



## SPQ Module 18 – Sleeping under the Midnight Sun



There is twenty-four hour sunlight in Antarctica now, and on December 21 - the summer solstice - the sun will trace a perfect circle around the South Pole. How are Ray, Richard and Kevin responding to having to sleep in perpetual daylight, in a small tent that allows bright light to penetrate? Is the light interfering with their sleep?

Scientists believe that prolonged lack of sleep may decrease length of life. Some believe this may shed some light on the fate of the Scott expedition. When Scott and his men set out for the South Pole in December 1911, they chose to march at 'night' and sleep during the 'day'. Although the sun was up for the entire 24 hours, it was higher during the midday hours and lower during the midnight hours. Due to this differential height over the course of the day there was a similar difference in temperature, and the snow was firmer for marching during the cooler midnight hours, and it was warmer for sleeping during the midday hours.

### Did You Know?

The world record for sleeplessness is 264 hours (eleven days), set by an 18 year old American in 1965.

There have been many theories about what led to Robert Falcon Scott and his men's death. One novel hypothesis is that profound sleep deprivation precipitated their demise. In the surviving journals from the expedition reference is made by the British team to the difficulties they were having getting proper sleep. Their insomnia was likely attributable to the sodden or frozen sleeping bags in which they slept, as much as the perpetual light.

We humans spend about a third of our lives asleep. Why is it that we sleep? There are many theories to explain this need but no established explanation. Most experts believe we need sleep to restore and rejuvenate the body, but how this occurs is not clearly understood.

The average adult human needs to sleep about 8 hours a night, although the amount needed can vary quite markedly from person to person. Studies have found that people who sleep 6 to 7 hours a night live the longest. Adults who sleep

either less, or interestingly, more than 6 -7 hours on average, do not live as long. In other words, too much sleep may be as bad for adults as too little sleep. The same does not apply to children and adolescents!

All animals need sleep to remain healthy, but the amount of sleep they required is variable. In the mammal world Giraffes hold the record for the least average amount of required sleep, at 2 hours a day, while bats require the most sleep at about 20 hours a day.

Human beings are programmed by a rhythmic cycle of hormones to sleep when it is dark. This cycle is called the Circadian Rhythm. A specific location in the brain is responsible for governing this sleep cycle, and appears to interact with information received by the eyes on the presence or absence of light. Humans respond to the loss of light in two manners:

- By secreting a hormone called melatonin.
- By lowering the body temperature.

Human beings sleep best at night when it is dark and melatonin levels are highest, and their core body temperature is lowest. People who are exposed to more light have a reduction in the production of melatonin, such as those who work at night and sleep during the day. Decreased melatonin levels have been suggested as an explanation for increased rates of certain cancers in night-shift workers.

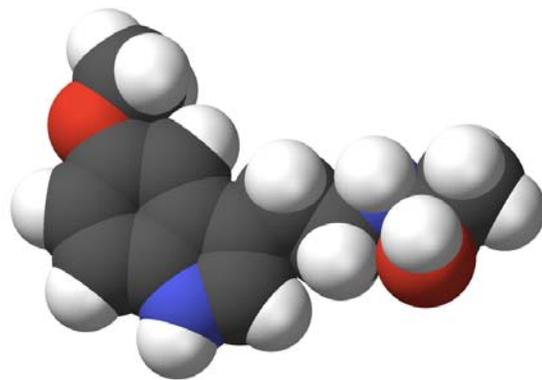


Figure 1: 3-D image of melatonin molecule (Source: Wikimedia Commons, Sbrools)

Complete sleep deprivation studies have not been done in human beings, but in rats total absence of sleep leads them to develop abnormally low body temperatures, skin sores, impaired healing and infections, and ultimately death. The theory is that the rat immune system breaks down with complete sleep deprivation, prohibiting them from fighting infection. Thus it appears that adequate sleep is core to maintenance of health.

How can this knowledge of sleep then be applied to the environment Ray, Richard and Kevin find themselves in? With constant exposure to sunlight during the entire

#### Did You Know?

The circadian rhythm is not unique to human beings. A daily 24-hour cycle in behavioral, biochemical and physiologic processes is also found in other animals, plants, fungi and even some bacteria.

course of their expedition they can be expected to be secreting significantly less melatonin. However, even though some arctic animals, such as reindeer and ptarmigan, completely lose their circadian rhythm during the 24 hour sunlight of summer, humans exposed to either constant light or constant dark continue to have an inborn circadian rhythm of approximately 24

hours - the so-called “internal body clock”. So Ray, Richard and Kevin can expect to become sleepy for a period every day, although given their lower melatonin levels, their sleep may not be as restful as usual.

There are other factors that may contribute to impaired sleep the team may experience while in Antarctica. Firstly, cold has been demonstrated to disrupt effective sleep. Fortunately, unlike the men on the Scott expedition, Ray, Richard and Kevin have excellent sleeping bags that should keep them warm and prevent sleep disruption.

They may also be subject to the sleep disruption associated with an increase in altitude. Studies of individuals living at

sea level, who are flown to work at the South Pole station at 10,000 feet, demonstrate that they initially can experience altitude insomnia. Altitude insomnia results from poor oxygenation at altitude. However, this occurs most often with sudden changes in altitude, and as Ray, Richard and Kevin will be travelling gradually upward over 35 days they likely will accommodate to the altitude, and not experience sleep disruption as a consequence.

#### Did You Know?

The ‘internal body clock’, or more properly the primary circadian clock in mammals is located in a part of the brain called the hypothalamus. Destruction of this area of the brain leads to the complete absence of a regular sleep wake cycle.



Photo: Julio Rojas