National Aeronautics and Space Administration

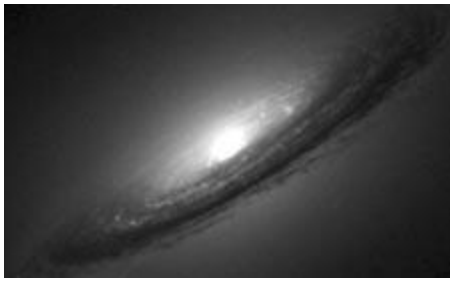
NASA CONNECT™

The Right Ratio of Rest:
Proportional Reasoning©

An Educator Guide with Activities in Mathematics, Science, and Technology

Educational Product	
Educators	Grades 6-8

EG-2005-09-08-LARC



NASA CONNECT™: *The Right Ratio of Rest: Proportional Reasoning* is available in electronic format. Find a PDF version of the educator guide for at the NASA CONNECT™ web site: **http://connect.larc.nasa.gov**

NASA CONNECT™ is produced by NASA's Center for Distance Learning, a component of the Office of Communication and Education at the NASA Langley Research Center, Hampton, VA, and is a collaborative endeavor of NASA with the organizations below. NASA's Center for Distance Learning is operated under cooperative agreement. Use of trade names does not imply endorsement by NASA.

PARTNERS

VirginiaTech
www.vt.edu

National Institute of Aerospace
www.nianet.org

AECC
Aerospace Education Coordinating Committee
www.nasa.org

National Space Biomedical Research Institute NSBRI
www.nsbri.org

NCTM
www.nctm.org

AIAA Foundation
www.aiaa.org

Knowitall.org
http://knowitall.org

Apple Learning Interchange
http://ali.apple.com

ibiblio
http://www.ibiblio.org

NASA CONNECT™

The Right Ratio of Rest: Proportional Reasoning

An Educator Guide with Activities in Mathematics, Science, and Technology

Program Overview

Hands-On Activity

Acknowledgements

Special thanks to:

- Summer 2005 Educators in Residence, Center for Distance Learning
- National Council of Teachers of Mathematics (NCTM)
- Dr. David Pugalee, University of North Carolina, Charlotte
- Dr. Charles Czeisler, Director of the Division of Sleep Medicine, Harvard Medical School
- Ph.D., Walter Sipes, Space Medicine and Health Care Systems, NASA Johnson Space Center
- Sean Kelly, International Space Station Program Office, NASA Johnson Space Center
- Human Health and Performance Education Outreach, NASA Johnson Space Center
- Chris Giersch, Communications and Education Lead, Exploration Systems and Space Operations Technology Directorate
- Program Managers
  Ellen Holmes
  Becky Jaramillo

AIAA FOUNDATION

Registered users of NASA CONNECT™ may request an American Institute of Aeronautics and Astronautics (AIAA) classroom mentor. For more information or to request a mentor, e-mail **nasaconnect@aiaa.org**.

NASA

Program Overview
SUMMARY AND OBJECTIVES

In NASA CONNECT™, *The Right Ratio of Rest: Proportional Reasoning,* students learn about the human circadian clock and how it affects peoples' daily lives. Students see how NASA scientists are studying the circadian timing system to improve astronaut's physical and mental tasks while working in space. Conducting research to help astronauts sleep better in space also helps people on Earth with similar problems. The hands-on activity in this guide allows students to demonstrate how fractions, decimals, and percents are related and further develop their proportional reasoning skills.

Student Involvement

Inquiry-Based Questions

Host Jennifer Pulley, NASA engineers, and scientists post inquiry-based questions throughout the program, allowing students to investigate, discover, and think critically about the concepts presented. When viewing a videotape or DVD version of NASA CONNECT™, educators should pause the program at the designated segments so students can answer and discuss the inquiry-based questions. During the program, Jennifer Pulley, NASA engineers, and scientists indicate the appropriate time to pause the tape or DVD. For more information about inquiry-based learning, visit the NASA CONNECT™ web site, http://connect.larc.nasa.gov.

