***Why We Sleep***

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**Part 1: This Thing Called Sleep**

**Chapter 1: To Sleep**

* Two-thirds of adults throughout all developed nations fail to obtain the recommended eight hours of sleep
* Sleeping less than six or seven hours a night demolishes your immune system, more than doubling your risk of cancer.
* Insufficient sleep is a key lifestyle factor determining whether or not you will develop Alzheimer’s disease.
* Inadequate sleep-even moderate reductions for just one week-disrupts blood sugar levels so profoundly that you would be classified as pre-diabetic.
* Short sleeping increases the likelihood of your coronary arteries becoming blocked and brittle, setting you on a path toward cardiovascular disease, stroke, and congestive heart failure.
* Sleep disruption further contributes to all major psychiatric conditions, including depression, anxiety, and suicidality.
* The shorter your sleep, the shorter your life span.
* There does not seem to be major organ in the body, or process within the brain, that isn’t optimally enhanced by sleep (and detrimentally impaired when we don’t get enough).
* Within the brain, sleep enriches a diversity of functions, including our ability to learn, memorize, and make logical decisions and choices.
* Sleep recalibrates our emotional brain circuits, allowing us to navigate next-day social and psychological challenges with cool-headed composure.
* Sleep restocks our immune system, helping fight malignancy, preventing infection, and warding off all manner of sickness.
* Sleep regulates our appetite, helping control body weight through healthy food selection.
* Adequate sleep is intimately tied to the fitness of our cardiovascular system, lowering blood pressure while keeping our heart in fine condition.
* The physical and mental impairments caused by one night of bad sleep dwarf those caused by an equivalent absence of food or exercise.
* Sleep is the single most effective thing we can do to reset our brain and body health each day.
* Drowsy driving is the cause of hundreds of thousands of traffic accidents and fatalities each year.
* One person dies in a traffic accident every hour in the United States due to fatigue related error. Vehicular accidents caused by drowsy driving exceed those caused by alcohol and drugs combined.

**Chapter 2: Caffeine, Jet Lag, and Melatonin (*Losing and Gaining Control of Your Sleep Rhythm*)**

* Circadian Rhythm- This is your twenty-four-hour rhythm. Every living creature on the planet with a lifespan of more than several days generates this natural cycle. This internal twenty-four-hour clock within your brain communicates its daily circadian rhythm signal to every other region of your brain and every organ in your body. Your twenty-four-hour clock helps to determine when you want to be awake and when you want to be asleep. But it controls other rhythmic patterns, too. These include your timed preferences for eating and drinking, your moods and emotions, the amount of urine you produce, your core body temperature, your metabolic rate, and the release of numerous hormones.
* Your biological circadian rhythm coordinates a drop in core body temperature as you near typical bedtime, reaching its low point, about two hours after sleep onset.

**My Rhythm Is Not Your Rhythm**

* Not everyone’s circadian timing is the same.
* For some people, their peak wakefulness arrives early in the day, and their sleepiness arrives early at night. These are the “morning types,” and make up 40 percent of the population. They prefer to wake at or around dawn, are happy to do so, and function optimally at this time of day.
* Others are “evening types,” (or “night owls”) and account for approximately 30 percent of the population. They naturally prefer going to bed late and subsequently wake up late the following morning, or even in the afternoon.
* The remaining 30 percent of people lie somewhere in between morning an evening types, with a slight leaning toward eveningness.
* Unlike morning types, night owls are frequently incapable of falling asleep early at night, no matter how hard they try. Having not fallen asleep until late, night owls of course strongly dislike waking up early. They are unable to function well at this time, one cause of which is that, despite being “awake,” their brain remains in a more sleep-like state throughout the early morning. When a night owl is forced to wake up too early, their prefrontal cortex remains in a disabled, “offline” state. Night owls are not owls by choice. They are bound to a delayed schedule by unavoidable DNA hardwiring. It is not their *conscious* fault, but rather their *genetic* fate. Owls are more chronically sleep deprived than “morning types.” Greater ill health caused by a lack of sleep therefore befalls night owls, including higher rates of depression, anxiety, diabetes, cancer, heart attack, and stroke.

