable schedules also would take advantage of the fact that sleep needs change throughout a person's life span. For example, data suggest that students temporarily shift to more of an owlish chronotype as they transit through their teenage years. This has led some school districts to start their high-school classes after 9 a.m. This may make some sense. Sleep hormones (such as the protein melatonin) are at their maximum levels in the teenage brain. The natural tendency of these kids is to sleep more, especially in the morning. As we age, we tend to get less sleep, and some evidence suggests we need less sleep, too. An employee who starts out with her greatest productivity in one schedule may, as the years go by, keep a similar high level of output simply by switching to a new schedule.

### *Promote naps*

To embrace the midday nap zone, engineers at MetroNaps have created a nap-on-the-go device called a Sleep Pod. "It looks like a sperm that got electrocuted!" exclaimed one person upon seeing the device for the first time. Actually, the pods are portable glorified recliners that can fit in an office—complete with light-canceling visors, noise-canceling earphones, heat-canceling circulation coils, and—at more than $14,000 each—budget-canceling prices. The company, based in New York, has pods in four countries and is busy



expanding its business. Others are bringing naps into the workplace, too. Hotels with stacked-bed "nap salons" have sprung up all over Japan. A Boston-based researcher named William Anthony is trying to create National Napping Day, a day set aside so that everybody can take a nap. He finds that 70 percent of Americans who admit to being workplace nappers still have to take their naps in secret. The favored clandestine venue? In the back seat of the employee's car. At lunch.

What if businesses and schools took seriously the existence of nap zones? No meetings or classes would ever be scheduled at the time when the process C and process S curves are flat-lined. No high-demand presentations and no critical exams would be assigned anywhere near the collision of these two curves. Instead, there would be deliberately planned downshifts. Naps would be accorded the same deference that businesses reluctantly treat lunch, or even potty breaks: a necessary nod to an employee's biological needs. Companies would create a designated space for employees to take one half-hour nap each workday. The advantage would be straightforward. People hired for their intellectual strength would be allowed to keep that strength in tip-top shape. "What other management strategy will improve people's performance 34 percent in just 26 minutes?" says Mark Rosekind, the NASA scientist who conducted that eye-opening research on naps and pilot performance.

### *Try sleeping on it*

Given the data about a good night's rest, organizations might tackle their most intractable problems by having the entire "solving team" go on a mini-retreat. Once arrived, employees would be presented with the problem and asked to think about solutions. But they would not start coming to conclusions, or even begin sharing ideas with each other, before they had slept about eight hours. When they awoke, would the same increase in problem-solving rates available in the lab also be available to that team? We ought to find out.