



A GOOD NIGHT'S SLEEP: NECESSARY FOR YOUNG MINDS

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YOUNG REVIEWERS:



JACOB
AGE: 12



ST. BERNARD
REGIONAL
CATHOLIC
SCHOOL
AGES: 11–14

During your lifetime, you will spend almost 250,000 h asleep. Why do we need so much sleep? Sleep is not just rest from the day, but also necessary for your body and brain to be healthy, particularly as you grow up. For example, a good night's sleep enables you to pay attention and learn the next day. When and how long you sleep will change as you get older. So, how do you know how much sleep you should get, or when you should go to bed at night? Here, we will share answers to these questions and more. We have studied the science of sleep and we now understand a little more about what your brain does throughout the night: keeping you healthy, alert, and ready for school and fun the next day. If you read this right before bed, you will be sure to get enough ZZZ's tonight.

Of all the things you do, which do you do the most? It is not eating or drinking, it is sleeping! We spend a third of our lives sleeping. Scientists have worked for decades to understand why we sleep. While your body

lies still in your bed, your brain is processing the day's information to get you ready for tomorrow. Here, we will explain the what, when, why, and how of sleeping and how it changes as you grow up.

SUPRACHIASMATIC NUCLEUS (SCN)

A small region deep in the brain that forms the "biological clock" and generates the circadian rhythms.

CIRCADIAN RHYTHMS

One of the two ways we know when to sleep. The naturally occurring pattern of sleeping and waking that repeats every 24 h in response to light.

SLEEP HOMEOSTAT

One of the two ways we know when to sleep. Sleep need increases as we stay awake and decreases as we sleep.

WHEN DO YOU SLEEP?

If we asked, "When do you sleep?" you might say, "at night!", or "when I am tired!" Turns out, both are right. Humans prefer to sleep at night, which makes us diurnal, as opposed to nocturnal animals that sleep during the day. This preference is hard-wired. Deep in your brain sits the **suprachiasmatic nucleus (SCN)**. The SCN is your biological clock. It tells time for every part of your body. We call this the **circadian rhythm** (circadian is Greek for "about a day," because the rhythm of sleeping and waking repeats once every 24-h). Like any clock, the SCN can be reset, based on when we see sunlight. When we travel, our bodies adjust to the new pattern of light. This is why people who travel from North America to Australia can adjust to a new pattern of sleep within a couple of days.

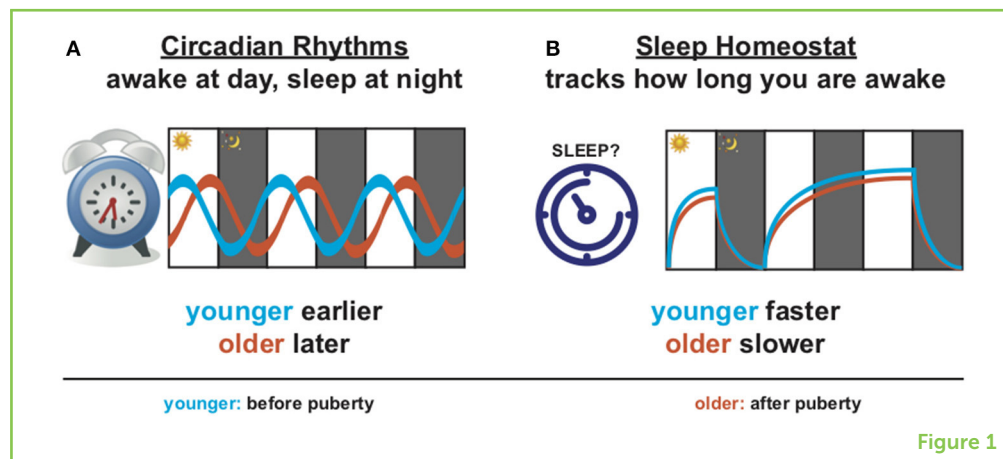
Saying, "I sleep when I am tired," is also true. Have you ever taken a nap in the middle of the day? Another system in the brain keeps track of how much time you have been awake and how much you slept the night before. We call this the **sleep homeostat**. Homeostat sounds like another word: "thermostat," which is a good way to think about this. Just like a thermostat turns the air conditioning on when it is too hot and turns it off when it is too cool, the sleep homeostat listens to how long you have been awake. Your need to sleep grows throughout the day, and when it reaches a certain point, you fall asleep. Once you have rested, the sleep homeostat turns off and lets you wake up, and the process repeats every day. The sleep homeostat, however, does not know if it is daytime or nighttime outside, only whether you have been awake or asleep. If you force yourself to stay awake all night, the need for sleep will continue to grow throughout the night until you finally go to sleep. If you skip a night's sleep, you might be very tired and it will take longer to pay back that sleep need (just like it would take longer for the A/C to cool a super-hot room). The circadian rhythm and the sleep homeostat ultimately work together, which is why you may feel alert in the middle of the day, even if you did not get much sleep the night before, or why you suddenly feel tired at night, even if you woke up late that day.

