

Why Do We Sleep?

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The most obvious thing about sleeping is that in general we close our eyes to do it. We normally leave the other 4 senses on: if someone calls our name or touches us or there is a new smell: we are inclined to wake up. This suggests that sleep has to do substantially with the eyes.

The human [optic nerve](#) connecting an eye to the brain has about 1,000,000 or 10^6 fibres, each with a response time of about 1/100th of a second. In computer terms that accommodates a bandwidth of about 100 Megabits per second. We are awake in general for about 16 hours per day which is 57,600 seconds, so the brain receives from the eyes about 10 trillion or 10^{13} informations bits per day. Under extreme conditions the the human brain can stay awake for longer than this, but its performance degrades significantly and becomes unusable at a week (168 hours) of wakefulness. During a week of wakefulness, the brain would receive about 100 trillion or 10^{14} bits of information from the eyes.

The [human brain](#) has about 100 trillion or 10^{14} synapses.

The similarity of these two numbers: the maximum number of bits from the eyes and the total number of synapses suggests a very simple explanation for the need for sleep. It may simply be the period when the brain processes its images and compresses them so that it has room to function again the next day.

We are familiar with the idea of information compression. A single picture of 4,000 x 3,000 pixels with one byte (8 bits = 256 levels) of information about each of the red, green and blue values at each pixel would use 36 Megabytes. So a 2 hour movie of 25 frames/second at this resolution would require storage for $2 \times 3,600 \times 25 \times 36 = 64.8$ Gigabytes. Yet using MP4 compression, we can get good results stored in just 1 Gigabyte. Our brains do not of course use the MP4 compression algorithm. Over millenia of evolution, they have evolved more sophisticated techniques. But compressing information still takes time. And that is why we sleep.

(created 7 January 2007, updated 16 April 2013)
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