**Melatonin**

* Melatonin helps regulate the *timing* of when sleep occurs by systemically signaling darkness throughout the organism. But melatonin has little influence on the *generation* of sleep itself: a mistaken assumption that many people hold. Melatonin simply provides the official instruction to commence the event of sleep, but does not participate in the sleep race itself.
* Once sleep is underway, melatonin slowly decreases in concentration across the night and into the morning hours. With dawn, as sunlight enters the brain through the eyes (even through the closed lids), a brake pedal is applied to the pineal gland, thereby shutting off the release of melatonin.

**Jet Lag**

* This is jet lag: you feel tired and sleepy during the day in a new time zone because your body clock and associated biology still “think” it is nighttime. At night, you are frequently unable to sleep solidly because your biological rhythm still believes it to be daytime.
* Jet lag places a torturous physiological strain on the brain, and a deep biological stress upon the cells, organs, and major systems of the body.

**Sleep Pressure and Caffeine**

* Your twenty-four hour circadian rhythm is the first of the two factors determining wake and sleep. The second is sleep pressure. At this very moment, a chemical called adenosine is building up in your brain. It will continue to increase in concentration with every waking minute that elapses. The longer you are awake, the more adenosine will accumulate. Think of adenosine as a chemical barometer that continuously registers the amount of elapsed time since you woke up this morning.
* One consequence of increasing adenosine in the brain is an increasing desire to sleep. This is known as sleep pressure, and it is the second force that will determine when you feel sleepy, and thus should go to bed. As a result of that chemical sleep pressure, when adenosine concentrations peak, an irresistible urge for slumber will take hold. It happens to most people after twelve to sixteen hours of being awake.
* You can artificially mute the sleep signal of adenosine by using a chemical that makes you feel more alert and awake: caffeine. Caffeine is the most widely used (and abused) psychoactive stimulant in the world. Caffeine tricks you into feeling alert and awake, despite the high levels of adenosine that would otherwise seduce you into sleep.

**Am I Getting Enough Sleep?**

* How do you know whether you’re routinely getting enough sleep? First, after waking up in the morning, could you fall back asleep at ten or eleven a.m.? If the answer is “yes” you are likely not getting sufficient sleep quantity and/or quality. Second, can you function optimally without caffeine before noon? If the answer is “no,” then you are most likely self-medicating your state of chronic sleep deprivation.
* If you didn’t set an alarm clock, would you sleep past that time? (If so, you need more sleep than you are giving yourself.) Do you find yourself at a computer screen reading and then rereading (and perhaps rereading again) the same sentence? (This is often the sign of a fatigued, under-slept brain.)

**Chapter 3: Defining and Generating Sleep**

NREM Stage 1

This stage occurs after you have decided to sleep and your eyes are closed. During this stage—which typically lasts between 1 and 10 minutes—you are lightly asleep, and you can quickly return to being fully awake.

Defining features

* Although you are asleep, you may wake up feeling like you didn’t sleep at all.
* Your body’s muscles are not inhibited yet: your eyes roll a little bit and you may slightly open your eyelids.
* Your breathing slows down and your heartbeat becomes regular.
* Your blood pressure and brain temperature decrease.
* The hypnic jerk we sometimes experience when falling asleep, accompanied or not by the sensation of falling down, happens during this stage. Some say it is a vestigial reflex humans developed during the evolutionary process to prevent them from falling off the trees they slept in.

NREM Stage 2

When NREM Stage 2 sleep kicks in, things get serious!

Defining features

* Stage 2 sleep, which usually lasts about 20 minutes, is characterized by a slowing heart rate and a decrease in body temperature. Your body reduces its activity to prepare you to go into a deep sleep.
* It becomes harder to wake you up.
* Your brain starts to emit larger waves.
* Your blood pressure also decreases, and other metabolic functions slow down too.
* The 2 first stages of NREM Sleep together are often referred to as light sleep.