Teacher note: *It is recommended that you preview the program before introducing it to your students so you will know where the pauses occur.*

Hands-On Activity

The hands-on activity is teacher created and aligned with the National Council of Teachers of Mathematics (NCTM) Standards, the National Science Education (NSES) Standards, and the National Health Education (NHES) Standards. Students record data concerning their sleep habits and create a fraction wheel to represent the data. Using real-life math skills to analyze the data, students convert fractions, decimals, and percents. Students conduct research to find the different light-dark cycles for other planets and moons and use proportional reasoning to calculate the length of personal sleep periods in these environments.

Resources

Teacher and student handouts enhance and extend the NASA CONNECT™ program. Books, periodicals, pamphlets, and web sites provide teachers and students with background information and extensions.

Background

Most of us sleep about the same number of hours each night and wake up about the same time each morning, even without an alarm. Many people, however, vary their sleep patterns by using external alarm clocks to meet school, work, or travel schedules. An internal clock, which consists of about 10,000 nerve cells located deep inside the brain, governs daily wake-up times in human beings. This internal clock is called a circadian clock. It appears to control or initiate various biological processes, including sleep, wakefulness, digestion, and hormonal activity for a set number of hours unique to each individual.

On Earth, the circadian clock is set to the 24-hour light-dark cycle. This light-dark cycle is a function of the rotational period of the Earth. Each planet or moon has a distinctive light-dark cycle related to its rotational period. The circadian system is set so that a person is best prepared to be alert and awake during the biological day and to sleep during the biological night. When people are required to perform activities at the wrong biological time, they may not function at their best. Each day the circadian clock is reset by cues received from the light of the Sun.

A person's environment and situation can have a great effect on the quality and quantity of sleep he or she gets. Abrupt changes in sleeping times, such as those caused by air travel or changes in work schedules, can cause difficulty falling asleep or staying awake because external cues conflict with messages sent by the body's internal clock. The brain may be signaling, "Sleep!" while outside conditions may be saying, "Be active, it's morning!" Adjusting to a new time zone may take several days. Other factors can also affect the sleep cycle. Excessive physical exercise right before bedtime, medicines, mealtimes, and stimulants (such as caffeine in coffee, tea, and soft drinks) can all contribute to disrupted sleep schedules.

Astronauts experience changes in their environment and sleeping habits while they're in space. Researchers are looking for ways to address these problems. In space, astronauts commonly experience difficulty sleeping because of several factors—excitement, stress, noise, different environmental light and dark cues, and apparent weightlessness. Resulting alterations in sleeping patterns can lead to deterioration of alertness and cognitive performance during the active hours of the work day. NASA researchers intend to evaluate the altered sleep patterns of astronauts during long-duration space flight for exploration of the Moon, Mars and beyond. This study should lead to a better understanding of sleep mechanisms during space exploration and possibly to the development of new treatments for sleep disturbances associated both with space flight and for people with sleep disorders on Earth. One aspect of space flight that NASA researchers are studying is how the different wavelengths of light that astronauts receive affect their bodies' ability to reset the circadian clock. The information learned from this work can also apply to other groups of individuals, such as shift workers, the elderly, and people prone to insomnia. By expanding our knowledge about human physiology and biological processes such as sleep, space experimentation serves as an educational tool that benefits Earth-based life science research as well.

Instructional Objectives

Students will

- collect and record data about sleep habits.
- calculate the length of sleep periods.
- calculate the mean average of a data set.
- convert fractions to decimals and percents.
- create graphic representations of data, including line graphs, bar graphs, histograms, and fraction wheels.
- use proportional reasoning to find an unknown quantity.
- identify the importance of sleep.
- draw conclusions from a given set of data.
- make predictions about the outcome of an event.
- check solutions and revise anticipated outcomes.
- conduct research.
- communicate solutions effectively, both orally and written.

National Standards

NCTM Mathematics Standards

Number and Operations

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
- Compute fluently and make reasonable estimates.

Algebra

- Understand patterns, relations, and functions.
- Use mathematical models to represent and understand quantitative relationships.

Data Analysis and Probability

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data.
- Develop and analyze inferences and predictions that are based on data.

Mathematics and Problem Solving

- Build new mathematical knowledge through problem solving.
- Apply and adapt a variety of appropriate strategies to solve problems.
- Monitor and reflect on the process of mathematical problem solving.

