Making days longer than 24 hours

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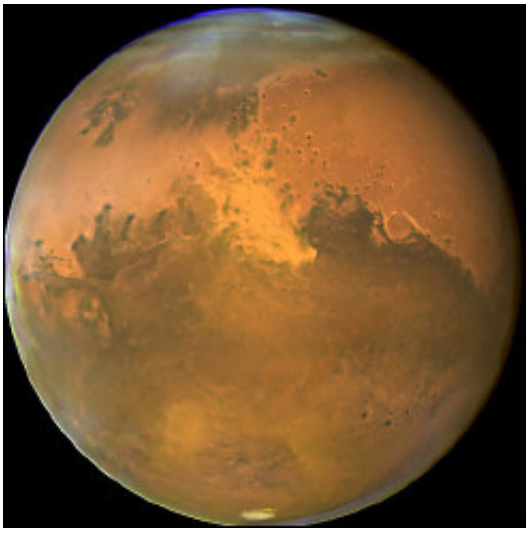

This NASA Hubble Space Telescope image shows Mars in 2005. Scientists have proved it is possible to pack another hour into the day in a study which could help prepare humans for life on Mars.

People at a research hospital in Boston have been living 24-hour, 39-minute days. They were part of an experiment to show that the 24-hour human sleep-wake cycle can be adapted to other biological rhythms like the longer days on Mars.

And it appears to be a relatively easy thing to do. All that seems to be needed is two 45-minute exposures to bright light in the evening.

The shift was done at Brigham and Women's Hospital by Harvard Medical School researchers looking to help out astronauts who one day

may spend a year and a half on Mars.

"Evidence of significant sleep loss and disruptions of circadian [24-hour] rhythms in astronauts and associated decreases in performance have been reported during space missions," notes Charles A. Czeisler, Frank Baldino Jr. Professor of Sleep Medicine. "In these situations, sleep and circadian disruptions could have serious consequences on the effectiveness, health, and safety of astronaut crews. Moreover, long-duration space missions may require them to be scheduled to non-24-hour light/dark cycles for extended durations of time. These issues emphasize the importance of developing effective countermeasures to maintain synchronized circadian rhythms."

The National Aeronautics and Space Administration (NASA) plans to have a colony on the moon by 2024, and the agency considers this a giant step toward landing humans on Mars. Plans even include a mobile Martian greenhouse where the astronauts can grow their own food. Lights in the greenhouse could also serve to keep the space colonists adapted to the 24-hour, 39-minute days on Mars.

Not everyone is going to Mars, so Czeisler and his colleagues look forward to using their lighting scheme to help Earthlings who have trouble getting to sleep or waking up, foggy-headed shift workers, and the jet-lagged travelers.

Brain clocks vs. wall clocks

While checking the biological clocks of young, healthy subjects, Czeisler's team made what he calls, "an amazing observation." They knew that all people don't operate on the same clocklike 24-hour cycle, but the differences they found were startling. The 12 men and women in the Mars study, who were 22 to 33 years old, showed circadian periods ranging from 23 1/2 to 24 1/2 hours.

These natural differences cause some people to jump energetically out of bed in the morning, or to enjoy staying up late. Those with less than 24-hour brain rhythms tend to go to bed earlier and get up earlier. They are morning people. Those with a 24-hour-plus rhythm tend to stay up later. They are evening people. "Such individuals would have no trouble adjusting to a Martian day," Czeisler notes.

After determining the natural timekeeping of the 12 subjects' brain clocks, the researchers scheduled them to live on a longer-than-24-hour light/dark cycle for 30 days. During this time, their environment was free of clues and cues of Earthly 24-hours cycles. One group was also exposed to two pulses of bright light, each lasting 45 minutes, in the evening. These people synchronized their brain clocks to the Martian day, while those living in dim/bright conditions alone did not.

In other words, Czeisler and his team squeezed extra minutes into the subjects' biological day simply by exposing them to bright light for 90 minutes each evening. The switch seems to work by resetting the time when humans begin to release a hormone called melatonin, which gets their bodies ready for sleep.

Light boxes that help people adjust to such things as night shifts and jet lag are available commercially. The Harvard research suggests that only two 45-minute pulses in the evening could keep some morning people more alert later in the day. Exposure to such bright light in the morning should also get evening people going faster in the morning. "We haven't tested this yet, but it should work in many cases," Czeisler says.

What's more, he adds, "we should be able to make the adjustment faster by using blue light." Other experiments with blue light show that it is more efficient than white light for readjusting melatonin levels. If this works, people could bring the clocks in the brains into sync with those in the bedroom by staring at dimmer light for less time. This could be

especially helpful to people who live with chronic sleep problems caused by brain clocks that run even shorter or longer than 23 1/2 or 24 1/2 hours.

What about the moon?

Czeisler believes his findings "suggest that appropriately timed light exposure can be used as an effective means to maintain the circadian [brain] clock in synchrony with a rest-activity cycle different from 24 hours." He and his time team are now attempting to determine if such adjustments can be made more quickly with blue light.

NASA certainly will not land astronauts on Mars for decades. The trip would take six months and they would stay on the Red Planet for a year and half. A permanent colony would require a greenhouse so Martian immigrants could be self-sustaining. If all goes well, the colonists could adjust better to the longer day by working in their garden twice in the evenings for 45 minutes.

Before Mars, the space agency hopes to work out some of the challenges of living out of this world by founding a colony close to the South Pole of the moon. (That is where light, and thus energy, would be most plentiful.) Czeisler has begun working on the tough problem of synchronizing the brain clocks of lunar colonists to days that are about 709 Earth-hours long and consists of two weeklong periods of light, followed by two weeklong periods of darkness.

Source: Harvard University

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