NREM Stage 3

This sleep stage refers to the combined stages of what was previously separated into Stage 3 & 4 sleep.

Defining features

* This stage typically starts 35-45 minutes after falling asleep.
* As electroencephalograms show, our brain waves slow down and become larger.
* At this point, you sleep through most potential sleep disturbances (noises and movements) without showing any reaction.
* If you actually wake up during NREM Stage sleep, there’s a high probability you are going to feel disoriented for the first few minutes.

REM Stage 4

This is the final stage of a standard sleep cycle. The first Rapid Eye Movement sleep stage lasts around 10 minutes and usually happens after having been asleep at least 90 minutes.

Defining features

As its name indicates, your eyes move rapidly in all directions during Rapid Eye Movement sleep.

* It is during this stage of sleep (the deepest) that powerful dreams usually happen. Same goes for sleepwalking and bedwetting episodes.
* This stage is also characterized by an increase of the heart and respiration rates, and their rhythms may become irregular.
* REM stages typically get longer and longer as the night goes by, and the last REM stage can last an hour.

**Chapter 4: Ape Beds, Dinosaurs, and Napping with Half a Brain**

**Who Sleeps?**

* Without exception, every animal species studied to date sleeps, or engages in something remarkably like it.
* How “old” does this make sleep? Worms emerged during the Cam-brain explosion: at least 500 million years ago. That is, worms (and sleep by association) predate all vertebrate life. This includes dinosaurs, which, by inference, are likely to have slept.

**We Are Special**

* The total amount of time we spend asleep is markedly shorter than all other primates (eight hours, relative to the ten to fifteen hours of sleep observed in all other primates), yet we have a disproportionate amount of REM sleep, the stage in which we dream. Between 20 and 25 percent of our sleep time is dedicated to REM sleep dreaming, compared to an average of only 9 percent across all other primates!
* *Homo erectus*, the predecessor of Homo sapiens, was the first obligate biped, walking freely upright on two legs. We believe that *Homo erectus* was also the first dedicated ground sleeper. Shorter arms and an upright stance made tree living and sleeping very unlikely.
* Evolution saw to it that our ancient form of sleep became somewhat shorter in *duration*, yet intensified in *intensity*, especially by enriching the amount of REM sleep we packed into the night.
* The act of sleeping on solid ground, and not on the precarious branch, was the impetus for the enriched and enhanced amounts of REM sleep that developed, while the amount of time slept was able to modestly decrease. When sleeping on the ground, there’s no more risk of falling. For the first time in our evolution, hominids could consume all the body-immobilized REM-sleep dreaming they wanted, and not worry about the lasso of gravity whipping them down from treetops. Our sleep therefore became “concentrated”: shorter and more consolidated in duration, packed aplenty with high-quality sleep.
* The tree-to-ground re-engineering of sleep was a key trigger that rocketed *Homo sapiens* to the top of evolution’s lofty pyramid.
* The coolheaded ability to regulate our emotions each day- a key to what we call emotional IQ- depends on getting sufficient REM sleep night after night.

