

muse®

Bodies in Space

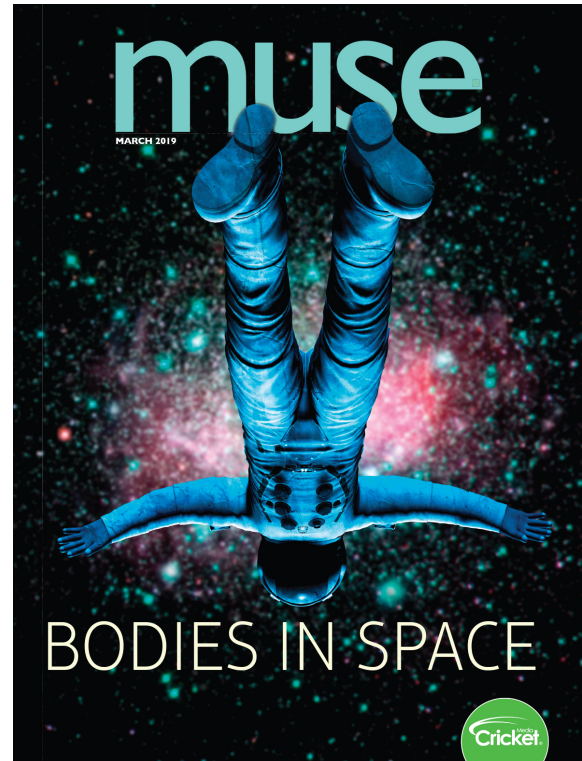
3-2-1 . . . Blast Off! From pillownauts to spidernauts, this issue of *Muse* includes out-of-this-world information about some unique space studies. Students will learn how NASA researchers are working with human and animal test subjects to develop techniques to keep astronauts healthy in space for longer periods of time.

CONVERSATION QUESTION

How are researchers working to make space travel safer and more comfortable for astronauts?

TEACHING OBJECTIVES

- Students will learn how jumping spiders adapted to survive when exposed to microgravity.
- Students will learn how astronauts regulate their circadian rhythms in space.
- Students will learn how analog missions are making space travel safer and more comfortable for astronauts.
- Students will obtain and record relevant information.
- Students will identify problem-and-solution relationships.
- Students will analyze a cause-and-effect relationship.
- Students will research the benefits of studying animals in space.
- Students will create mathematical word problems that relate to information from the text.
- Students will create journal entries chronicling a week in the life of an analog mission participant.



In addition to supplemental materials focused on core STEM skills, this flexible teaching tool offers vocabulary-building activities, questions for discussion, and cross-curricular activities.

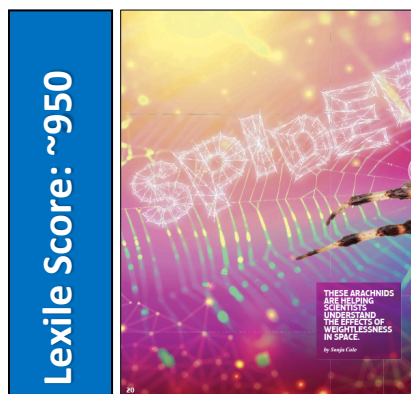
SELECTIONS

- **Spidernauts**
Expository Nonfiction, ~950L
- **Sleeping Isn't Simple**
Expository Nonfiction, ~750L
- **Beyawned Earth**
Expository Nonfiction, ~1150L

Spidernauts

pp. 20–23, Expository Nonfiction

Students will be lured into this web of words that teaches young readers how even tiny creatures like spiders can advance our space program. Discover how jumping spiders were able to adapt to microgravity and how this information can help keep human astronauts safer in such an unusual environment.



RESOURCES

- Itsy Bitsy Spidernaut

OBJECTIVES

- Students will learn how spiders adapted to survive when exposed to microgravity.
- Students will obtain and record relevant information.
- Students will research the benefits of studying animals in space.

KEY VOCABULARY

- **adapt (p. 23)** become adjusted to new conditions
- **controlled habitat (p. 21)** a controlled physical environment that replicates the place where an animal naturally or normally lives
- **disorienting (p. 23)** causing a loss in perception of time, place, or one's identity

ENGAGE

Conversation Question: How are researchers working to make space travel safer and more comfortable for astronauts?

Have the children draw, or use construction paper to create a spider, complete with eight legs. Instruct them to write the word "spidernaut" on the body and add a space helmet to the head for fun. On each of the eight legs, ask students to write a fact about astronauts or our space program.

