BioEd℠

THE SCIENCE OF SLEEP AND DAILY RHYTHMS

Sleep: Assessment

by

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RESOURCES

For online presentations of each activity and downloadable slide sets for classroom use, visit http://www.bioedonline.org or http://www.k8science.org.

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www.ngdc.noaa.gov/geomagmodels/Declination.jsp

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www.srrb.noaa.gov/highlights/sunrise/sunrise.html

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TEAMING WITH BENEFITS

by Jeffrey P. Sutton, M.D., Ph.D., Director, National Space Biomedical Research Institute (NSBRI)

Dr. Jeffrey P. Sutton

Space is a challenging environment for the human body. With long-duration missions, the physical and psychological stresses and risks to astronauts are significant. Finding answers to these health concerns is at the heart of the National Space Biomedical Research Institute's program. In turn, the Institute's research is helping to enhance medical care on Earth.

The NSBRI, a unique partnership between NASA and the academic and industrial communities, is advancing biomedical research with the goal of ensuring a safe and productive long-term human presence in space. By developing new approaches and countermeasures to prevent, minimize and reverse critical risks to health, the Institute plays an essential, enabling role for NASA. The NSBRI bridges the research, technological and clinical expertise of the biomedical community with the scientific, engineering and operational expertise of NASA.

With nearly 60 science, technology and education projects, the NSBRI engages investigators at leading institutions across the nation to conduct goal-directed, peer-reviewed research in a team approach. Key working relationships have been established with end users, including astronauts and flight surgeons at Johnson Space Center, NASA scientists and engineers, other federal agencies, industry and international partners. The value of these collaborations and revolutionary research advances that result from them is enormous and unprecedented, with substantial benefits for both the space program and the American people.

Through our strategic plan, the NSBRI takes a leadership role in countermeasure development and space life sciences education. The results-oriented research and development program is integrated and implemented using focused teams, with scientific and management directives that are innovative and dynamic. An active Board of Directors, External Advisory Council, Board of Scientific Counselors, User Panel, Industry Forum and academic Consortium help guide the Institute in achieving its goals and objectives.

It will become necessary to perform more investigations in the unique environment of space. The vision of using extended exposure to microgravity as a laboratory for discovery and exploration builds upon the legacy of NASA and our quest to push the frontier of human understanding about nature and ourselves.

The NSBRI is maturing in an era of unparalleled scientific and technological advancement and opportunity. We are excited by the challenges confronting us, and by our collective ability to enhance human health and well-being in space, and on Earth.

NSBRI RESEARCH AREAS

CARDIOVASCULAR PROBLEMS

The amount of blood in the body is reduced when astronauts are in microgravity. The heart grows smaller and weaker, which makes astronauts feel dizzy and weak when they return to Earth. Heart failure and diabetes, experienced by many people on Earth, lead to similar problems.

HUMAN FACTORS AND PERFORMANCE

Many factors can impact an astronaut's ability to work well in space or on the lunar surface. NSBRI is studying ways to improve daily living and keep crewmembers healthy, productive and safe during exploration missions. Efforts focus on reducing performance errors, improving nutrition, examining ways to improve sleep and scheduling of work shifts, and studying how specific types of lighting in the craft and habitat can improve alertness and performance.

MUSCLE AND BONE LOSS

When muscles and bones do not have to work against gravity, they weaken and begin to waste away. Special exercises and other strategies to help astronauts' bones and muscles stay strong in space also may help older and bedridden people, who experience similar problems on Earth, as well as people whose work requires intense physical exertion, like firefighters and construction workers.

NEUROBEHAVIORAL AND STRESS FACTORS

To ensure astronaut readiness for space flight, preflight prevention programs are being developed to avoid as many risks as possible to individual and group behavioral health during flight and post flight. People on Earth can benefit from relevant assessment tests, monitoring and intervention.

RADIATION EFFECTS AND CANCER

Exploration missions will expose astronauts to greater levels and more varied types of radiation. Radiation exposure can lead to many health problems, including acute effects such as nausea, vomiting, fatigue, skin injury and changes to white blood cell counts and the immune system. Longer-term effects include damage to the eyes, gastrointestinal system, lungs and central nervous system, and increased cancer risk. Learning how to keep astronauts safe from radiation may improve cancer treatments for people on Earth.