**Chapter 5: Changes in Sleep Across the Life Span**

* Even though total sleep time decreases in the last trimester, a paradoxical and quite ballistic increase in REM-sleep occurs. In the last two weeks of pregnancy, the fetus will ramp up its consumption of REM sleep to almost nine hours a day. In the last week before birth, REM sleep amount hits a lifetime high of twelve hours a day. REM sleep is vital for promoting brain maturation.
* Rationality is one of the last things to flourish in teenagers, as it is the last brain territory to receive sleep’s maturational treatment. When your children finally reach their mid-twenties and your car insurance premium drops, you can thank sleep for the savings.
* Adolescents face two other harmful challenges in their struggle to obtain sufficient sleep as their brains continue to develop. The first is a change in their circadian rhythm. The second is the early school start times.
* Adolescent teenagers have a different circadian rhythm from their young siblings. During puberty, the timing of the suprachiasmatic nucleus is shifted progressively forward: a change that is common across all adolescents, irrespective of culture or geography. So far forward, in fact, it passes even the timing of their adult parents.
* As a nine-year-old, the circadian rhythm would have the child sleep by around nine p.m., driven in part by the rising tide of melatonin at this time in children. By the time that same individual has reached sixteen years of age, their circadian rhythm has undergone a dramatic shift forward in its cycling phase. The rising tide of melatonin, and the instruction of darkness and sleep, is many hours away. As a consequence, the sixteen-year-old will usually have no interest in sleeping at nine p.m. Instead, peak *wakefulness* is usually still in play at that hour. By the time the parents are getting tired, as their circadian rhythms take a down-turn and melatonin release instructs sleep-perhaps around ten or eleven p.m., their teenagers can still be wide awake. A few more hours must pass before the circadian rhythm of a teenage brain begins to shut down alertness and allow for easy, sound sleep to begin.
* It will not always be this way for the teenager. As they age into young and middle adulthood, their circadian schedule will gradually slide back in time. Not all the way back to the timing present in childhood, but back to an earlier schedule: one that, ironically, will lead those same (now) adults to have the same frustrations and annoyances with their own sons and daughters. By that stage, those parents have forgotten (or have chosen to forget) that they, too, were once adolescents who desired a much later bedtime than their own parents.
* That older adults simply *need* less sleep is a myth. Older adults appear to need just as much sleep as they do in mid-life, but are simply less able to generate that (still necessary) sleep.

**Twelve Tips for Healthy Sleep**

1. **Stick to a sleep schedule**. Go to bed and wake up at the same time each day. Sleeping later on weekends won’t fully make up for a lack of sleep during the week and will make it harder to wake up early Monday morning.
2. **Exercise is great, but not too late in the day**. Try to exercise at least thirty minutes on most days but not later than two to three hours before your bedtime.
3. **Avoid caffeine and nicotine**. Coffee, colas, certain teas, and chocolate contain the stimulant caffeine, and its effects can take as long as eight hours to wear off fully.
4. **Avoid alcoholic drinks before bed**. Heavy alcohol use robs you of REM sleep and also may contribute to impairment in breathing at night.
5. **Avoid large meals and beverages late at night**. A large meal can cause indigestion, which interferes with sleep. Drinking too many fluids at night can cause frequent awakenings to urinate.
6. **If possible, avoid medicines that delay or disrupt sleep**. Some commonly prescribed heart, blood pressure, or asthma medications, as well as some over-the-counter and herbal remedies for coughs, colds, or allergies, can disrupt sleep patterns.
7. **Don’t take naps after 3p.m.** Late afternoon naps can make it harder to fall asleep at night.
8. **Relax before bed.** Don’t overschedule your day so that no time is left for unwinding. A relaxing activity, such as reading or listening to music, should be part of your bedtime ritual.
9. **Take a hot bath before bed.** The drop in body temperature after getting out of the bath may help you feel sleepy, and the bath can help you relax and slow down so you’re ready to sleep.
10. **Dark bedroom, cool bedroom, gadget-free bedroom.** Get rid of anything in your bedroom that might distract you from sleep, such as noises, bright lights, an uncomfortable bed, or warm temperatures. You sleep better if the temperature in the room is kept on the cool side. A TV, cell phone, or computer in the bedroom can be a distraction and deprive you of needed sleep. Turn the clock’s face out of view so you don’t worry about the time while trying to fall asleep.
11. **Have the right sunlight exposure.** Daylight is key to regulating daily sleep patterns. Try to get outside in natural sunlight for at least thirty minutes each day. If possible, wake up with the sun or use very bright lights in the morning. Sleep experts recommend that, if you have problems falling asleep, you should get an hour of exposure to morning sunlight and turn down the lights before bedtime.
12. **Don’t lie in bed awake.** If you find yourself still awake after staying in bed for more than twenty minutes or if you are starting to feel anxious or worried, get up and do some relaxing activity until you feel sleepy.