HOW DOES YOUR SLEEP CHANGE AS YOU GET OLDER?

Think about your own sleep. You probably sleep differently now compared to when you were a baby or a young child. The SCN and the sleep homeostat change as we grow up (Figure 1). When you hit puberty, your SCN acts as if it shifted time-zones. Your body wants

Figure 1

Why do you sleep when you do? In each graph, the sleep of younger children (6–13 years) is plotted in blue and that of older children (14–17 years) is plotted in orange. Dark bars indicate nighttime; light bars daytime. **(A)** Circadian Rhythms: the biological clock, organized by the SCN, keeps us awake during the day and asleep at night. It is affected by light, cycles every 24 h, and shifts during adolescence. **(B)** Sleep Homeostat: the thermostat for sleep and wakefulness. It tracks how long we have been awake. The need for sleep increases throughout the day as we remain awake and decreases during the night as we sleep. If we skip sleep, the homeostat tracks that we are awake, until we are able to sleep again. As we get older, this process is slower, allowing us to stay up longer before we need to sleep.



to wake up later and go to bed later. Eventually, somewhere in your twenties, the SCN starts reversing again (Figure 1A).

As for the sleep homeostat, during puberty, your need for sleep builds a bit more slowly than it did when you were young. Put another way, if we remember the thermostat example, you have slowed down how quickly the room heats up, so that the A/C waits longer before turning on (Figure 1B). As both the SCN and the homeostat change during puberty, it becomes easier to stay up late.

HOW MUCH SLEEP DO YOU NEED?

The National Sleep Foundation recommends that school-aged kids (6–13 years) sleep between 9 and 11 h a night. Teens are recommended to get 8–10 h a night and adults about 7–9 h [1]. If you are a student, particularly in the United States, you may find it difficult to get this amount of sleep on school nights. As you go through puberty, your body wants to go to bed later and sleep later. But school (particularly in the U.S.) often starts too early! This makes it hard for teenagers to get enough sleep on school nights [2]. By the weekend, you probably have missed so much sleep that you feel particularly sleepy, and you may dramatically oversleep as your sleep homeostat works hard to recover the sleep you need. If you oversleep all weekend, however, this can make waking up on Monday morning a miserable experience.

WHY DO YOU NEED SLEEP?

Sleep is critical for both your body and your mind. In your body, your metabolism (how you digest and use food), your immune system (how quickly you get over being sick), and your physical fitness (how exercise impacts your body) all benefit from a good night's sleep. We will focus on one organ in your body: your brain. All the functions of your mind depend on your brain's different regions. For example, your

Figure 2

Regions in the brain affected by sleep. A side view of the brain, as if looking in from the ear. Two regions are impacted by a good night's sleep and support brain health: The prefrontal cortex (blue) is critical for paying attention in school; and the amygdala (pink) is a key center for regulating emotion and mood.

