



Mark Rosekind, Ph.D.

The Science of Sleep

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Dr. Mark Rosekind began his talk on The Science of Sleep by giving the audience permission to nod off. Dr. Rosekind is an internationally-renowned expert on sleep and fatigue. Dr. Rosekind, (while averaging 8 hours of sleep a night), obtained his B.A. with Honors from Stanford University, his M.S., M.Phil., and Ph.D. from Yale University, and completed a postdoctoral fellowship in sleep and chronobiology at Brown University. Dr. Rosekind has 30 years of experience in sleep science research at Stanford and NASA and founded an innovative fatigue management company. He currently serves on the National Transportation Safety Board. Dr. Rosekind also works with peak performance athletes and states that many of them, including Apollo Ono, consider getting enough sleep their secret weapon.

Despite the fact that we are all sleepers, very few of us know much about the science of sleep. About a decade ago, the National Sleep Foundation conducted a simple 10-item "Sleep IQ" test and found that 82% of respondents failed the test with an average score of 46%. Flipping a coin could provide a 50% score, so the average respondent did worse than chance. Generally, our society is informed about trends in exercise and nutrition. However, the need for sleep and its importance to our performance, alertness, safety, health, and mood continues to be ignored or diminished.

Four Basics About Sleep That Everyone Should Know

1. Sleep need: Physiologically, adult humans require about 8 hours of sleep; with a range of around 7 to 9 hours. The amount of sleep an individual requires is genetically determined and "training" cannot reduce this sleep requirement. Children and young adults from junior high through their early 20's physiologically require about 9 to 10 hours of sleep.

2. Sleep debt: Lose sleep and it builds into a cumulative sleep debt. Though most adults require about 8 hours of sleep per night, on average, they obtain about 1.5 hours less. This sleep loss accumulates into a sleep debt. For example, over a five-day work week, a daily 1.5 hours of sleep loss would build into a 7.5 hour sleep debt by Friday. This equates to losing one full night of sleep (i.e., pulling an all-nighter) going into the weekend.

3. Circadian rhythms: Humans are hard-wired with a biological clock located in the hypothalamus. This circadian (circa=around, dies=a day) clock controls the 24-hour fluctuations in sleep/wakefulness, hormones, alertness, performance and is exhibited at the cellular level. (Circadian levels in children and adults are highest between 9-11am and 9-11pm and lowest between 3-5am and 3-5pm, meaning we are biologically-wired to need a mid-afternoon siesta). During adolescence, children experience a 'delayed sleep phase' in which their circadian clock readjusts so that their most wakeful times are between 11am-1pm and 11pm-1am. During this phase, adolescents may complain of difficulty falling asleep at night and difficulty waking up in the mornings. Bright light can assist in counteracting this phase by helping the adolescent turn back their circadian clock. Try to minimize the amount of light exposure right before bedtime (no television or computer screens) and expose the adolescent to daylight immediately upon waking.

4. Experience reality: How alert an individual "feels" does not reflect reality. In a study of anesthesiologists who report feeling wide-awake and at peak alertness, 68% of them appeared to fall asleep in less than five minutes (a sign of pathological sleepiness) and exhibited a 'head-bob' (your body's natural alarm clock) while being videotaped. Similar results are found studying pilots. A person's ratings of alertness and performance do not accurately reflect actual levels. This "disconnect" is one reason why individuals feel that sleep loss and circadian disruption have minimal or no effect.

How Much Sleep Loss Does it Take To See Levels of Performance Reduction? Studies have shown that getting 2 hours less sleep than needed can significantly impair performance. For example, in one study, allowing 8-hour sleepers to get only 6 hours of sleep (2 hours less than they needed) impaired performance to the equivalent of drinking two to three 12 oz beers, a level that equates to about .05% breath ethanol concentration. Getting 4 hours of sleep (4 hours less than they needed) impaired performance to the equivalent of drinking five to six 12 oz beers, a level that equates to about .10% breath ethanol concentration. Sleep loss and circadian disruption also can reduce safety and health. According to Dr. Rosekind, there could be an estimated 1 million car crashes annually due to fatigue and drowsy driving. National Sleep Foundation polls indicate that 60% of Americans have driven drowsy in the last year and 37% report nodding off at the wheel. Irregular schedules can be associated with up to a 50% increase in on-the-job injuries and accidents. Disturbed

sleep and circadian disruption also can be associated with increased risks for obesity, ADHD, heart and stomach problems, high blood pressure, cancer, pregnancy problems, obesity, anxiety, and depression.