Communication

- Organize and consolidate mathematical thinking through communication.
- Communicate their mathematical thinking coherently and clearly to peers.
- Analyze and evaluate the mathematical thinking and strategies of others.
- Use the language of mathematics to express mathematical ideas precisely.

Connections

- Recognize and apply mathematics in contexts outside of mathematics.

Representation

- Create and use representations to organize, record, and communicate mathematical ideas.

NSES Science Standards

Science as Inquiry

- abilities to do scientific inquiry
- understandings about scientific inquiry

Life Science

- regulation and behavior

Science in Personal and Social Perspectives

- personal health

History and Nature of Science

- science as a human endeavor
- nature of science

National Health Education Standards

Health Standard 1
Students will comprehend concepts related to health promotion and disease prevention.

- Explain the relationship between positive health behaviors and the prevention of injury, illness, disease, and premature death.
- Analyze how environment and personal health are interrelated.
- Describe how lifestyle, pathogens, family history and other factors are related to the cause or prevention of disease and other problems.

Health Standard 3
Students will demonstrate the ability to practice health-enhancing behaviors and reduce health risks.

- Explain the importance of assuming responsibility for personal health behaviors.
- Analyze a personal health assessment to determine health strengths and risks.

Health Standard 6
Students will demonstrate the ability to use goal-setting and decision-making skills to enhance health.

- Predict how decisions regarding health behaviors have consequences for themselves and others.

NASA Relevance
Astronauts experience dramatic changes in environment when they go into space. The Space Shuttle orbits Earth about every 90 minutes, exposing astronauts on the flight deck to 45 minutes of light followed by 45 minutes of dark. The lights in the International Space Station or the interior of the Shuttle, may also cause circadian rhythm misalignment, making it difficult to sleep. Because of these changes and the critical tasks that astronauts perform while in space, NASA closely monitors the astronauts to ensure their health and safety. Fatigue is a serious problem that affects performance, concentration, reaction time, and overall mood. The astronauts' abilities to be alert and perform at their best are observed and recorded. NASA researchers are looking at the circadian timing system to help them understand how to better schedule the astronauts' work and sleep to avoid errors, how to help them adjust to the space environment, and how to help them maintain a healthy schedule in space. NASA also has the chance to use space as a unique laboratory, so different from the Earth, to further understand the human circadian clock.

Preparing for the Activity

Student Materials
log or journal
2 sheets of white construction paper
1 light colored sheet of construction paper
compass
protractor
scissors
markers or crayons
student handouts
calculators (optional)

Teacher Materials
copy of NASA CONNECT™: The Right Ratio of Rest: Proportional Reasoning video or DVD

enlarged copies (letter size copy paper) of Pictures 1 and 2 (in Engage section)

2-meter length of string

tape

clothespins (one for each student)

index cards or small pieces of paper (one for each student)

Vocabulary
circadian clock – a biological timing mechanism with a set number of hours distinct to each individual that appears to control or initiate various biological processes including sleep, wakefulness, digestion, and hormonal activity

light-dark cycle – the complete rotational period of a planet or other satellite; length of time considered one "day"
(The Earth's rotational period is 24 hours and the light/dark cycle for the Earth is approximately12 hours of light and approximately 12 hours of dark at the equator.)

ratio – a special kind of fraction that compares two quantities

proportion – an equation that shows that two ratios are equal. Four quantities, a, b, c, d are said to be in proportion if

$$\frac{a}{b} = \frac{c}{d}$$

percent – a ratio comparing a number to 100; percent means "per hundred"

fraction – a number describing part of a whole or part of a group when the whole is cut into equal pieces

numerator – the top number (or number above the bar) in a fraction telling how many equal parts of the whole are named or considered

denominator – the bottom number (or number below the bar) in a fraction telling how many equal parts into which the whole is divided

Time for Activitiy
Engage
30-45 minutes to conduct initial class discussion and journal activity

