



Education in Action on the International Space Station

Classroom Connections



Sleep
Science

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Sleep Science

Teacher Background



Grade Level: **6th-8th**



Suggested Time: **60 Minutes**



Next Generation Science Standards (NGSS):

MS-LS2-4 Ecosystems. *Interactions, Energy, and Dynamics. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.*

Background

The hazards of lost sleep can range from poor attention at school, to on-the-job errors, to chronic disease. People of all ages experience disruptions in circadian rhythm, or the body's natural regulator for sleep and wake cycles based on a daily 24-hour schedule. This instinctual process can be disrupted by abnormal daily schedules, extensive traveling between time zones, and by daily life for International Space Station crew members, who experience 16 sunrises and sunsets a day. In this lesson, students will relate their sleep patterns to those of astronauts. Students will identify deficiencies in their sleep patterns and determine ways to solve these deficiencies to prevent health problems from occurring.

Circadian misalignment, or a change in one's sleep cycle, and sleep deficiency, or a lack of sleep, occur during both short- and long-duration spaceflight, and can lead to significant, fatigue-induced errors and long-term sleep loss. In addition to the astronauts, employees working around the clock in Mission Control, where shift work and abnormal hours are common to accommodate the crew, often experience the effects of circadian misalignment. Chronic sleep deprivation and circadian disruptions are associated with health complications such as metabolic disorders, cardiovascular diseases, gastrointestinal diseases and some types of cancers. NASA's flight surgeons and scientists have devised tools for crew members and Mission Control employees to help promote a more natural circadian rhythm in space and during shift work back on Earth. Here are seven ways NASA addresses circadian rhythm disruption.

1. Schedule Sleep and Wake Times

Allowing the body time to prepare for situations where circadian misalignment may occur is the most effective

countermeasure against sleep problems like insomnia and fatigue. Developing a schedule that takes into account human circadian rhythm and an individual's typical sleeping habits is the first tool in ensuring optimal performance, alertness and sleep quality. In addition to noting sleep and wake time, lighting instructions, diet, exercise and sleep aid information are needed to ensure proper adaptation. Crew members follow a strict sleep and wake schedule for at least two days leading up to a launch and continue to follow a sleep schedule during spaceflight.

2. Sleep Education and Training

Being aware of what factors impact sleep quality and quantity is important for promoting healthy sleep hygiene, or the behaviors, environmental conditions and other sleep-related factors that can affect sleep. Properly-timed exercise, minimizing light from digital devices in the evening, and thoughtful dietary choices can all lead to a better night's sleep and help to prevent circadian misalignment.



3. Sleep Environment

Every effort is made to provide space station crew members a sleeping environment that encourages healthy, undisrupted sleep times. Private sleeping quarters like those currently found aboard the station contain sleep restraints used to keep crew members from floating around while sleeping. The sleeping quarters also help to minimize the opportunity for disruption from other crew members and allow for varying sleep schedules. Other environmental factors that affect sleep for crew members aboard the station are temperature, lighting, airflow, noise and carbon dioxide.

4. Light

The space station orbits Earth every 90 minutes, which means the crew members see 16 sunrises and sunsets each day. This frequent change from darkness to light severely impacts the body's ability to adjust to a natural circadian rhythm. To combat this, lighting on the station is being transitioned from traditional lighting, to lighting that allows the crew members to adjust the color spectrum and intensity of the light to promote alertness and circadian resetting, or to promote sleep. Many laboratory investigations have shown that bright lights and blue lights, when administered appropriately, provide a safe, reversible, natural countermeasure to evoke alertness and enhance performance.

5. Non-prescription Sleep and Alertness Substances

Melatonin and caffeinated products may be used to address circadian rhythm disruptions. Melatonin, a naturally produced hormone that functions to regulate day-night cycles, can help to facilitate circadian shifts during off-normal times by aiding in sleep. Caffeinated products can help to keep someone awake and alert.

6. Sleep Cognitive Behavioral Therapy

Sleep Cognitive Behavioral Therapy (CBT) provides a solution to the random, unwanted thoughts that tend to cloud the mind just before bedtime and lead to the inability to naturally transition to sleep. Sleep CBT techniques help crew members to cope with the day's events, pre-sleep preparation, adherence to sleep hygiene, engage in structured relaxation and psychological strategies. Sleep CBT helps crew members to leave undesirable sleep behaviors behind, and replace them with routines and techniques that promote good sleep. Techniques include avoiding caffeinated products before bed and sleeping in a cool, dark room.



7. Medical Interventions

Once a crew member has exhausted all natural options for successful circadian shifting techniques, options for medicinal interventions are explored. Prior to spaceflight, flight surgeons conduct ground testing on each crew member to test individual physiological responses while using a variety of sleep-aid and alertness medication to ensure the safety and effectiveness of the crew.

