Astronauts Need Their Rest Too

Sleep-Wake Actigraphy and Light Exposure During Space Flight

The success and effectiveness of human space flight depends on astronauts' ability to maintain a high level of cognitive performance and vigilance. This alert state ensures the proper operation of sophisticated instrumentation. An important way for humans to remedy fatigue and maintain alertness is to get plenty of rest. Astronauts, however, commonly experience difficulty sleeping while in space. During flight, they may also experience disruption of the body's circadian rhythm — the natural phases the body goes through every day as we oscillate between states of high activity during the waking day and recuperation, rest, and repair during nighttime sleep. Both of these factors are associated with impairment of alertness and performance, which could have important consequences during a mission in space.

The human body was designed to sleep at night and be alert and active during the day. We receive these cues from the time of day or amount of light, such as the rising or setting of the sun. However, in the environment of the Space Shuttle or the International Space Station where light levels are highly variable, the characteristics of a 24-hour light/dark cycle are not present to cue the astronauts' bodies about what time of the day it is. Astronauts orbiting Earth see a sunset and sunrise every 90 minutes, sending potentially disruptive signals to the area of the brain that regulates sleep.

On STS–107, researchers will measure sleep-wake activity with state-of-the-art technology to quantify how much sleep astronauts obtain in space. Because light is the most powerful time cue to the body's circadian system, individual light exposure patterns of the astronauts will also be monitored to determine if light exposure is associated with sleep disruption.

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Scott Altman, mission commander for STS–109, sleeps on the flight deck of the Space Shuttle *Columbia*.

The results of this research could lead to the development of a new treatment for sleep disturbances, enabling crewmembers to avoid the decrements in alertness and performance due to sleep deprivation. What we learn about sleep in space informs treatment for earthbound populations, such as the elderly and insomniacs, who experience frequent sleep disturbances or altered sleep patterns.

Earth Benefits and Applications

This research could benefit the health, productivity, and safety of certain earthbound populations with similar conditions:

- Insomniacs
- Shift workers
- The elderly
- Travelers with jetlag.

Background Information

Science

Astronauts will wear a light-recording and activity-monitoring device called the Actilight watch for the duration of the mission. Data on sleep-wake activity and light exposure patterns obtained during flight will be compared with those measured for two weeks on Earth, approximately 90 days prior to flight. This will allow researchers to compare how much the astronauts slept in space versus how much they sleep normally. Astronauts will also wear the Actilight watch for the 11 days immediately prior to launch to determine if astronauts sleep less prior to flight. Recovery from space flight will also be assessed for one week following landing.

The sun rises over Earth in this photo taken during STS–101 (the rear of the Space Shuttle *Atlantis* is silhouetted in the foreground). The Shuttle environment has highly variable light levels, a factor possibly contributing to astronauts' sleeping difficulties.

Astronauts of STS–51 are caught during a sleep period in the Shuttle *Discovery's* middeck.

Each astronaut will also fill out a sleep log each morning. The logs are their subjective evaluation of the amount and quality of sleep. If an astronaut reports that his or her sleep was disturbed, questions in the log address the cause of the disturbance. The astronauts will also report how much caffeine they consumed or if they took medication, as both could impact sleep.

Hardware

The Actilight watch and a sleep log will be used for each astronaut in the study. The Actilight watch is a flight-approved version of the Actiwatch-L product, made by Mini-Mitter, Inc. This device resembles a small wristwatch and measures the wearer's activity and exposure to ambient light. It is powered by a lithium manganese battery and can record data for about 30 days. The sleep log is a hard copy booklet.

Operations

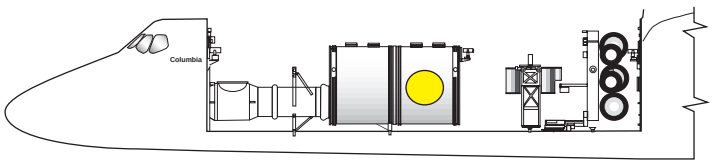
The crewmembers will don their Actilight watches as soon as possible in flight, and simply wear them continuously on their non-dominant wrists outside of their sleeves. The watches can be removed temporarily for specific activities, such as a spacewalk. Upon landing they will turn in the watches for analysis. In addition, each crewmember will complete a sleep log every day, recording how long they slept and rating the quality of sleep and how alert they feel.

Baseline data will be collected before and after the flight using the same methods. Comparison of the data obtained in flight to baseline data will indicate to scientists the changes in astronauts' sleep-wake cycle and light exposure patterns.

Earlier Results

The results of previous research on both short- and long-duration space missions suggest that approximately 25 percent of crewmembers experience dramatic impairment of amount and/or quality of sleep. Hypnotic medications are the most frequently administered medications after the first several days in flight. This suggests that insomnia is a prevalent symptom among astronauts. Despite these data, little is known of the cause, prevalence, or severity of sleep disruption during short-duration missions and less is known about the effects on sleep during long-duration missions. Scientists hope that deeper understanding of sleep disturbances in space will lead to the development of treatments to help astronauts, as well as those who experience sleep disorders on Earth.

Shown is an actiwatch, similar to the model that STS–107 astronauts will don.



Approximate location of this payload aboard STS–107.