30 minutes to watch the video

Explore
5–7 day period for students to collect data on sleep times

Explain
90 minutes for data analysis and discussion of results

Evaluate/Extend
45 minutes to complete proportional reasoning activity

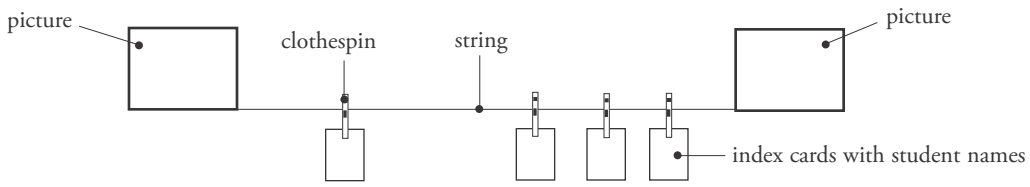
The Activity

Brief Lesson Description

In this lesson, students will collect and record data about their sleep habits in a journal for 5–7 days. We suggest this number of days to ensure that the data set is large enough to provide sufficient information with which to work. By analyzing the data, students calculate the length of their personal sleep periods and create graphs to help them discover patterns in their sleep habits. Fraction wheels help students visualize their data. After applying math skills to convert fractions, decimals, and percents, students must communicate in writing the most effective way to represent their data to various target audiences and find real-life examples of this method of representation. Students use proportional reasoning to consider sleep amounts in relation to the different lengths of light-dark cycles for other planets and moons.

Engage

Show the students pictures 1 and 2 of RJ. Fasten the pictures onto opposite ends of a large flat surface, such as a wall or board. The pictures should be approximately 2 meters from each other. Connect a piece of string from one picture to the other. You will use this string as your number line. Ask students to write their names on index cards or small pieces of paper. Using clip clothespins or tape, students should place their cards on the line to indicate how alert or tired they feel at that particular time.



Use questions to engage the students in discussion and assess student understanding of sleep.

1. Why are you sleepy or alert?
2. What time do you usually go to sleep? Does your bedtime vary depending on the day of the week?
3. Why is sleep important?
4. What types of things happen when your body is trying to let you know that it's time for you to go to sleep?
5. How does the amount of light affect your ability to go to sleep?
6. What is our typical light-dark cycle?
7. Are there other places in the world where light-dark cycles are different? How do you think these cycles would affect you?
8. What other factors might affect your sleeping habits? Discuss specific real-life situations when your sleep was affected.

Journal Write (Students): Working in groups, discuss how astronauts must deal with disruptions in their light-dark cycles. Astronauts orbiting the Earth experience light-dark cycles that are only 90 minutes long because they are moving so quickly around the Earth. Just as our light dark cycle on Earth is about half-light and half-dark, 45 minutes of the cycle in orbit is light and 45 minutes is dark. In addition, astronauts in the International Space Station (ISS) or in the Shuttle must deal with lights that are on at all times. How do you think these disruptions would affect your sleep patterns? What other effect would a lack of sleep have on the astronauts? What countermeasures might NASA use to help the astronauts overcome these problems? In your journal, write your responses.

Teaching note: *See resources section for mathematics journal suggestions.*

Video Component

View NASA CONNECT™: *The Right Ratio of Rest: Proportional Reasoning* and answer all inquiry-based questions.

Teaching note: *After viewing the NASA CONNECT™ program, you may wish to revisit the questions asked earlier about sleep, checking for a change in student understanding. Using different color ink, ask students to write any new information they have learned about the situation the astronauts face.*

Picture 1: RJ Awake

Picture 2: RJ Sleeping

Explore

Have students create "Sleep Logs" to record information about their sleep habits. Students should include the date, the time they went to bed, how they felt at bedtime, the time they woke up, how they felt upon waking, and how they felt during the day. You may want to include a column for information about other factors such as physical activity or amounts of caffeine consumed. You may duplicate the sample sleep log included in the student activity sheets, or you may have students create one for the class, reaching an agreement about what should be included in everyone's log. If possible plan the activity so that students can compare weeknight and weekend sleep patterns.

