**June 10, 2018 story by Georgia Frances King, published in “Quartz”**

For something that we spend a third of our lives doing (if we’re lucky), sleep is something that we know relatively little about. “Sleep is actually a relatively recent discovery,” says Daniel Gartenberg, a sleep scientist who is currently an assistant adjunct professor in biobehavioral health at Penn State. “Scientists only started looking at sleep 70 years ago.”

As anyone who has lay awake at night contemplating the complexities of the universe can attest, sleep is a slippery beast. It involves a complex web of biological and neurological processes, all of which can be thrown off by something as simple as a partner’s nasal trumpeting or a coffee too late in the day.

There are also many, many misconceptions about sleep: that you can “[catch up](https://sleepjunkies.com/features/the-33-biggest-myths-about-sleep-and-insomnia-de-bunked/)” on the weekend for lost hours of shuteye. That you can get by on [four hours’ sleep](https://www.webmd.com/sleep-disorders/sleep-fact-fiction) a night. That a [nip of whiskey](https://www.webmd.com/sleep-disorders/news/20130118/alcohol-sleep) before bed helps you sleep better. Even that [eating cheese before snoozing](http://www.bbc.com/future/story/20120417-does-cheese-give-you-nightmares) causes nightmares.

 For something that we spend a third of our lives doing (if we’re lucky), sleep is something that we know relatively little about. “Sleep is actually a relatively recent discovery,” says Daniel Gartenberg, a sleep scientist who is currently an assistant adjunct professor in biobehavioral health at Penn State. “Scientists only started looking at sleep 70 years ago.”

As anyone who has lay awake at night contemplating the complexities of the universe can attest, sleep is a slippery beast. It involves a complex web of biological and neurological processes, all of which can be thrown off by something as simple as a partner’s nasal trumpeting or a coffee too late in the day.

There are also many, many misconceptions about sleep: that you can “[catch up](https://sleepjunkies.com/features/the-33-biggest-myths-about-sleep-and-insomnia-de-bunked/)” on the weekend for lost hours of shuteye. That you can get by on [four hours’ sleep](https://www.webmd.com/sleep-disorders/sleep-fact-fiction) a night. That a [nip of whiskey](https://www.webmd.com/sleep-disorders/news/20130118/alcohol-sleep) before bed helps you sleep better. Even that [eating cheese before snoozing](http://www.bbc.com/future/story/20120417-does-cheese-give-you-nightmares) causes nightmares.

**Why do we need sleep?**

Daniel Gartenberg: Every organism on the planet sleeps in some fashion, to some degree—even the basic fruit fly. What makes sleep so essential for our wellbeing comes down to three main things: to save our energy, to help our cells recover, and to help us process and understand our environment.

This third one is what I study. The “[synaptic homeostasis hypothesis](https://www.ncbi.nlm.nih.gov/pubmed/14638388)” is this idea that during the day, we make all these connections with the world around us. It used to be like, “Don’t go over there—the lions live there now.” Now it’s like, “What did Barbara say to me in the office?” These excitatory connections we make during the day result in the neurons in our brains getting overall higher activation. Then during the nighttime when we sleep, we have a downregulating process where the things that didn’t really matter to your survival sink to the bottom, and the things that are most relevant to your survival rise to the top. What deep sleep does is all the neural processing, and what REM sleep [rapid-eye-movement sleep] and light sleep do is basically integrate that into your long-term personality and understanding of the world.

**Why do we need sleep?**

Daniel Gartenberg: Every organism on the planet sleeps in some fashion, to some degree—even the basic fruit fly. What makes sleep so essential for our wellbeing comes down to three main things: to save our energy, to help our cells recover, and to help us process and understand our environment.

This third one is what I study. The “[synaptic homeostasis hypothesis](https://www.ncbi.nlm.nih.gov/pubmed/14638388)” is this idea that during the day, we make all these connections with the world around us. It used to be like, “Don’t go over there—the lions live there now.” Now it’s like, “What did Barbara say to me in the office?” These excitatory connections we make during the day result in the neurons in our brains getting overall higher activation. Then during the nighttime when we sleep, we have a downregulating process where the things that didn’t really matter to your survival sink to the bottom, and the things that are most relevant to your survival rise to the top. What deep sleep does is all the neural processing, and what REM sleep [rapid-eye-movement sleep] and light sleep do is basically integrate that into your long-term personality and understanding of the world.

That being said, some people are [short sleepers](https://www.scientificamerican.com/article/genetic-mutation-sleep-less/): You can do a test to find out if you have genetic makeup that makes you a short sleeper. That’s rare, though, so by and large, people are not getting enough sleep. Getting half an hour less than what you need to really adds up over a week period.

To see how much sleep you really need, my professor suggests that when you go on vacation, try to stick to your normal bedtime and then see what time you wake up. With no stressors or time to get up, you’ll just fall into a natural pattern, and that’s probably how much sleep you actually need.

