Unit 2:
Electrical Rhythms in the Brain

GRADE 5

”I was amazed how much the children shared during the review. Great job!"
Grade 5 Teacher

"Great way to drill skills without being tedious. There was drama and music; we played games. Again, even low performing students got something from the exercises and stayed with the lessons."
Grade 5 Teacher

B

Sleep Unit: Background Information

Unit Overview

In the previous unit, students learned that there are different forms of energy. This provides an important foundation for understanding the forms of energy that allow the human body to function. In this unit, students explore concepts of electrical activity in the human brain and body during the sleep-wake cycle.

Engage

Lesson 1: Dream Journaling

In Lesson 1, students are encouraged to write an essay about a dream they experienced. Students often enjoy talking about their dreams and have many different questions. The role of the educator is to encourage students to think about the question, "What happens in our bodies when we dream?"

Explore/Explain

Lesson 2: Brain Electricity

"Frequency Counts"

In Lesson 2, students begin to think about ways to study the central component of the unit, rhythms of electrical energy in the brain. Students consider the tools that scientists use to study the brain, particularly the EEG machine. In addition, students think about the techniques that scientists use to record what they observe. Specifically, the lesson activity is designed to help students become aware of the how rhythms and wave patterns can be described in quantitative terms by measuring frequency and amplitude. Drum rhythms are used to illustrate these basic quantitative properties of rhythms. Drum rhythms of varying frequency are then related to brain wave frequency during active attention, and compared to those associated with associated with "zoned out watching T.V."

Expand

Lesson 3: Sleep Graphs

"Quantify Your Dreams"

In Lessons 3 and 4, the educator uses props and the imagination of students to create a "sleep lab" in the classroom. Students ask and answer the questions, "What are the electrical rhythms in the brain when someone sleeps?" A student becomes a sleep lab subject, a drum represents the EEG machine, and yarn and stickers signify electrodes. In lieu of an EEG printout, students create a record of the "brain waves" they observe and analyze them. Students discover that the electrical rhythms in the brain vary in a systematic way during the course of a night's sleep, with alternating periods of high and low frequency brain waves. Students then create graphs of the brain wave data and interpret the results.

Lesson 4: The Sleep Cycle

"Musical Sleep"

Students enter the imaginary sleep lab again to answer the question, "What happens in the brain and body when someone sleeps?" An 8-hour period of sleep is simulated over about 30 minutes during which "readings" are taken and recorded on charts. Students learn that

there is a sleep cycle and that people experience this cycle 4 to 5 times over the course of one night of sleep.

Evaluate

Lessons 5: Sleep Game

To assess their understanding of sleep, students break into small groups and play a board game that is designed to help them review the basic concepts introduced in the previous lessons. The game provides a self-assessment for the students.me.

Lesson 6: Test

A test is provided to assess mastery of concepts. The test consists of fill- in-the-blank and multiple choice questions, as well as components that require the students to interpret and quantify brain wave patterns in different parts of the sleep wake cycle.

Sleep Basics

In Unit 1, students learned about many forms of energy. This provided a background for an understanding of electricity, which is key for understanding the basic workings of the nervous system.

Electricity: The Power of the Brain

The idea that the brain is electrically active is new to most students, but is critical to understanding concepts in this unit. The brain is electrically active all the time, even when we sleep.

EEG Machine

To understand the brain, scientists have observed the patterns of electrical activity in the brain. Scientists use a tool called the EEG machine, which is short for an electroencephalogram. When a person undergoes an EEG test, electrodes are placed on the person's head in specific locations. These positions ensure that electrodes are placed to correspond with the five lobes of the cerebral cortex. The electrodes are connected to a recording machine by wires.

The electrodes detect electrical signals by the brain. The EEG machine converts these electrical signals into a visual representation, which look like wavy lines on a piece of paper. These wavy lines are known as brain waves. The EEG procedure is not painful. In fact, the patient doesn't feel anything.

Brain Waves: Amplitude and Frequency

The appearance of brain waves vary during the day and during sleep. To characterize these variations, scientists examine both amplitude (the height of the brain waves) and frequency. The frequency of brain waves is typically measured in Hertz (Hz), which the number of waves in a second.

Scientists have observed high frequency electrical activity in the brain when a person is awake and alert, as well as during some periods of sleep. There is lower frequency electrical activity in the brain when a person is awake but not concentrating, and even lower frequencies in some periods of sleep.

The Sleep Cycle

There are many good descriptions of the sleep cycle (see resources section). Normally during sleep, brain waves exhibit a predictable pattern. There are basically two forms of sleep: slow wave sleep (SWS) and fast rapid-eye movement (REM) sleep, where high frequency brain waves are observed. A single sleep cycle lasts about

90 minutes and includes both forms of sleep.

When people first go to sleep, they enter slow wave sleep. As the name implies, if you were to look at an EEG output then you would see a low frequency of brain waves. In addition, slow wave sleep is characterized by a pattern of moderate activity in the skeletal muscles (e.g., turning over in bed), no eye movements, and a slow heartbeat. People remain in SWS for approximately 65 minutes before shifting to REM sleep. In REM sleep, brain waves exhibit a high frequency and eye movements can be observed under the eyelids. The heartbeat is faster than in slow wave sleep; however, there is little or no movement and skeletal muscles are virtually shut off. REM sleep lasts for about 20 minutes. In the final 5 minutes of the sleep cycle, people shift back to slow wave sleep.