Teaching note: *This hands-on activity was adapted from activities in* ***From Outer Space to Inner Space/Sleep and Daily Rhythms: Activities Guide for Teachers*** *created by Baylor College of Medicine for the National Space Biomedical Research Institute under NASA Cooperative Agreement NCC 9-58. The activities are used with permission of Baylor. All rights reserved.*

For additional activities visit **http://www.nsbri.org/Education/Elem_Act.html**

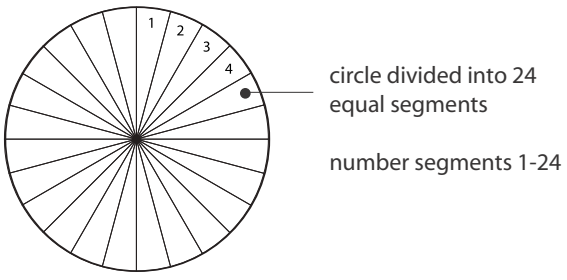
Explain

1. After one week, have students collect and analyze their data about the length of their personal sleep periods. Calculate the length of time each night the students spent sleeping. Create a graph to represent the sleep period for each night. Let students determine what kind of graph to use but ask them to explain why they chose the graph.

   Technology Insertion Point: *Have students use programs such as Excel, graphing calculators, or PDAs to create their graphs. Compare the graphs constructed by the students to those created by the computer. Were they the same? If not, why?*

   Teaching Note: *Ask the students to look for patterns in their data. Was there an increase or decrease in the number of hours slept each night? Is the relationship linear? Do you see an inverse relationship? You may ask students to redo their graphs, mixing up the days of the week. Exchange graphs with other students in the class and ask them to identify which days are Friday, Saturday, and Sunday. Why did they make certain choices?*

2. Have the students calculate their average length of sleep for each night based on the data they collected this week. Round answers to the nearest whole number.
3. To develop a fraction wheel, ask each student to get three pieces of construction paper, two white sheets and one light color sheet; a compass; a protractor, and a pair of scissors. Show the students how to use the compass to create a 16-cm circle on each piece of paper. Mark a dot at the center point of each circle. Instruct the students to cut out the circles. As a class, discuss how to divide the circle on the colored sheet of construction paper into 24 equal segments. Discuss with the students why 24 segments were chosen. *(to represent the 24-hour light-dark cycle on Earth)* Trace the segment lines with a pencil so they are clearly visible. Number each segment from 1 – 24.



   a. Divide one of the white circles into two equal segments. Use a colored marker or crayon to trace the segment lines.

   b. Direct students to use a different color to divide the circle into four equal parts.

   c. Divide the circle again into eighths and trace the segment lines by using a third color. Because some of the lines will overlap, instruct students to place the lines next to each other so each color is visible.

   Teaching Note: *For some students, you may wish to use a separate white circle for halves, fourths, eighths, and so on, rather than using different colored lines.*

   d. Tell students to divide the second white circle into thirds and sixths, again by using a different color marker for each set of line segments.

4. After the circles have been divided into segments, instruct students to carefully cut a line along the radius of each circle (from the center point of the circle to the outside edge), by using one of the marked segment lines as a guide as seen in Figure 1. Slip one cut circle into the other circle so that the circles are joined and one slides around the other as seen in Figure 2.