INTRODUCE VOCABULARY

Prepare students to read by introducing the key vocabulary terms and the title of the article. Discuss the meanings of the words and challenge students to write a definition for the word "spidernaut." Have students speculate on the content of the text by writing a prediction statement utilizing all of the vocabulary terms. Revisit predictions after reading.

READ & DISCUSS

Reinforce comprehension of the material presented in the article by leading a class discussion based on the following questions.

- Why were spiders sent into space?
- Explain how this was a student-designed experiment.
- What did the spiders teach researchers about microgravity?
- In what circumstances can humans experience the sensation of weightlessness?

CONCEPT/SKILL FOCUS: Obtaining Information

INSTRUCT: Elicit from the students that this article contains information to help the reader understand the research benefits of "spidernauts." Distribute copies of the *Itsy Bitsy Spidernaut* graphic organizer and have the class reread the article independently. Instruct them to underline relevant information and to thoroughly complete each section of the organizer.

ASSESS: Circulate and have conversations with the students as they are completing their work. Collect and review their organizers. Arrange peer remediation groups for any students who had difficulty recording pertinent details.

EXTEND

Science Have students use books and the internet to research other animals that have been in space. Assign students the task of creating an informational page including a picture/photograph that details the animal's time in space. Consider questions such as: What was the purpose of the mission? Why was this particular animal selected? What were the results?

Itsy Bitsy Spidernaut

Use information from the article, "Spidernauts," to record relevant information.

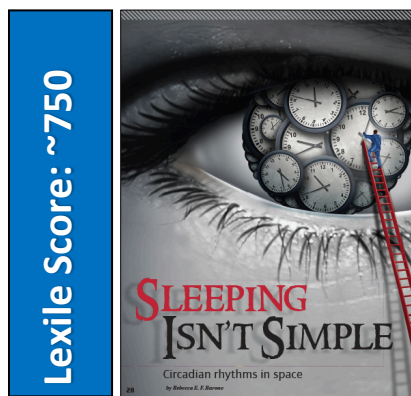
What are spidernauts?	What was the purpose of sending them to space?
What were the results?	How can this research benefit astronauts?

Spidernauts

Sleeping Isn't Simple

pp. 28–30, Expository Nonfiction

Come aboard the International Space Station and discover the many factors that contribute to sleep disturbances for astronauts in space. Students will learn how biological rhythms are affected, why sleep is so important, and how space travelers can counteract the negative effects of their cosmic environment.



RESOURCES

- Goodnight Moon, Goodnight Earth

OBJECTIVES

- Students will learn how astronauts regulate their circadian rhythms in space.
- Students will identify problem-and-solution relationships.
- Students will create mathematical word problems that relate to information from the text.

KEY VOCABULARY

- **circadian** (p. 29) biological processes recurring naturally on a twenty-four-hour cycle
- **melatonin** (p. 30) a hormone that makes you feel sleepy and helps to regulate circadian rhythms
- **sync** (p. 29) a state in which things happen at the same time or in the same way, or are suited to each other

ENGAGE

Conversation Question: How are researchers working to make space travel safer and more comfortable for astronauts?

Instruct students to create two columns on their paper and to write the following headings: What helps me fall asleep/What helps me wake up. Allow the students a few minutes to list and share their responses. Pose the question, “Why might different sleep/wake cues be necessary for astronauts in space?” Discuss and then distribute the article.

INTRODUCE VOCABULARY

Discuss the three key vocabulary terms and then post the definitions. Display the title of the article, “Sleeping Isn’t Simple,” and ask the students to write a sentence using all three words that could summarize the article. Next, read aloud the subtitle of the article, “Circadian Rhythms in Space,” and ask students to revise their sentences. Use this example to remind students that the purpose of subtitles is to give the reader additional information about the content of the text.

READ & DISCUSS

Pose the following questions to the students to facilitate meaningful discussion following the reading of the article.

- What things does our body respond to for sleep/wake cues?
- How do neurotransmitters function differently during the day and at night?
- What is jet lag?
- Why can being sleepy be dangerous?

CONCEPT/SKILL FOCUS: Problems and Solutions

INSTRUCT: Inform students that they will be rereading the article with a partner and highlighting passages that depict how sleep problems are solved in space. Distribute the graphic organizer, *Goodnight Moon, Goodnight Earth*, and tell students that they will be responsible for recording the problem/solution relationships from the article. Encourage pairs of students to discuss their findings as they complete the chart.