**I normally get around six to seven hours of sleep a night and feel fine. But is that just because how I feel has become my normal operating mode, and I could really be functioning at a higher level?**

Right. That’s like the fish and the fish bowl phenomenon: The fish doesn’t know that he’s in the fishbowl, nonetheless that he’s in water. Also, when you’re sleep deprived, research has shown that you’re really bad at being able to tell that you’re sleep deprived.

A lot of this has to do with stress in our environment and our external need to work all the time. This is what’s driving the fact that we’re sleeping so poorly nowadays.

**How else does the workplace affect sleep?**

I think of sleep like the new worker’s rights: We’re being worked to the point that we’re not sleeping, and it’s having physical detriments on our health and wellbeing.

People should be able to sleep like they’re able to get healthcare. This also means making our work environments more conducive to sleep. For optimum productivity, we need around eight hours of sleep, right? But that doesn’t have to be in one go. Maybe I’ll get a little less than that during the night, and then I’ll take a 20-to-30-minute power nap at midday. There’s a siesta for a reason! New Yorkers oftentimes try to pound through with coffee and whatever, but giving in to your natural circadian rhythm during that afternoon lull might be a good thing. We weren’t made to produce for eight hours straight.

**Let’s talk more about circadian rhythms. What are they, and why are they responsible for that mid-afternoon slump?**

We evolved from bacteria in the ocean that could differentiate sunlight from darkness—that’s what ended up forming the human eye. That means every organism is responsive to a circadian rhythm that’s largely dictated by sunlight. The photo receptors in our eyes pick up on sunlight, which controls the release of melatonin and all these other neurotransmitters that dictate your energy levels throughout the day.

You have a peak moment of awakeness during the morning. After lunch you usually have a glucose spike, especially if you have a big heavy lunch, like a cheeseburger. That glucose spike combined with a circadian dip gives you a period of fatigue between around 2 and 4pm. You’ll then have another spike in alertness right before dinner, and then you’ll start getting tired again closer to bedtime. That’s your 24-hour circadian rhythm, basically.

Then there’s also something called “[chronobiology](https://www.chronobiology.com/about-chronobiology/).” You actually have genes that dictate whether you’re a morning person or an evening person.

Yeah! If you’re a morning person, they call it a lark. If you’re a night person, they call it a night owl. Your genes give you a greater proclivity to being a lark or an owl. And then some people have genes that make them very flexible. The environmental cues they react against are called zeitgebers

Zeitgebers! It’s this weird German word. There’s a lot of cool words in sleep: like the photo receptors control the release of melatonin by sending signals to the suprachiasmatic nucleus, just like supercalifragilisticexpialidocious.

Zeitgebers! It’s this weird German word. There’s a lot of cool words in sleep: like the photo receptors control the release of melatonin by sending signals to the suprachiasmatic nucleus, just like supercalifragilisticexpialidocious.

That’s one of the best things that you can do to entrench your circadian rhythm.

If your circadian rhythm is off, it negatively impacts your sleep quality. So having that consistent rhythm of going to bed and getting up at the same time will actually make your sleep more regenerative at night. Going for a walk outside and getting that sunlight in the morning is the best thing to do to wake up. Your circadian rhythm isn’t a fixed thing: It’s actually shiftable based on your environmental cues.

**If you wake up in the middle of the night (say, to go to the bathroom) but get back to sleep quickly, does that screw around with your sleep quality?**

It varies. There’s no clear answer. In our studies, we’ll play really loud sounds that people have no conscious awareness of at all: We can play a sound literally at 70 decibels, which is like someone screaming, and that’ll wake them up briefly and then they’ll go right back into the sleep stage that they were in. Other times you can get a full awakening, and you’ll have to go through the process again.

It’s actually pretty normal to wake up during the night, anyway. In *The Canterbury Tales*, one of the oldest manuscripts in English culture, they describe “[second sleep](https://www.sciencealert.com/humans-used-to-sleep-in-two-shifts-maybe-we-should-again).” There’s some evidence that we used to go to bed when the sun went down, then wake up for a little bit at night—putter around, make sure we’re not getting eaten by a lion—and then go back to sleep. So it’s pretty normal to like wake up in the middle of the night and use the bathroom or whatever.

**How is society changing our relationship with sleep? What will be the consequences of this?**

Gallup has reported that over the past 50 years, [we’re sleeping a whole hour less per night](http://news.gallup.com/poll/166553/less-recommended-amount-sleep.aspx) than we did in the 1950s. That’s a lot. A lot of that has to do with having TV on all the time, and mobile phones are taking it to the next level. But I think the biggest issue right now is the lack of work/life balance. I mean, I’m an entrepreneur, so I feel like I’m basically always “on”. A lot of people have jobs where they’re getting emails all hours the night, and there’s no longer a nine-to-five schedule.