SENSORIMOTOR AND BALANCE ISSUES

During their first days in space, astronauts can become dizzy and nauseous. Eventually they adjust, but once they return to Earth, they have a hard time walking and standing upright. Finding ways to counteract these effects could benefit millions of Americans with balance disorders.

SMART MEDICAL SYSTEMS AND TECHNOLOGY

Since astronauts on long-duration missions will not be able to return quickly to Earth, new methods of remote medical diagnosis and treatment are necessary. These systems must be small, low-power, noninvasive and versatile. Portable medical care systems that monitor, diagnose and treat major illness and trauma during flight will have immediate benefits to medical care on Earth.

For current, in-depth information on NSBRI's cutting-edge research and innovative technologies, visit www.nsbri.org.

OVERVIEW

Summative assessment activity in which students will review concepts about sleep and daily cycles, and will create their own illustrated poems.

ACTIVITY

SLEEP: ASSESSMENT

Cycles and rhythms can be found in all organisms on Earth. Many are synchronized to the 24-hour cycle of Earth's rotation about its axis. In general, 24-hour cycles are called circadian, from the Latin words for "about" (circa) and "day" (dies).

People's schedule of sleeping and waking is determined, to a large extent, by an "internal clock" in our brains. Environmental cues, particularly light, keep this clock synchronized to external conditions. However, the clock will continue to run on approximate 24-hour cycles, even without changes in the environment.

The human cycle of sleeping and waking can be disrupted by changes in external conditions. Such changes occur when travelers move across time zones, or when astronauts travel in space. Not getting enough sleep can contribute to poor performance on mental or physical tasks, and may even lead to dangerous accidents.

Space life scientists are seeking ways to help astronauts achieve the sleep they need to function well under the stresses of long-term space flight. Their research also will help to solve sleep-related problems for people on Earth.

TIME

10 minutes for setup; 45 minutes to conduct activity

MATERIALS

Each student will need:

- Writing paper
- Markers, pencils

SETUP & MANAGEMENT

Conduct discussion with the entire class. Students should work independently or in small groups to write their poems.

PROCEDURE

1. Review the major concepts to which students were exposed in this unit.
2. Read or have students read the poem, "Tick-Tock, Tick-Tock.". Lead a class discussion about the poem's key concepts.
3. Have students create their own illustrated poems about sleep and/or circadian rhythms. Each poem should include at least one new concept that students learned about this topic from the activities in this unit. Possible approaches are given below.
   - After the poem is read, have students write their own poems about sleep and/or circadian clocks.
   - Read a few verses of the poem to get students started, and then have them write their own verses to complete the poem.
   - Share the first line of each verse and have students complete the verses with their own words.

Reliable Sources

Reliable information about sleep and related topics is available online at the following Web sites.

Healthy Sleep
http://healthysleep.med.harvard.edu

MedLine Plus*
http://medlineplus.gov

NASA CONNECT™
http://connect.larc.nasa.gov/episodes.html

National Heart, Lung, and Blood Institute
www.nhlbi.nih.gov

*Health information is available in more than 40 languages.

ACTIVITY

TICK-TOCK, TICK-TOCK

Tick-tock, tick-tock, tick-tock, tick-tock.
Did you know you have a "brain clock?"

Like the sundial's shadow-line
your inside clock can measure time.

It tells you when it's time to eat,
and even when to go to sleep!

But people aren't the only ones
who know it's time for rest or fun.

Plants know when it's time to bloom.
They know that springtime's coming soon!

At dawn, most birds begin to sing
without alarms that ring-a-ling.

Frogs know when to leap and croak,
or chase some flies... or take a soak!

Barn owls hunt when your day's done.
They rarely ever see the sun.

How do they always know the time
without a clock or watch like mine?

How can we solve this mystery?
The answer's in our cells, you see.

People, plants and animals
have "inside clocks" that send a call.

The clocks tune in to many cues
like, "When it's dark, it's time to snooze!"

Now you know that you're a clock,
so shout it out: *Tick-tock, Tick-tock!*