ASSESS: Review the information that the students listed on their charts. Evaluate the thoroughness and accuracy of their statements. If errors are noted, direct students to return to the text and to make corrections.

EXTEND

Mathematics The article states that the astronauts aboard the ISS see sixteen sunrises and sunsets each day. Have the students use this fact to create various word problems. Example: How many sunrises/sunsets would they see in a week? In a month? In a year? Further challenge students to research and create word problems focusing on time zones, as referenced in the “Never-Ending Jet Lag” section of the article.

Goodnight Moon, Goodnight Earth

Use information from the article, "Sleeping Isn't Simple," to detail solutions to the problems listed below.

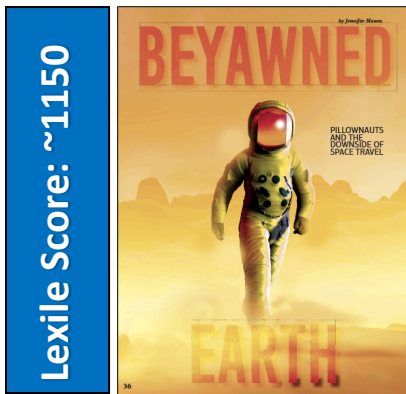
Problems	Solutions
Traveling to outer space causes a disruption to the astronauts' circadian rhythm.	<ol style="list-style-type: none"> 1. 2. 3.
A lack of sleep can be dangerous for astronauts in space.	<ol style="list-style-type: none"> 1. 2. 3.

What things do **YOU** do to regulate your sleep/wake cycle?

Beyawned Earth

pp. 36–41, Expository Nonfiction

Students will learn how passionate volunteers are helping NASA discover new ways to keep humans healthy in space for longer periods of time. Journey inside the Human Test Subject Facility and observe the trials of the pillownaut, a very special type of volunteer who helps researchers learn about the effects of low gravity on the body.



RESOURCES

- To Infinity and Beyawned!

OBJECTIVES

- Students will learn how analog missions are making space travel safer and more comfortable for astronauts.
- Students will analyze a cause-and-effect relationship.
- Students will create journal entries chronicling a week in the life of an analog mission participant.

KEY VOCABULARY

- **internally** (p. 39) inside; referring to the inner surface or structure
- **mandatory** (p. 39) required by the rules
- **microgravity** (p. 40) a very weak gravity, as in an orbiting spacecraft
- **simulate** (p. 37) imitate, replicate

ENGAGE

Conversation Question: How are researchers working to make space travel safer and more comfortable for astronauts?

Discuss the pros and cons of being a Human Test Subject for NASA. Inquire about students' willingness to be a participant and tally the yes/no responses. Repeat the survey after reading the article and determine why answers may have changed.

INTRODUCE VOCABULARY

After posting and discussing the key vocabulary terms and definitions, guide students to recognize that they are all different parts of speech. (*internally*: adv, *mandatory*: adj, *microgravity*: n, *simulate*: v) Have the class fold a piece of paper into quarters and label them with the parts of speech and place words in the correct section. After reading the article, they should add other words from the text into the appropriate boxes.

READ & DISCUSS

Read aloud the following questions prior to reading the text. Advise the students to note where in the article these answers are found. Discuss responses to the questions as a post-reading activity.

- What is a pillownaut? How has their work benefited astronauts?
- Why do our bodies experience rapid changes when gravity is taken away?
- Describe some of NASA's other analog missions such as HERA, NEEMO, and RATS.
- The article states, "... the more we improve space exploration, the more our lives improve on Earth." Explain.

CONCEPT/SKILL FOCUS: Cause and Effect

INSTRUCT: Lead the students in a discussion that guides them to recognize the cause-and-effect relationships that are studied in this article. Introduce the graphic organizer and tell students that they will be rereading the article and highlighting pertinent information to record on the chart. Encourage peer assistance and dialogue.

ASSESS: Converse with students as they are working on the graphic organizer. Collect and review the worksheets to evaluate individual understanding of the cause-and-effect relationship.

EXTEND

Language Arts Have students use information from the article to chronicle a week in the life of a pillownaut (or HERA, NEEMO, or RATS participant). Instruct the class to create mini-journals, complete with a cover. They are to fill their journal with entry dates, times, and details that accurately represent the analog mission. Students should insert drawings to enhance the entries.

To Infinity and Beyawned!

Use information from the article, "Beyawned Earth," to record the effects of existing in microgravity.

Space travelers must exist in a microgravity environment.



Effect 1

Effect 2

Effect 3

How have analog missions helped the astronauts to counteract these effects?
