The Sleep Cycle *"Musical Dreams"*

GOAL

This lesson demonstrates how the brain and body cycle together throughout the course of a night's sleep; the state of the brain affects the behavior of the body. Students gain experience in the scientific method with the collection and interpretation of data, which they then use to make predictions or hypotheses about the outcomes of future tests. They also tie musical rhythms to body rhythms through a mini-play.

Set-up:

- Charts for data collection
- Glass beads for data collection
- A xylophone to be played by the eyes monitor
- A triangle to be played by the brain monitor
- A drum to be played by the heart monitor
- Shaker instrument to be played by the muscle monitor
- Placards to be worn by monitors
- Observation Handout
- Conclusion handout

PROCEDURE

Engage (10 minutes)

- Review information of last lesson (class discussion).
- Choose actors. Remaining students get into pairs.
- Pass out data collection charts and stones to pairs.
- Instruct students how to play their role as data collectors.

Explore (15 minutes)

- Give an overview of the lesson. Introduce characters.
- Hand out instructions to actors and data collection pairs.
- For the first couple of intervals all of the vital statistics are announced by the teacher, but later the data collectors have to listen to the monitors for themselves and mark the appropriate squares, on their charts.

PROCEDURE

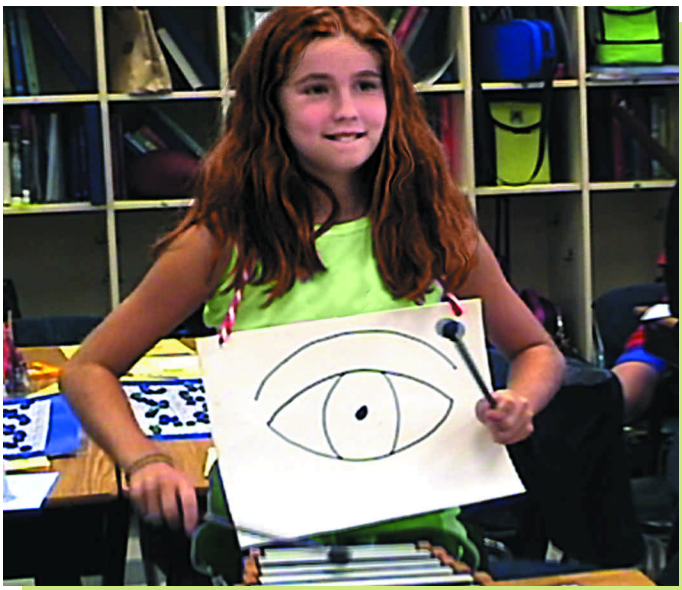
• The class runs the activity through 2 or 3 dreams and then actors returns to their seats. There, they join with pairs to interpret the data and help fill out the observation sheet.
• Students do not clear data charts until instructed.

Explain (15 minutes)
• Distribute observation sheet.
• Class works on data interpretation.
• Slow wave sleep and REM sleep are identified within the collected data.
• Review concept that most dreaming occurs during REM sleep.

Expand (10 minutes)
• New actors are chosen. Data run and collection resumes to the end of the chart.

• Throughout this part of the data run, the instructor asks class for predictions of activity levels for different body parts.

Evaluate (10 minutes)
• Students are given a handout asking them to write down the patterns of activity, in the body parts tested, during Slow Wave Sleep and REM Sleep. They should also write down the average duration of Slow Wave Sleep and dreams.



Notes:

Brain-Body Sleep Cycle: Lesson Overview

Making Music of Our Dream Cycle

Students pretend to be in a sleep lab observing a sleep subject.

5 students will be in front of the class

- One student plays the role of a sleep subject. They lie on a table and pretend to sleep. The teacher pretends to take their pulse at intervals.
- 4 students play the role of machines. The "machines" monitor the sleep subject's body reactions. The "machine" records by playing the rhythm of the specific body part it is monitoring on an instrument. The four musical parts are as follows:

1) One student "monitor" records the heartbeat (pulse) of the sleeping patient using a hand drum. When the heart beat is fast, the students beats a fast drumbeat. When the heartbeat is slow, they play a slow beat. The teacher tells the heart monitor if the heartbeat is fast or slow for each time interval measured.

2) A second student "monitor" measures the electrical brain rhythms of the sleeping patient using a triangle. When the heartbeat is fast, the brain waves are fast, and so is the playing of the triangle. When the heartbeat is slow, the brain rhythms tend to be slow also, so the monitor will play a slow beat.

3) A third student "monitor" measures the eye patterns under the closed lids of the sleeping patient, observing and representing the movements on a xylophone. When the heartbeat is fast, the eye movement is fast, and so is the playing of the xylophone. The eyes are moving as they "watch" the dream. When the heartbeat is slow, the eyes do not move much and the monitor will play a slow beat.