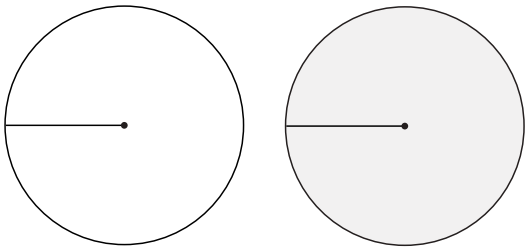


figure 1

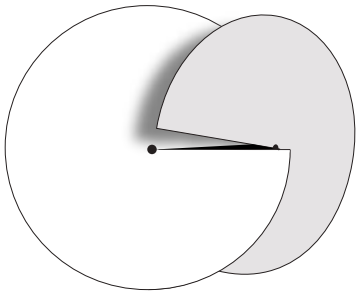


figure 2

5. Tell the students to set their fraction wheels to show the average number of hours of light in our light-dark cycle on Earth. (Wheels should be set showing 12 hours.) Write that number as a fraction. (12/24) Ask the students to use their fraction wheels to find equivalent fractions for 12/24. Remind them to change the top (white) wheel to find as many of the equivalent fractions as they can. List the numbers as the students name them. Identify which fractions are in simplest form.
6. Have students reset their fraction wheels to the average number of hours they slept last week. Find the equivalent fractions for these numbers.
7. Tell students that fractions are only one way of representing the parts of a whole. That relationship can also be written as a decimal number or as a percent. Think of the entire fraction wheel (24 hours) as one entire day. The number 24/24 could also be written as 1.0 (24 divided by 24 is equal to 1). Because 24 hours represents the entire circle, 24 hours are equal to 100% of the light-dark cycle.
8. Ask students to write their average sleep period for the week as a fraction, as a decimal, and as a percent. Check for understanding.

Teaching note: *For students who may need more practice in this skill, complete an equivalency chart by writing each hour in the light-dark cycle (1-24) as fraction, decimal, and percent. See Light-Dark Cycle Equivalancy Chart.*

Technology Insertion Point: *You may choose to have students complete these charts in a spreadsheet program. For interactive practice converting fractions to decimals and percents, send students to the Internet to sites such as:* **http://www.aaamath.com**

http://www.shodor.org/interactivate/activities/conversions/index.html

http://my.nctm.org/eresources/repository/2071/applet/FractionPie/

Light-Dark Cycle Equivalency Chart

Hour	Fraction	Equivalent Fractions	Decimal	Percent
24	**24/24 = 1**	12/12; 8/8; 6/6; 4/4; 3/3; 2/2	**1.00**	**100**
23	23/24		0.958	95.8
22	**22/24**	11/12	0.917	91.7
21	21/24		0.875	87.5
20	20/24	10/12; 5/6	0.833	83.3
19	19/24		0.792	**79.2**
18	18/24	6/8; 3/4	0.750	75.0
17	17/24		0.708	70.8
16	16/24	8/12; 2/3	**0.667**	66.7
15	15/24	5/8	0.625	62.5
14	14/24	7/12	0.583	58.3
13	13/24		0.542	54.2
12	12/24	6/12; 4/8; 3/6; 1/2	0.500	50.0
11	11/24		0.458	45.8
10	10/24	5/12	0.417	41.7
9	9/24	3/8	0.375	37.5
8	8/24	4/12; 2/6; 1/3	0.333	**33.3**
7	7/24		0.292	29.2
6	6/24	3/12; 2/8; 1/4	0.250	25.0
5	5/24		0.208	20.8
4	4/24	2/12; 1/6	0.167	16.7
3	3/24	1/8	0.125	12.5
2	2/24	1/12	0.0833	8.33
1	1/24		0.0417	4.17

Journal Write (Students): Tell students they have just looked at multiple ways to represent the same numbers (as fractions, decimals, or percents). Ask them to determine which method would be the most effective way to communicate the average number of hours they slept each night. In their journals, students should justify their preferred method. Ask them to consider different target audiences. Would they change the method of representation if speaking to young children? their parents? other scientists? Why?

Based on the method of representation students chose, ask them to find real-world examples of this same type of number. Students may use the Internet, newspapers, or magazines. Include the examples in their journals. Have students convert the numbers to one or more of the other forms. Decide whether or not the number still makes sense in that context.

9. In groups, guide the students as they investigate proportional reasoning.

a. Download copies of the *NASA Lithograph Set for Planets.* **http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/By_Type_Lithographs_landingpage.html**
Ask students to use information on the back of the pictures to compare and contrast the light-dark cycles of the Earth and Mars. Remind students to consider what they learned about the circadian clock, and that the light-dark cycle is directly related to the rotational period of the planet. As a group, have students predict how their data about average sleep periods would change? Use proportional reasoning to check predictions. Help students set up the proportion correctly.

$$\frac{\text{Length of sleep period on Earth}}{\text{Hours in the light-dark cycle on Earth}} = \frac{\text{Length of sleep period on Mars}}{\text{Hours in the light-dark cycle on Mars}}$$

If a student's average sleep period were 8 hours, the ratio would look like this:

$$\frac{8}{24} = \frac{X}{25}$$

Solve by cross multiplication.

