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# Sleep in Space

*Can we adapt to a new night and day?*

By Gina Dewink

**N**ASA is planning a mission to the Moon in 2024. After several lunar missions, NASA plans to send astronauts to Mars. This series of missions for exploration is called Artemis 1. While many potential concerns arise, one is already being studied by sleep researchers. How will astronauts sleep in space—and specifically, on Mars?

“I have always been a space enthusiast,” says Erin E. Flynn-Evans, PhD, MPH, who is currently the Director of the Fatigue Countermeasures Laboratory at NASA Ames Research Center. A circadian physiologist and epidemiologist, Dr. Flynn-Evans has worked in the sleep field for 20 years. “When I was training, I was asked if I would consider working on a study to assess sleep in space. That study eventually led to my position at NASA.”

## SLEEP ON MARS

After sending human explorers 250,000 miles to the Moon, NASA intends to then send astronauts 140 million miles to Mars sometime in the 2030s. As of now, the plan is that astronauts will remain on Mars for 30-45 days. But from there, people are already imagining what life on Mars could mean for humans. And one potential health challenge that has arisen is a misaligned night and day.

“There are numerous challenges that humans will face when sleeping on Mars,” Dr. Flynn-Evans begins. “The biggest challenge is that Mars rotates with a period of 24 hours and 39 minutes, compared to the 24-hour rotation of the Earth. As a result, astronauts living on Mars will need to shift their sleep-wake timing by 39 minutes every day to stay aligned with Mars.” To many, thirty-nine minutes may not seem like a large-scale reason to worry, but sleep experts see more. “In order to be awake when the sun is out and asleep when it’s night,” Dr. Flynn-Evans continues, “astronauts will

have to shift their schedules 39 minutes later every day. If the astronauts do not shift appropriately, they would live in a circadian misaligned state, which would feel like perpetual jet-lag or doing shift work. This is concerning because sleep loss and circadian misalignment are associated with reduced alertness and performance and the astronauts living and working on Mars will need to be able to perform at their best.”

## BLUE LIGHT ON THE RED PLANET

Fortunately, studies on Earth have shown that most people can shift to a Mars Sol—a solar day on Mars—if exposed to bright, blue-enriched light at the right times. Research has shown that the human circadian system is the most sensitive to light in the blue-wavelength spectrum; and the intensity, pattern, duration and timing of light also influence how one will be affected by light.

On Mars, astronauts will be exposed to dimmer light that is shifted from blue into the red end of the spectrum. Since this natural light exposure pattern on Mars may not be sufficient to facilitate human adaptation to the Mars day, Dr. Flynn-Evans suggests providing astronauts with special lights inside their habitat that help their bodies align to the Mars Sol. “We wouldn’t want them to follow their natural rhythms because everyone has a slightly different circadian period,” Dr. Flynn-Evans explains. If the astronauts did not receive light to help them stay aligned with Mars time, they might start to desynchronize their schedules from each other, which would not be good for maintaining team cohesion and work schedules while there.

Dr. Flynn-Evans states, “We still have more work to do in order to ensure we can provide astronauts with tailored countermeasures that will allow them to maintain stable circadian alignment on Mars.” In



Erin Flynn-Evans, a research psychologist and director of the Fatigue Countermeasures Laboratory at NASA's Ames Research Center, holds electrodes that measure brain wave activity. Her team uses the electrodes as one tool in its studies of the way fatigue affects people on the job in diverse fields such as aviation, spaceflight and NASA mission operations.

addition to the misaligned night and day, there are other issues associated with sleeping on the Moon or Mars that are similar to issues that individuals on Earth might experience. Dr. Flynn-Evans uses the examples of astronauts maintaining good sleep hygiene practices by going to bed on time and reducing environmental sleep disrupters like light and noise pollution, which might be more difficult under the extreme circumstances. In addition, the astronauts will live and work in isolated and confined environments, which could also influence sleep. “Additionally,” Dr. Flynn-Evans says, “we don’t yet understand how other factors in space—such as microgravity, partial gravity and radiation—might affect sleep.”

## SHOULD SLEEP BE A CONCERN FOR MARS SETTLERS?

Getting enough sleep at the right time is important for short-term alertness and performance and for long-term health outcomes. Whenever a person is engaged in complex, safety-sensitive tasks, they should ensure that they get enough sleep to function at a high level. In situations such as a space mission, one mistake can have major consequences.

Based on research that has been done on Earth, experts believe most humans will be able to adapt to a Mars Sol. Since most people have a circadian period that is a little longer than 24 hours, many people will probably not have much difficulty adapting to the Mars Sol. On the other hand, some people, especially those with a circadian period that is shorter than 24 hours such as some early birds, may find it difficult or impossible to adapt to a stable Mars schedule.

NASA and its researchers are learning more about sleep during spaceflight and sleep in space all of the time. Dr. Flynn-Evans expects that much will be observed and learned about sleep in space during the upcoming lunar expeditions and that will help us prepare for future deep space exploration.

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*Erin E. Flynn-Evans, PhD, MPH is the current Director of the Fatigue Countermeasures Laboratory at NASA Ames Research Center. A circadian physiologist and epidemiologist, Dr. Flynn-Evans has worked in the sleep field for 20 years. Her current primary area of interest is studying the influence of work hours on alertness, performance, and sleep in a variety of occupational cohorts. At the NASA sleep lab she performs characterization studies. Previously, she has done basic laboratory studies assessing the influence of light on the circadian system and long-term health consequences of shiftwork and circadian misalignment.*

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*Gina Dewink has been working and writing for nonprofit health organizations since 2004. With a degree in communications, her career history includes the American Academy of Neurology and the RLS Foundation.*