Optimal Sleep and Alertness Strategies. There are a variety of scientifically validated strategies that are effective in promoting optimal sleep, alertness and performance. Here are two approaches for obtaining optimal sleep and one powerful strategy to increase performance and alertness.

Good sleep habits. The following “good sleep habits” should become part of everyone’s routine to obtain optimal sleep.

- **PRIORITIZE SLEEP FOR YOU AND YOUR CHILDREN** – Give your children a bedtime and limit their activities if they interfere with their sleep! Start with a 9.25 hour block reserved for sleep, and fit all the other activities into the 14.75 wakeful hours – if it does not fit, cut it out.
- **Keep a regular bedtime and wake time whenever possible** – most important is keeping the wake time consistent – try not to let your teens sleep past 10am on weekend mornings – better to wake them at 10 and give them a mid-afternoon nap than to let them sleep until noon as it interferes with the circadian clock.
- **Use a pre-bedtime routine to prepare for sleep** – take this routine with you when traveling.
- **Use the bedroom only for relaxation and sleep** – Working and studying should be done in another room.
- **Keep technology out of children’s bedrooms** – studies show that teens with electronics in their bedrooms average an hour less of sleep a night than teens with technology-free bedrooms.
- **Avoid worry in the bed and bedroom** – if your head hits the pillow and you begin to ruminate, get up and go into another room, make a list of your worries, allot some “worry time” for the next day in which you can go over the list, leave the list in the other room, and then go back to your bedroom to sleep.
- **Learn and practice a relaxation technique for sleep** – i.e. progressive muscle relaxation and deep breathing.
- **Avoid caffeine, alcohol, and exercise within at least 2 hours of sleep** – alcohol is a REM-suppressor and can affect both the quality and quantity of sleep.
- **Do not be a clock watcher** - if you are lying awake for more than 30 minutes, get out of bed, go into a different room and read (preferably a boring book – Dr. Rosekind recommends the Tax Code) – do not watch television or look at a computer screen – you want to avoid exposing your eyes to direct light.

Environmental factors. Evaluate and address the following “bedroom” factors.

- **Noise** – control for background noise and intrusive events
- **Temperature** – cooler is better (67-70 degrees is ideal)
- **Light** - use black out curtains when possible – even night lights or other ambient light can throw off the circadian clock – if you need a night light, keep it away from eye-level
- **Use a reliable, regular, effective alarm clock** – to prevent worry about oversleeping
- **Mattress and pillows** – personal comfort is paramount - no specific brand is better than any other

Strategic naps significantly increase performance and alertness.

While at NASA, Dr. Rosekind conducted a unique real-world study that provided commercial airline pilots a planned nap opportunity in flight to determine the effects of a 40-min nap on performance and alertness. The study found, that on average, pilots fell asleep in about 6 minutes and slept for about 26 minutes. These 26-minute naps enhanced objective performance by 34% and increased physiological alertness by 54%, with effects lasting around 3 to 4 hours.

Some general guidance for effective napping:

- a. Ideal time for a nap is during the lull in the circadian cycle – between 3pm and 5pm.
- b. For a short nap, only sleep up to 40 minutes (helps to avoid falling into deep sleep)
- c. For a longer nap, sleep about 2 hours
- d. Avoid a long nap too close to planned bedtime
- e. Allow 10-15 minutes “wake-up” after nap
- f. Consider sleep aids: eye mask, ear plugs

Strategic and Optimal Use of Caffeine

Plan the timing and amount of caffeine intake. Caffeine can take 15-30 minutes to take effect, and its effects can last 3-4 hours, so plan accordingly. Additionally, different forms of caffeine require different doses – find the ideal dose based on your body mass. As a baseline, average folks need about 150mg for optimal results. The typical 7-ounce cup of coffee has between 115 and 175 mg of caffeine; brewed tea is 40-60mg; one Red Bull is 80mg. Remember that caffeine is a drug and be aware of the tremors and edginess associated with overuse.