Taking steps toward a better night's sleep, whether on Earth or orbiting almost 250 miles above it, ensures faster response times, sharper cognitive skills, and an overall healthier mind and body.

Objective

Following this activity, students will be able to:

- Describe causes of disruptions in sleep patterns.
- Identify ways to obtain healthier sleep patterns.

Materials

- Sleep Schedule Pre-Survey and Post-Survey
- Sleep Science Worksheet
- Pen/pencil to record data

Procedure

- **Sleep Schedule Pre-Survey:**

Students complete the Sleep Schedule Pre-Survey.

- **Inquiry Discussion:**

Ask students the following questions and discuss the following information:

1. How important is sleep to you?
2. What effect do you believe sleep has on your grades?
3. How does your sleep environment affect how much sleep you get?
4. Why is NASA involved in sleep science?

- **Watch and Discuss Video:**

Watch the video STEMonstrations: Sleep Science.

- **Sleep Schedule Worksheet:**

Students complete the Sleep Schedule Worksheet.

- **Sleep Schedule Post-Survey:**

Students complete the Sleep Schedule Post-Survey.

- **Final Discussion:**

Students share their survey results with the class. Encourage students to share what they learned about sleep science, including what may have surprised them or encouraged them to change their sleep habits.

Learn More

Study Compiles Data on Problem of Sleep Deprivation in Astronauts

<https://www.nasa.gov/content/study-compiles-data-on-problem-of-sleep-deprivation-in-astronauts>

Seven Ways Astronauts Improve Sleep May Help You Snooze Better on Earth

https://www.nasa.gov/mission_pages/station/research/astronauts_improve_sleep

NASA Research Reveals Biological Clock Misalignment Effects on Sleep for Astronauts

<https://www.nasa.gov/feature/ames/nasa-research-reveals-biological-clock-misalignment-effects-on-sleep-for-astronauts>

NASA Bed Rest Studies

<https://www.nasa.gov/analogs/envihab/bed-rest-faqs>



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Name: _____

Directions

Complete the following survey by circling answers or filling in blanks.

- How many hours of sleep do you believe you need each night?
 Less than 6 hours 6 hours 7 hours 8 hours More than 8 hours
- Fill in the table below based on your average sleep schedule during the school year.

Day of the Week	Time You Go to Bed	Time You Fall Asleep	Time You Wake-Up	Total Hours of Sleep
Sunday				
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				

- Do you believe you get enough sleep each night? YES NO
- Do you sleep with a television on in your bedroom? YES NO
- Do you sleep with music playing in your bedroom? YES NO
- Do you sleep with any light on in your bedroom? YES NO
- Do you share a bedroom with anyone else? YES NO
- Do you ever get too hot or cold while sleeping? YES NO
- Do you bring electronic devices, such as smartphones, to bed? YES NO
- Do you eat or drink anything right before going to bed? YES NO
- List anything else that distracts you during the night while you are trying to sleep.

Name: _____



Directions

Complete the following questions after watching the STEMonstratation: Sleep Science video.

1. List some of the hazards that lost sleep can have on your daily routine.
2. Define circadian rhythm.
3. Astronauts in space experience _____ sunsets and sunrises each day.
4. These sunrises and sunsets experienced aboard the space station can cause _____ and _____ on long-duration spaceflight.
5. Astronauts in space sleep in _____, where they can control different aspects of their environment to create a better night's sleep.
6. Minimizing _____ created from digital devices directly before sleep time can help create a better night's sleep.
7. _____ prevents astronauts from floating during sleep as a result of the air currents in the space station.
8. What are three benefits of a good night's sleep for the astronauts living and working in microgravity?

Sleep Schedule Post-Survey

Name: _____

Directions

Students will complete the following survey by circling answers or filling in blanks after participating in the Sleep Science Lesson.

- How many hours of sleep should you get each night based on NASA research?
 Less than 6 hours 6 hours 7 hours 8 hours More than 8 hours
- Fill in the table below based on what your sleep schedule should be during the school year.

Day of the Week	Time You Go to Bed	Time You Fall Asleep	Time You Wake-Up	Total Hours of Sleep
Sunday				
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				

- Do you believe you get enough sleep each night? YES NO
- Should you sleep with a television on in your bedroom? YES NO
- Should you sleep with music playing in your bedroom? YES NO
- Should you sleep with any light on in your bedroom? YES NO
- Should you bring electronic devices, such as smartphones, to bed? YES NO
- Should you eat or drink anything right before going to bed? YES NO
- Explain what changes you should make to your sleep schedule and environment to gain more energy and be healthier and more productive during the day.