I think that’s why meditation is so in vogue right now. But I actually think sleep is a more regenerative process than meditation. A lot of times people talk about doing meditation around midday, but for most people I would recommend a quick power nap instead of a quick meditation.

**But if I try to take a powernap at lunch and can’t get to sleep, haven’t I just wasted 20 minutes of my day that I could have been meditating—or working?**

Even when you close your eyes and turn off your brain for little bit—even if you don’t fully fall asleep—your brain creeps into theta waves. Similarly, when you meditate, you get a little bit of theta. So if you’re one of these people who really has a hard time with napping, maybe meditation could be better.

 Taking a break—whether it’s meditation or nap—during the circadian dip can be much more conducive to productivity.

The most important thing is taking that time off—it’s more conducive to your productivity. A lot of times people think they can like fight through and push harder and harder and harder to get better results, but sleep can give you that, too. When you transition in and out of sleep, your brain produces theta waves, which help you think more divergently. That’s why a lot of times when you wake up from a power nap or from sleeping, you’ll be able to solve that intractable problem that you couldn’t earlier in the day. That’s one of the reasons I think taking a break—whether it’s meditation or nap—during that circadian dip can be much more conducive to productivity

This is especially true for creative jobs. Jobs used to be very manual, but as jobs are becoming more and more cognitive, I think caring for your cognition is going to become increasingly important for the work.

**What are some tips for getting a better sleep?**

You want a cold, quiet environment with no light: That’s basically the ideal way to improve your sleep quality. However, people have a different ideal sound, light, and temperature environment to improve their sleep quality. We need stimulus control: You want to save the bedroom for sleep and sex.

**SOUND**: We focus on sound a lot. Quiet environments are going to improve your sleep quality. Your brain has these micro arousals throughout the night without you being consciously aware of it—even an air-conditioning unit turning on wakes up your brain. So blocking out noises is a low-hanging fruit to improve your sleep quality. [Bose just released an earbud](https://www.bose.com/en_us/products/headphones/noise_masking_sleepbuds/noise-masking-sleepbuds.html) that you can sleep with, for example.

There’s this new finding where playing sounds at a certain frequency when your brain is in deep sleep actually increases the percentage of time spent in deep sleep. We’re publishing this paper in Society for Neuroscience Conference in a couple of weeks, and it’s basically [what my TED talk is about](https://www.ted.com/talks/dan_gartenberg_the_brain_benefits_of_deep_sleep_and_how_to_get_more_of_it). Playing these pulses at the same frequency as your deep-sleep brainwaves primes more deep sleep. Scientifically speaking, it’s a similar process as [transcranial direct-current stimulation](https://www.hopkinsmedicine.org/psychiatry/specialty_areas/brain_stimulation/tdcs.html), except it doesn’t use electricity—just sound. Sound gets transmitted into electricity because you’re picking up on the auditory cortex while you’re sleeping.

**TEMPERATURE**: This is a big problem, especially if you have a sleep partner. Everyone has different natural body temperatures, and usually men run hotter than women, but it can go either way. That can be a big issue if you have a different body temperature, because then no one’s happy. I wrote this article called “[Split blankets, not beds](https://www.huffingtonpost.com/entry/im-thinking-about-sleeping-and-science_us_593aaa5ae4b014ae8c69df9e),” where I said that you shouldn’t share the same comforter. Of course it’s nice to share, and I do that at some points, but it’s also important to have different bedding on your bed so you can have that lighter sheet or comforter to try to mitigate differences in body temperature. There’s also something called a [chili pad](https://qz.com/1301123/why-eight-hours-a-night-isnt-enough-according-to-a-leading-sleep-scientist/chilly%20pad). You put on half of your bed and it’ll dictate the temperature level on your half if you run at a different temperature than your sleep partner.

**LIGHT**: The other thing is no blue light close to bedtime. There are a lot of studies that [screen time close to bed is bad](https://www.health.harvard.edu/staying-healthy/blue-light-has-a-dark-side). One of the ideal ways of using our app is to connect it to your Bluetooth speakers so that you can put your phone in another room: There is something important to not having your phone in reach, because then you’re looking at the screen and getting the brightness. If you live in the city and there’s bright lights at night, having blackout shade can also be super useful.

**STRESS**: When you’re stressed, your flight-or-fight response is active during the night, and your sleep quality is going to be shallow. It’s natural: If you have kids, you are programmed to be able to respond to your environment during the night to make sure you’re not getting eaten by a predator. Parents have this issue when their fight-or-flight response system is overly activated by worrying about their kid, and that worry actually makes their sleep quality worse.

One of the things I recommend to people who have a racing mind and worrying thoughts about work is to segment a time to get it out during the day—encapsulate it in a little mental box so you’re not laying down in bed and just having your mind race about all these things.