$$24x = (8 \times 25)$$

$$24x = 200$$

$$x = 8.3 \text{ hours}$$

(The amount of time that a person slept during each light-dark cycle would increase slightly compared to the amount of sleep he/she gets during each light-dark cycle on Earth.)

b. Have students conduct research to find the light-dark cycles on other planets or moons. Using the data about their own personal sleep period on Earth, have them predict the length of their sleep period on the planet or moon of their choosing. Tell them to check their predictions using proportional reasoning. After calculating the sleep period on the new planet or moon, have students evaluate the accuracy of their predictions. If their predictions were not correct, determine why they weren't. Have students exchange information with a partner to check work.

Teaching note: *Remind students that if rotational periods are given in units of days, they must first convert them to hours, multiplying the number of days by 24. To save research time, you may ask students to post the rotational period of the planets and moons on a large chart so other students have access to the information for the journal prompt.*

Journal Write (Students): Based on the length of students individual sleep periods, ask them to determine on which planet or moon they would most like to live. For instance, a student who likes to sleep would want to find a planet that would give him/her an extended sleep period. Students should check choices using proportional reasoning.

EXTEND

1. Have students complete the "How I Spend My Time" chart for Earth. Students calculate the time they spend doing selected activities and convert those times to fractions, decimals, and percents. Students then apply proportional reasoning to complete a second chart for the planet or moon of their choice.
2. Compile the sleep habits of other students in the class. Compare their sleep habits to how they felt and determine appropriate sleep needs. In groups, discuss any conclusions they can draw about sleep needs for different age groups and genders. Consider any other categories that pertain to the group, such as physical activity level or amount of stimulants consumed. Students can then give presentations to the class by using graphs and charts to explain any conclusions they draw from their data.
3. Have students collect data on pets or other animals. Compare the sleep patterns of these animals to their own.

EVALUATE

- To evaluate individual progress use the post-activity assessment, "How I Spend My Day." After the students complete the charts, have them exchange and check each others' papers.
- Have students create posters to encourage healthy sleep habits.

Student Handout

Journal Write

Journal Write #1

Working in groups, discuss how astronauts must deal with disruptions in their light-dark cycles. Astronauts orbiting the Earth experience light-dark cycles that are only 90 minutes long because they are moving so quickly around the Earth. Just as our light-dark cycle on Earth is about half-light and half-dark, 45 minutes of the cycle in orbit is light and 45 minutes is dark. In addition, astronauts on the International Space Station (ISS) or in the Shuttle must deal with lights that are on at all times. How do you think these disruptions would affect your sleep patterns? What other effect would a lack of sleep have on the astronauts? What countermeasures might NASA use to help the astronauts overcome these problems? In your journal, write your responses

Journal Write #2

You have just looked at several ways to represent the same numbers: as fractions, as decimals, and as percents. Decide which method is the most effective way to communicate the average number of hours you sleep each night. In your journal, justify your answer by giving clear reasons. Would you change the way you wrote the number if you were talking to younger children? How about if you were talking to your parents? To another scientist?

After you have chosen fractions, decimals, or percents as the best way to tell others about your sleep period, look for other real-world examples of how the same kinds of numbers are used. Use the Internet, newspapers, or magazines to find examples. Convert the numbers you find to one or more of the other forms. If you find a fraction, for example, change it to a decimal and a percent. Decide whether or not the number still makes sense in that context.

Journal Write #3

Based on the length of your average sleep period, decide on which planet or moon you would most like to live. For instance, if you have a long sleep period, you would probably want to choose a planet that will allow you to sleep the longest. Of course, remember that your sleep period is a percent of your entire day, so planets with long sleep periods also have long days! Give reasons for your choices.

