

THE SCIENCE OF SLEEP

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(1) Imagine the following changes happening to your body: your muscles go limp, your body temperature decreases by 1-2°F, you become much less responsive to stimuli, you produce less urine but your body increases its ability to heal itself. Should you be worried about these unusual changes? No, because these changes happen to you every day and they aren't unusual at all; they occur when you sleep.

(2) Though most animals sleep, scientists are just beginning to understand the science behind it. Sleep and wakefulness can be considered two vastly different mental and physiological states that humans experience each day. Wakefulness involves consciousness and the ability to respond to stimuli. Sleep involves unconsciousness and a greatly reduced ability to respond to stimuli. Sleep itself can be broken down into two states. One sleep state is called rapid eye movement (REM) sleep and the other is called non-rapid eye movement (NREM) sleep.

(3) During REM sleep, the sleeper's eyes move quickly under their closed eyelids and their brain is very active. REM sleep is characterized by increased heart rate and blood pressure and less regular breathing. Many of the features of REM sleep are similar to wakefulness, however, the body is paralysed during this time. Vivid and strange dreams happen during REM sleep and nightmares can occur in this state of sleep. Newborns spend about 9 hours a day in REM sleep. The amount of REM sleep decreases rapidly over time and by the age of 5, they only spend 2 hours a day in REM sleep.

(4) During NREM sleep, the sleeper's eyes exhibit very little eye movement, their breathing is slower, and their heart rate and blood pressure lowers. During this type of sleep, the muscles of the sleeper are not paralyzed and cases of sleep walking can occur during NREM sleep whereas it cannot during the paralytic state of REM sleep. Much less dreaming is reported during this time than in REM sleep, but the dreams that are reported seem more organized and less bizarre. Though nightmares occur during REM sleep, night terrors occur during NREM sleep. Unlike nightmares, which usually wake up the sleeper, night terrors are characterized by intense fear



and even crying during sleep and it is difficult to wake up the sleeper. Night terrors are typically experienced by children.

(5) Most humans experience monophasic sleep, meaning that they sleep once a day. Some experience biphasic sleep if they have a habit of taking a nap during the day. In one night of monophasic sleep, a sleeper may go through 4 or 5 sleep cycles. Each cycle lasts for roughly 90 minutes and starts with NREM sleep and ends with REM sleep before starting again.

(6) The optimal amount of sleep a person needs differs for each individual depending on age, genetics and the presence of diseases. Usually a newborn needs to sleep for 14-17 hours a day, preteens and teens need 8-11 hours a day and adults need 7-9 hours a day. The length of sleep needed is also determined by a gene called DEC2. People with a mutation in this gene need two hours less sleep than the average person. Though they sleep less, they show no signs of lowered energy or impaired functioning when awake.

(7) Some people do not sleep enough for many reasons and when missed hours of sleep add up day after day, this is called a sleep debt. A large sleep debt can lead to mental impairment, negative emotional effects and a feeling of constant fatigue. People who suffer from insomnia can have a huge sleep debt. For a variety of reasons, insomniacs find it difficult to fall asleep and stay asleep. It is the most common sleep disorder. Insomnia can be caused by stress, poor sleeping conditions like a bright room, inconsistent sleep patterns like those seen in people who do shift work, and the presence of too many stimulating activities

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right before bedtime like video games and computer use.

(8) Though all mammals sleep, some do it very differently than we do. Aquatic mammals like whales and dolphins need to breathe air so they must make sure that they go to the surface even if they are asleep. When asleep, only one half of their brain (one hemisphere) sleeps at a time, while the other half remains conscious. This is called unihemispheric slow wave sleep. Both halves take turns being the one at rest and the one that is active. The active side is responsible for directing the sleeper to the surface to breathe. Cows,

horses, giraffes and camels can sleep while standing up but have to lie down during short periods of REM sleep when their muscles become paralyzed and unable to hold them up.

(9) Sleep researchers are not exactly sure why sleep is needed, but there are a few likely reasons. Sleeping gives the mind time to process the information learned during the day and assign this information to the correct parts of the brain. During sleep the body repairs itself. Even if you workout in the day, it is when you're asleep that your muscles repair and grow the fastest. When asleep, your brain has a chance to clean out waste material faster and your immune system can restore itself.

Article Questions

- 1) REM stands for Rapid Eye Movement sleep and NREM stands for Non-Rapid Eye Movement sleep. When only one hemisphere of a brain is asleep at a time, this is called Unihemispheric slow wave sleep. An insomniac is someone who has difficulty falling and staying asleep.
- 2) What are three differences between REM sleep and NREM sleep?
 - REM has rapid heart rate, REM is a sleeping state and not a paralysis, higher chance of dreaming
 - NREM - higher chance of nightmares and night terrors; heart rate slows down; eyes have limited movement
- 3) What is the difference between monophasic sleep and biphasic sleep? Are you a monophasic sleeper or a biphasic sleeper?
 - Monophasic sleep = sleep once per day
 - Biphasic sleep = take a nap throughout the day
- 4) How much sleep do you need for your age group? How much sleep do you usually get a day? If you are not getting enough sleep, calculate how much sleep debt you've accumulated this week?
 - Preteens = 8-11 hours of sleep per night
 - Adults = 7-9 hours of sleep per night
- 5) Why can't both halves of a dolphin's brain sleep at the same time?
 - Dolphins need to breathe air even when they are sleep so one half of their brain must remain awake to lead them to the surface to breathe air.
- 6) Even though cows can sleep standing up, they still lie down for short periods of time during sleep. Why is this necessary?
 - When cows enter REM sleep, their muscles become paralyzed and can no longer hold them up.
- 7) If you go to the gym and lift weights all day, you should make sure you get enough sleep. Why?
 - When we are asleep, our muscles repair and grow the fastest.