If sleepers are awakened during REM sleep and asked "were you dreaming" almost all people report dreaming. However, during slow wave sleep, mental activity does occur, although the mentation is less visual and vivid, less emotional, and not accompanied by the elaborate narratives typical of dreams. Thus the typical dreaming experience only occurs during REM sleep.

Over an 8- hour period of sleep, the average human goes through the sleep cycle 4 to 5 times. As noted by Pierce Howard, author of the Owner's Manual for the Brain, this fact has important implications for how we feel and function. It's not only the amount of sleep that counts, but also the number of sleep cycles a person completes. If you awaken in the middle of a sleep cycle, you will feel more tired than if you wake up at the end of a sleep cycle.

Children and Sleep

Helping Students Learn about Good "Sleep Hygiene"

Most children need 9 hours of sleep each night. You can help your students learn about good "sleep hygiene." The National Heart, Lung, and Blood Institute (NHLBI) recently began a 5-year educational initiative to educate children, parents, teachers, and health care providers about the importance of sleep. Details regarding this campaign, Garfield: Star Sleeper Campaign, can be accessed by the internet (http://starsleep.nhlbi.nih.gov) or the National Heart, Lung, and Blood Institute's Health Information Network (P.O. Box 30105, Bethesda, MD 2-824-0105).

Here are some helpful hints for students from The Star Sleeper Campaign. These hints, along with fun games and visuals, are included in a "Fun Pad" which can be downloaded from the campaign website.

Sleep Tip # 1: Eating too close to bedtime can ruin your sleep.

Sleep Tip # 2: Noises can keep you awake so make sure you're in a quiet place at bedtime.

Sleep Tip #3: Drinking colas with caffeine before bed can keep you from sleeping.

Sleep Tip #4: Exercising too close to bedtime can make you too jumpy to sleep.

Sleep Tip #5: Go to bed at the same time every night.

Sleep Tip #6: Have some "quiet" time before bed.

Sleep Tip #7: Make sure your bed and pillows are comfortable.

Sleep Tip #8: Keeping a sleep diary helps you see how well you're sleeping and if you need more sleep.

Sleep Tip #9: A warm bath before bed can help you relax!

References

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Owens, J.A., Spirito, A., McGuinn, M., & Nobile, C. (2000). Sleep habits and sleep disturbance in elementary school-aged children. Journal of Developmental and Behavioral Pediatrics, 21, 27-36.

Meijer, A.M., Habekothe, H.T., & Van Den Wittenboer, G.L. (2000). Time in bed, quality of sleep and school functioning of children. Journal of Sleep Research, 9, 145-153.

Book Resources for Teachers and Students

for Teachers:

The Owner's Manual for the Brain: Everyday Applications from Mind-Brain Research by Pierce J. Howard

for Children:

Sleep is a major topic of children's literature; however, the majority of these books are fiction picture books. The following are a few of the non-fiction books on the topic:

Ages 4 to 8

A Good Night's Sleep (Rookie Read About Science) by Allan Fowler

Sleep Well: Why You Need Your Rest (Your Health) by Kathy Feeny

Staying Healthy: Sleep and Rest (The Library of Healthy Living) by Alice B. McGinty

Ages 9 to 12

Counting Sheep! Why do we sleep? (At Home with Science) by Janice Lobb, Peter Ulton & Ann Savage (Illustrator)

Sleep (My Health) by Alvin Silverstein, Virginia B. Silverstein & Laura Silverstein Nunn

Young Adult

Sleep and Dreams (Single Title: Science) by Andrew McPhee

Zzz The Most Interesting Book You'll Ever Read about Sleep (Mysterious You) by Trudee Romanek

Internet Resources

Neuroscience for Kids. What is Sleep … and why do we do it?
http://faculty.washington.edu/chudler/sleep.html

This website has a lot of great information about the stages of sleep, how sleep change as people get older, and theories as to why people sleep. There are also some great links to other websites. If you want to learn about the specific placement of EEG electrodes, the Neuroscience for Kids website also has a description

Thriveonline: The New Health
www.thriveonline.oxygen.com/medical/library/article/003931.html

This website provides a brief description of the EEG test and how patients should prepare for it.

Garfield Star Sleeper.
http://starsleep.nhlbi.nih.gov

In February of 2001, the National Heart, Lung, and Blood Institute began a 5-year educational initiative to educate children, parents, teachers, and health care providers about the importance of sleep. The website has basic information about sleep and games that students can play.

The National Sleep Foundation.
www.sleepfoundation.org

The National Sleep Foundation has a wealth of information about sleep. You can access information related to sleep disorders, read brochures related to many topics (e.g., sleep and aging, the nature of sleep), and locate healthcare providers who are part of the NSF Community Sleep Awareness Partners.

The Better Sleep Council.
www.bettersleep.org

The Better Sleep Council is a non-profit organization that is supported by the mattress industry. Of course, there's information about mattresses (e.g., shopping for a mattress). However, this site also provides great information on how to get a good night's sleep.

Society for Neuroscience. Brain Briefings.
www.sfn.org/briefings

The Society for Neuroscience has created brief summaries (1 to 2 pages) of information on a broad range of topics, including nervous system disorders and diseases, nervous system repair, the senses, sleep, exercise, memory, etc. These briefings are a great resource for teachers. They are readable and interesting!