4) The fourth student "monitor" measures the muscle movements of the sleeping patient, observing and representing the movements with a shaker instrument. When the heartbeat is fast, the muscle movement is minimal to none. The shakers do not play. (Note: they are opposite the other three instruments which all play together.) The muscles do not move much during R.E.M. (rapid eye movement), or, dreaming.

Summary: Sleep Subject Body Rhythms

When the sleep lab subject is *dreaming*, a state known as R.E.M. (Rapid Eye Movement), they will have a fast pulse, high frequency electrical activity in the brain, rapid eye movement and no activity in the skeletal muscles. When the sleep lab subject is asleep and *not dreaming*, a state known as Slow Wave Sleep, they will have a slow pulse, low frequency electrical activity in the brain, no eye movement and low activity in the skeletal muscles.

FREQUENTLY ASKED QUESTIONS

How do the students know when to play?

At each time interval, indicated on the data chart, the instructor announces the pulse of the sleep lab subject. The student monitors have instruments and know what to play once they hear whether the pulse is fast or slow.

How do data collectors record the data?

When the musical instrument "monitors" play, the data collectors (who sit in pairs sharing a chart) hear the relative activity

Brain-Body Sleep Cycle: Lesson Overview

rates of the subject's brain, heart, eyes and skeletal muscles. The speed at which the instruments are played reflects the activity of the body part monitored. The data collectors place translucent glass stones on the chart to mark the data points.

What is the brain-body pattern that emerges over the course of the night?

An 8 hour period of sleep is simulated over about 30 minutes during which "readings" are taken from the monitors and recorded by the data collectors.

How do I assess if the students interpreted the chart correctly?

At the midpoint of the simulated test period, students are asked to look at the data compiled on their charts for patterns of body part activity. They complete a handout. They may notice, for example, that when there are high frequency brainwaves, the eyes are moving rapidly, the heart is beating quickly and there is no activity in the muscles. During the last part of data collection students are asked to hypothesize, making predictions for activity rates for data points before the monitors play.

Is this lesson successful and fun for students?

The best part of this lesson is the “aha” moment when students realize the patient is dreaming at specific intervals (every 90 minutes). They first notice a pattern but do not know how to interpret it, and then with encouragement, or simply time to study their charts, most realize that the body has very specific symptoms during dreaming, and when not dreaming. Many make the next leap to noticing the emerging time-interval pattern. Data interpretation is a learned skill. This lesson utilizes the dramatic and musical arts for a fun, integrative way to practice collecting, graphing and interpreting data.

Any helpful hints?

One instructor had fun “setting the stage” with students, darkening the room, describing the lab where we have been magically transported. They would start out, “Look, the windows aren’t there anymore. That’s a long hall now, and there are a few people out there wandering the halls. They’re wearing lab coats. This building is quiet. Look at you! You are now graduate students! Congratulations. You’re in the sleep lab, studying sleep. You’ll be up all night recording every action of this sleep lab subject. They’re getting paid to sleep. (You’re not getting paid to study them!) But, maybe you’ll make some observations of patterns tonight that will help scientists understand more about the brain-body-sleep connection. This patient is a typical subject, and what you see tonight is considered normal sleep behavior. Watch carefully, and record accurately. *Be sure not to dismantle your data until told because we will have two opportunities to fill out paperwork on your findings*.

In order for everyone to collect data and interpret the data, the instructor can switch mid-lesson to a new set of actors. This provides a breaking point for everyone to be seated to study the chart and fill out their interpretation form. Also, other students get a chance to perform.

Copy and cut into thirds. Plan for one set of instructions per pair. (approx. 3-4 copies.)

Instructions for data collectors:

A. For each time interval find the matching area on your chart.
B. Listen to the way each monitor plays at each time interval.
C. If the brain monitor is playing fast then place a stone over the high frequency waves square under the brain, if the brain monitor is playing slowly, place a stone in the low frequency box under the brain.
D. The same goes for the eye, heart and muscle monitors.
E. Each time you finish marking your data points raise your hand and keep it up until the next time interval is called.

Cut here

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SCRIPT FOR ACTORS/MUSICAL MONITORS

You will play the roles of **a sleep subject** and **4 monitors:**

The **sleep subject** is a sleep lab volunteer who is being observed while sleeping.

The **monitors** are machines collecting data. You play data rhythms on musical instruments.

• **Sleep lab subject:** When your pulse is fast, your eyes are closed and moving rapidly, and your body is not moving. When your pulse is slow, your eyes are closed and not moving, but your arms, legs and body are moving around. (You lie on the table "bed" pretending to sleep.)

