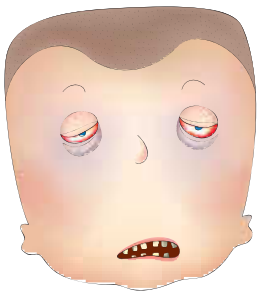
# How long can humans stay awake?

**J. Christian Gillin is at the San Diego Veterans Affairs Medical Center and is professor of psychiatry at the University of California at San Diego, where he conducts research on sleep, chronobiology and mood disorders. Gillin supplies the following response:**



The quick answer is 264 hours, or 11 days. In 1965 Randy Gardner, a 17-year-old high school student, set this apparent world record as a science-fair project. Several other research subjects have remained awake for eight to 10 days in carefully monitored experiments. None experienced serious medical or psychiatric problems, but all showed progressive and significant deficits in concentration, motivation, perception and other higher mental processes. Nevertheless, all returned to relative normalcy after one or two nights of sleep. Other, anecdotal reports describe soldiers staying awake for four days in battle and unmedicated patients with mania going without sleep for three to four days.

The more complete answer revolves around the definition of the word "awake." Prolonged sleep deprivation in normal subjects induces numerous brief episodes of light sleep (lasting a few seconds), often described as "microsleep," alternating with drowsy wakefulness, as well as loss of cognitive and motor functions. Many people know about the dangerous drowsy driver on the highway and sleep-deprived British pilots during World War II who crashed their planes, having fallen asleep while flying home from the war zone. Gardner was "awake" but basically cognitively dysfunctional at the end of his ordeal. Excluding accidents, however, I am unaware of any deaths in humans from sleeplessness.

In certain rare medical disorders, the question of how long people can remain awake receives surprising answers—and raises more questions. Morvan's syndrome, for example, is characterized by muscle twitching, pain, excessive sweating, weight loss, periodic hallucinations and sleeplessness. Michel Jouvet and his colleagues in Lyons, France, studied a 27-year-old man with this condition and found that he had virtually no sleep over a period of several months. During that time, the man did not feel sleepy or tired and did not show any disorders of mood, memory or anxiety. Nevertheless, nearly every night between approximately nine and 11 he experienced 20 to 60 minutes of auditory, visual, olfactory and somesthetic (sense of touch) hallucinations, as well as pain and vasoconstriction in his fingers and toes.

The ultimate answer to this question remains unclear. Indeed, the U.S. Department of Defense has offered research funding for the goal of sustaining a fully awake, fully functional "24/7" soldier, sailor or airman. Will bioengineering eventually produce soldiers and citizens with a variant of Morvan's syndrome, who need no sleep but stay effective and happy? I hope not. A good night's sleep is one of life's blessings. As Coleridge wrote in *The Rime of the Ancient Mariner,* "Oh sleep! it is a gentle thing, / Beloved from pole to pole!"

# When *Tyrannosaurus rex* fell, how did it get up, given its tiny arms?

—B. Lawrence, Montreal

**Paleontologist Gregory M. Erickson of Florida State University provides this explanation:**

I think we can look to birds (avian dinosaurs) for the answer, because they can stand up without the aid of arms. It's simply a matter of getting the legs below the center of gravity—where the front and back halves of the body will balance. Furthermore, tyrannosaurs would have had the aid of their tails. From skeletal evidence and tracks from tyrannosaur cousins known as albertosaurs, in which the tails did not drag, it is clear that tyrannosaur tails acted as counterbalances. The tail would have helped a 10,000-pound *T. rex* keep its center of gravity near its hips as its legs moved into position. Clearly, tyrannosaurs got up at least once during their lives (at birth), and there is no reason to believe that they could not do so throughout life—pathetic arms or not. SA

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