Student Handout

Light-Dark Equivalency Table

Light-Dark Cycle Equivalency Table

Hour	Fraction	Equivalent Fractions	Decimal	Percent
24	**24/24 = 1**	12/12; 8/8; 6/6; 4/4; 3/3; 2/2	**1.00**	**100**
23				
22	**22/24**			
21				
20				
19				**79.2**
18				
17				
16			**0.667**	
15				
14				
13		13/24		
12	12/24		0.500	
11				
10				
9				
8				**33.3**
7				
6	6/24			
5				
4			0.167	
3		1/8		
2				
1	1/24		0.0417	4.17

Student Handout

Sleep Log

MY SLEEP LOG

Date	Time I Went to Bed	How I Felt When I Went to Bed	Time I Woke Up	How I Felt upon Waking	How I Felt throughout the Day	Other Interesting Factors

Student Handout

How I Spend My Time – Planet Earth

Choose seven activities you do in one light-dark cycle and list them in the first column in the chart. In the second column, record how many hours it usually takes to do each of the seven activities you chose. Complete the columns labeled "Fraction", "Decimal," and "Percent," by comparing the hours you do the activity to the number of hours in the light-dark cycle.

Number of hours in the light-dark cycle: _____

Activity Table

Activity	Hours Doing Activity	Fraction	Decimal	Percent (%)
1.				
2.				
3.				
4.				
5.				
6.				
7.				

How I Spend My Time – Planet _____

Fill in the chart by making the time you spend doing your activities on your chosen planet proportional to the time you spend doing them on Earth. Remember to set up the fraction by comparing the number of hours you spent doing the activity to the number of hours in the light-dark cycle.
Number of hours in the light-dark cycle: _____

Time Spent on Activities

Activity	Hours Doing Activity	Fraction	Decimal	Percent (%)
1.				
2.				
3.				
4.				
5.				
6.				
7.				

Resources

Books

Gray, Shirley: *Sleeping to Stay Healthy.* Child's World, 2003, ISBN: 1592960804.

Riha, Susanne: *Animals at Rest: Sleeping Patterns and Habitats.* Blackbirch Press, 1999, ISBN: 1567114253.

Romanek, Trudee: Zzz. . . : *The Most Interesting Book You'll Ever Read about Sleep*. Kids Can Press, 2002, ISBN: 1550749463.

Silverstein, Alvin: *Sleep.* Scholastic Library Publishing, 2000, ISBN: 0531116360.

Simpson, Carolyn: *Coping with Sleep Disorders.* Rosen Publishing Group, 1996, ISBN: 0823920682.

Thorpy, Michael J.: *Sleeping Well: The Sourcebook for Sleep and Sleep Disorders.* Checkmark Books, 2001, ISBN: 0816040907.

Web Sites

Science @ NASA: Wide Awake in Outer Space
http://science.nasa.gov/headlines/y2001/ast04sep_1.htm

NASA Human Space Flight: Space Sleep
http://spaceflight.nasa.gov/living/spacesleep/index.html

NASA Planet Lithographs
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/By_Type_Lithographs_ landingpage.html

NASA NeuroLab
http://neurolab.jsc.nasa.gov/

NASA Quest Neuron: NeuroLab On Line
http://quest.arc.nasa.gov/neuron

National Space Biomedical Research Institute (NSBRI)
http://www.nsbri.org/Education/TG/TG_Sleep.pdf

Medical College of Wisconsin HealthLink: Sleep and Circadian Rhythms
http://healthlink.mcw.edu/article/922567322.html

National Institute of Mental Health: How Biological Clocks Work
http://www.nimh.nih.gov/publicat/bioclock.cfm

Howard Hughes Medical Institute: Shedding Light on Circadian Rhythms
http://www.hhmi.org/news/takahashi.html

Videos

NASA Center for Distance Learning: *NASA CONNECT™: Better Health from Space to Earth,* 2003
Grades 6-8

NASA Center for Distance Learning: *NASA CONNECT™: The Venus Transit (Ratios and Proportions)*, 2004
Grades 6-8

Educational Video Network: *Sleep Deprivation: Get the Sleep You Need*, 2004
Grades 5-9

Planning, Composing, and Revising Written Work in Mathematics*

Planning

- Do I understand what I am being asked?

Composing

- What mathematical concepts and ideas support the statements that I am making?
- How can I describe my thinking concisely and clearly?

Revising

- Have I answered the questions fully?
- Are my conjectures and ideas supported?
- Is my work clear and understandable?

*Pugalee, D.K.: *Writing to Develop Mathematical Understanding.* Christopher Gordon Publishers, 2005.