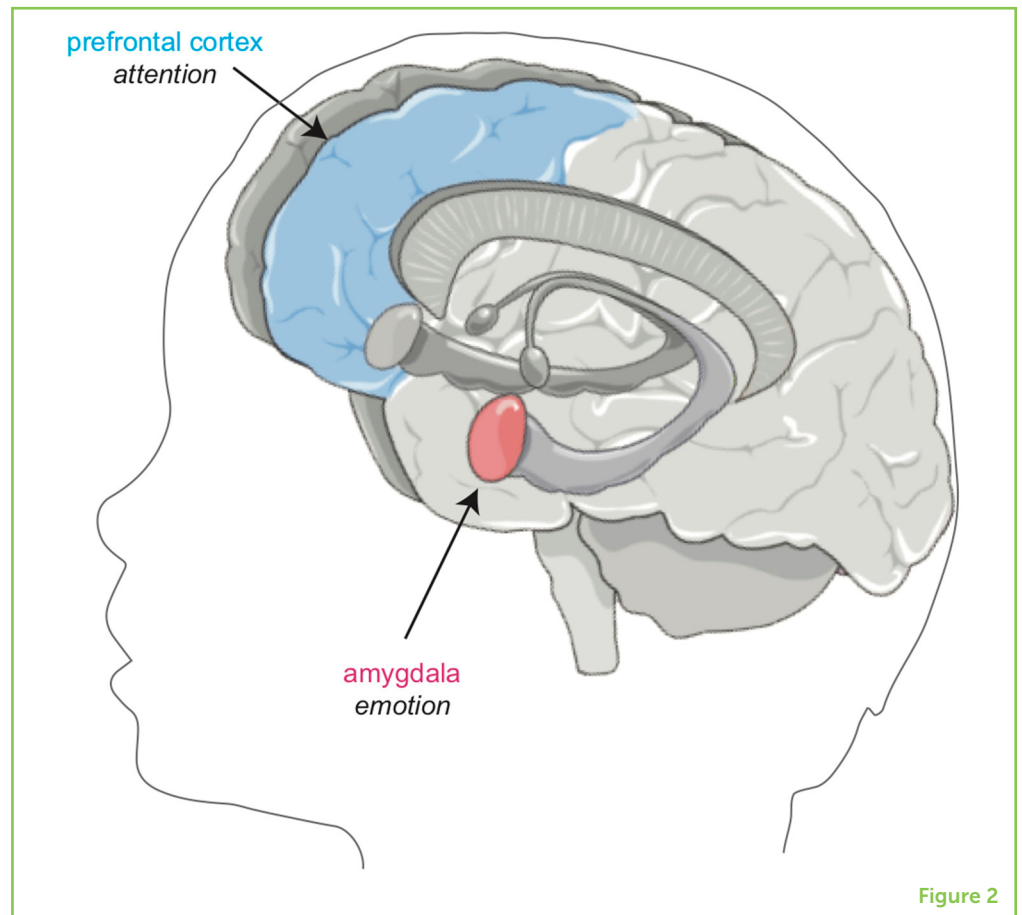


Figure 2

brain controls your ability to pay attention (such as staying focused in class), to learn and remember (when taking a test, for example), and to process emotions (like not getting too grumpy if things do not go your way). We will focus on attention and emotion, and how they are aided by sleep (Figure 2).

Attention

Have you tried paying attention in class after a bad night's sleep? It is hard. The last part of the brain to fully develop, the **prefrontal cortex (PFC)**, sits at the very front of the brain. This special region is critical for paying attention, planning, and switching between tasks. If you do not sleep the night before, or only sleep a little bit, the PFC cannot function efficiently the next day [3], making it extra hard to concentrate without getting distracted. If you do not get enough sleep, studying in the evening becomes hard as well. Students often ask if it is better to go to bed or stay up late to study. We hope by this point you can guess the right answer. Data shows that sleep is important for grades! An extra hour of sleep was associated with 3–5 point improvement on standardized test scores [4].

Emotion

After a night without good sleep, we often feel more irritable. Sleep is involved in keeping you happy and keeping your emotions in check.

PREFRONTAL CORTEX

The front portion of the brain, critical for paying attention and planning.

AMYGDALA

A small region deep in the middle of the brain responsible for processing emotions.

Sleep directly refreshes the emotional centers of our brain, like the **amygdala** [3]. This means that not only is your mood more stable after a good night's sleep, but you are also better able to respond to emotional things in your life. When looking at your friends' faces, you can tell if they are mad, sad, or happy. But when sleep deprived, we lose the ability to tell the difference between these emotions. A good night's sleep helps us process these complicated signals so that we are better able to detect, process, and react to emotions.

SLEEP AND MENTAL HEALTH IN CHILDREN

We all have some bad nights of sleep that can affect us the next day. The good news is that restoring healthy sleep habits will often fix these issues right away. However, some children may experience prolonged sleep difficulties that can impact their mental health in the long run. Because of all the ways sleep impacts the brain, sleep problems and mental health issues [like attention-deficit/hyperactivity disorder (ADHD), autism, anxiety, or depression] often go hand-in-hand. Children and adolescents struggling with mental health can also experience trouble falling and/or staying asleep, or difficulty waking up. We are still working to understand the connection between sleeping and mental health, to determine whether helping children sleep better can help children with mental health issues [5].

HOW CAN YOU HAVE HEALTHY SLEEP?