**How do you feel about sleep trackers and wearables?**

Probably the most common wearable to measuring sleep right now is the Fitbit. I’ve studied these devices in depth in a well-controlled laboratory experiment where we’re monitoring brainwaves. I can say the Fitbit is pretty accurate in measuring when you’re asleep and when you’re wake, but when it comes to measuring sleep stages, basically any device that measures heart rate, like the Apple Watch, is totally inaccurate. That’s because they don’t sample at the frequency necessary to get a good read on your sleep stages.

Fitbits can also cause bigger problems, because they stress you out about the fact you think you’re not getting enough deep sleep—even though they’re not good at accurately measuring sleep stages.

**What about people who mess with their sleep cycle and try things like the** [**da Vinci method**](https://qz.com/430415/i-once-tried-to-cheat-sleep-and-for-a-year-i-succeeded/)**, where you take a 20-minute nap every four hours?**

That [polyphasic sleep](http://time.com/5063665/what-is-polyphasic-sleep/) stuff? I mean, it’s just not enough sleep. It’s ridiculous.

I haven’t seen a study that empirically shows that it’s helpful. There is certainly a false myth that we need eight hours of *continuous* sleep: I think it’s possible to have your sleep be a little bit broken up and be perfectly healthy—but getting that eight hours is crucially important. The thing is that the placebo effect in some of these polyphasic sleep methods runs really high.

**There have also been some studies showing that** [**sleep deprivation**](https://mosaicscience.com/story/staying-awake-surprisingly-effective-way-treat-depression/) **could be a tool to combat persistent depression. How do you feel about that?**

That was really interesting. If you have an extreme case of depression, sometimes some therapists will sleep deprive you a little bit. It’s basically to activate your fight-or-flight response and jolt you out of your depression. But things like empathy and working with others are also impacted when you’re sleep deprived, and you’re also more sensitive to pain. Some people are studying this link to address the opioid epidemic and through actually sleeping better: Chronic pain might be associated with deep sleep.

**Even if you’ve got enough sleep, why do you still feel tired when you wake up? (Interview with Daniel Gartenberg, sleep scientist)**

Gartenberg: When you wake up, you have something called “sleep inertia.” It can last for as long as two hours. That’s why you get that groggy feeling, and if you’re sleep deprived, it’s going to be worse, too. Studies also show that [if you wake up while in deep sleep](https://www.tuck.com/sleep-inertia/), you’re going to have worse sleep inertia.

**What’s the science behind sleep inertia?**
The causal mechanism is a lack of cerebral blood flow when you wake up. It takes a while for the brain to kick back into gear after you are asleep. This “kicking back into gear” is represented by a gradual increase in your cerebral blood flow to normal levels. It starts with the more primitive/ancient parts of the brain, like the brainstem and thalmus, and then spreads to anterior cortical regions after 15 minutes or so. The ability to perform basic cognitive tasks is impacted by cerebral blood flow in these regions, as has been shown in transcrannial doppler somnography studies. [This paper](https://www.ncbi.nlm.nih.gov/pubmed/12244087) gets into the deep science.

Shifts in the blood flow of the prefrontal cortex also suggest that there is a reestablishment of our consciousness going on as well, where we are basically going from a state of forgetting who/what/when we are to our pre-frontal cortex reestablishing our personality and sense of being. I’m sure most people can relate to that feeling of waking up and not really knowing who you are.

**What can make sleep inertia worse?**

When you wake up in deep sleep, you often feel more tired: It’s like when you wake up to catch that flight before dawn and you feel like you have no idea where you are. If you wake up at the wrong time of a nap, you also feel that way, because the first sleep cycle you go through is very rich in deep sleep, and you’re probably waking up in the middle of that.

If you sleep a healthy amount—ideally 8.5 hours—you’re getting almost no deep sleep by the end of your sleep, as the amount of deep sleep reduces over the course of the night. That means you’re less likely to wake up in deep sleep if you’re well rested, and therefore less likely to feel groggy.

**What’s the best way to wake up to avoid sleep inertia?**

Instead of trying to time when you wake up so you’re not in deep sleep, it’s usually better to just sleep more. The right way to wake up is very gradually. Both iPhones and [my sleep app](https://sonicsleepcoach.com/) have this function: You set the time for when you want to wake up, but when the alarm goes off, it starts almost imperceptibly and then ramps up over a 10-minute period. If you didn’t have a good night’s sleep, it’ll take longer for you to wake up: When I’m really sleep deprived, I’ll wake up by minute eight, whereas if I’m not, I’ll wake up right when the thing goes off. We have to shake the snooze thing.

**What do you have against snooze buttons?**

So here’s the thing: Generally, it’s bad. I understand you have to do it. But what snooze means is that you’re sleep depriving yourself—you shouldn’t have to snooze. You should wake up when you should wake up.