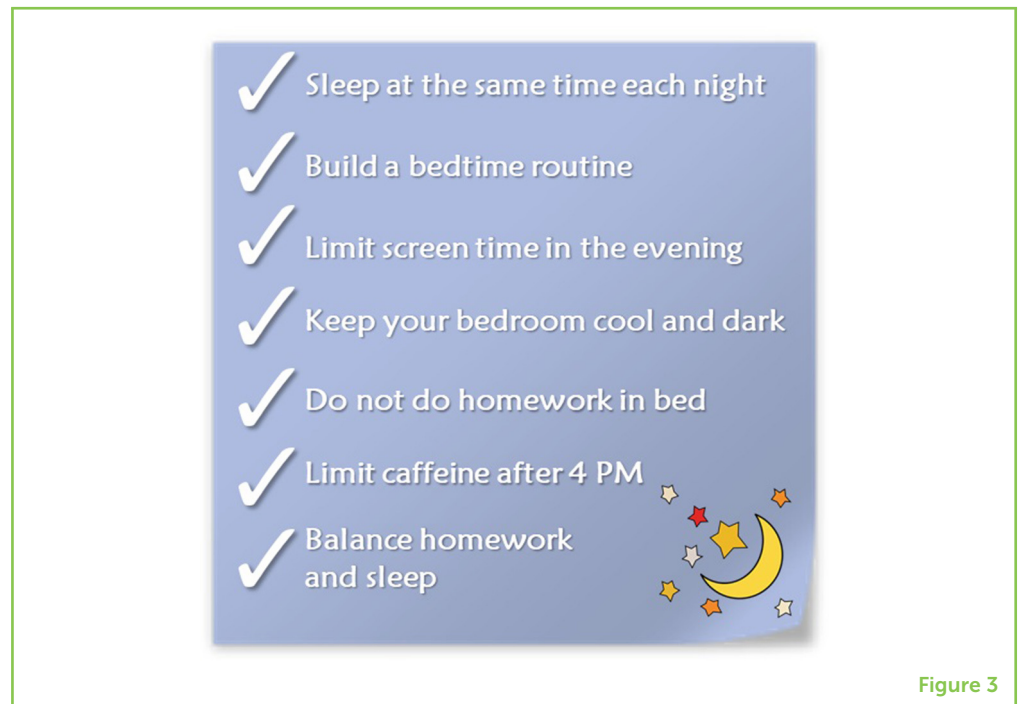
We hope you are convinced that sleep is important. But, what can you do to sleep better?

Good sleep begins with good sleep habits (Figure 3). First, go to bed around the same time each night, to keep the SCN and sleep homeostat properly functioning. Second, build a bedtime routine to make going to bed easier, like reading a book or dimming the lights. Third, try to limit the amount of digital screen time right before bed. This is for two reasons: (1) the light from your devices might trick your SCN into thinking it is still daytime, and (2) the excitement from games, TV shows, and the internet can keep you from settling down to sleep. Fourth, keep your bedroom simple, cool, dark, and free of distractions like TVs and devices (try not to take your phone to bed). Fifth, when possible, try not to do your homework in bed; keep your bed for sleeping. Finally, try to limit caffeine (soda, energy drinks, coffee/tea) during the day and avoid these drinks after 4 p.m. Caffeine essentially tricks your sleep homeostat, making you feel less sleepy, but without decreasing sleep need, which is not helpful when school starts at the usual time the next day.

Speaking of school—it is important that teachers and principals understand that sleep is critical for learning and health. Scientists are

Figure 3

Tips for good sleeping habits. Good sleep begins with good sleep habits. Working on each of these tips will help you get the best sleep you can each night, and to feel rested and ready for school the next day.

**Figure 3**

working with schools and governments to make school start later for teenagers. If you feel your school starts too early for you to get a good night's sleep, tell your teachers or write a letter to your mayor, governor, or congressperson. Tell them why it is important for schools to help protect everyone's sleep health.

SLEEP: WHAT IS IT ALL FOR?

Sleep is one of the strongest predictors of health, yet why we sleep is a mystery to us. We hope that we have shed light on that mystery and that you, your teachers, and your parents may better understand and apply the power of sleep to support learning success, emotional health, and brain health. We hope you sleep well tonight.

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YOUNG REVIEWERS

JACOB, AGE: 12

Hi, I am 12. Sleep is the foundation of life, so pay attention in class kids. I am a sporty guy. I play sports like baseball, basketball, and American-and-the-rest-of-the-world football. My love of reading is very extensive. I have love for food just like the other 7.8 billion people in the world. I especially have a love for Asian and American foods.



I have two siblings, two parents, and hopefully I am funny... So are you, so keep on trying.



ST. BERNARD REGIONAL CATHOLIC SCHOOL, AGES: 11–14

Eclectic group of middle school students and future engineers, teachers, politicians, dancers, musicians, doctors, and armed forces. We enjoy asking questions and inquiring about the world. Many of us look forward to assignments and future jobs that require creativity and problem solving. In the meantime however, we enjoy our over goofy and over caffeinated teacher, and interrupt our classes with witty comments and animal noises. A perfect balance of learning and fun!

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Elize is a psychologist and a researcher at the department of Child and Adolescent Psychiatry/Psychology at the Erasmus Medical Center in Rotterdam, The Netherlands. She studies sleep and mental health in the Generation R Study, a study following the development of around 7,000 children from Rotterdam. In her free time Elize loves to hike, read a lot of books, and to cook for her friends and family. Fun fact: she loves to go to bed early and get out of bed before 7 a.m. (also on the weekend).

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