• **Heart monitor:** The teacher will take the pulse of the sleep subject and tell you. You play fast for a fast pulse and slow for a slow pulse. (You play the drum and wear the heart sign.)

• **Brain monitor:** When the heart is beating fast, the brainwaves are fast, so you play a fast beat on the triangle. When the heart is beating slowly, the brain waves are slow, so you play slowly. (You play the triangle and wear the brain sign.)

• **Muscle monitor:** When the brain and heart are playing slow beats, you play a slow beat, when they are playing fast, you don't play. (You play the shaker and wear the muscle sign.)

• **Eyes monitor:** Watch the subject's eyes and play when they move, if you aren't sure, play when the brain and heart monitors are playing fast beats. (You play the xylophone and wear the eye sign.)

Practice examples of fast and slow beats before beginning data run.

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Cue Card

INSTRUCTOR DATA SHEET

The teacher takes the pulse of the sleep subject and whispers this result to the heart monitor. After the students have time to play and record the results of the time interval, the monitors stop. Teacher announces the new time, takes the pulse, and whispers the result to the heart monitor again. Teacher does this each time (or until the monitors discover the pattern and know what to play). The type of sleep, and the associated pulse, are as follows:

9:30 - Slow Wave Sleep, a slow pulse.
10:30 - Slow Wave Sleep, a slow pulse.

11:00 - Dream, a fast pulse.

11:30 - Slow Wave Sleep, a slow pulse.
12:00 - Slow Wave Sleep, a slow pulse.
12:30 - Dream, a fast pulse.
1:00 - Slow Wave Sleep, a slow pulse.
1:30 - Slow Wave Sleep, a slow pulse.
2:00 - Dream, a fast pulse.
2:30 - Slow Wave Sleep, a slow pulse.
3:00 - Slow Wave Sleep, a slow pulse.
3:30 - Dream, a fast pulse.
4:00 - Slow Wave Sleep, a slow pulse.
4:30 - Slow Wave Sleep, a slow pulse.
5:00 - Dream, a fast pulse.
5:30 - Slow Wave Sleep, a slow pulse.
6:00 - Slow Wave Sleep, a slow pulse.

(The other monitors play rhythms representing low frequency brain waves, no eye movement, and low activity in the skeletal muscles.)

(The other monitors play rhythms representing high frequency brain waves, rapid eye movement, and no activity in skeletal muscles.)

Some students may notice that the sleep subject is dreaming every 1.5 hours. Affirm quietly, then encourage them to allow others this same discovery.

Note: The sleep subject has just fallen asleep at 9:30, so they do not dream then.

Name _____

Date: _____

Teacher: _____

OBSERVATION SHEET

Please fill in the blanks during the experiement.

During the experiment in the sleep lab, I have noticed several things.

1. When there is LOW frequency electrical activity in the brain we see:

_____ eye movement

_____ pulse

_____ activity in the muscles

2. When there is HIGH frequency electrical activity in the brain we see:

_____ eye movement

_____ pulse

_____ activity in the muscles

Name _____

Date: _____

CONCLUSIONS

Please circle the correct answer

1. When we dream there are:
   a.) High frequency brain waves
   b.) Low frequency brain waves
   c.) No brain waves

2.) When there are high frequency brain waves during sleep, there is:
   a.) Rapid eye movement
   b.)Some eye movement
   c.) No eye movement

3.) When there are high frequency brain waves during sleep, there is:
   a.) A lot of skeletal muscle activity
   b.)Some skeletal muscle activity
   c.) No skeletal muscle activity

4.) When there are low frequency brain waves during sleep, there is:
   a.) A fast pulse
   b.)SA slow pulse
   c.) No pulse

5.) The period of sleep with low frequency brain waves is called:
   a.) REM sleep
   b.) Dreaming
   c.) Slow Wave Sleep

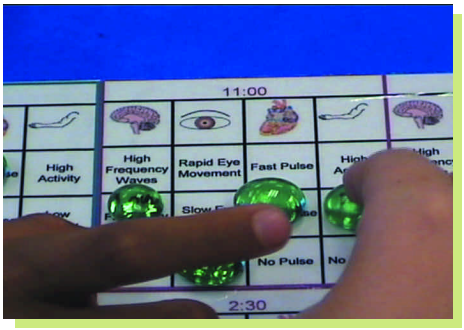
6.) When there are low frequency brain waves during sleep, there is:
   a.) A lot of skeletal muscle activity
   b.)Some skeletal muscle activity
   c.) No skeletal muscle activity

PROJECT 2061 : BENCHMARKS FOR SCIENTIFIC LITERACY

1 Nature of Science
A. Scientific World View
B. Scientific Inquiry
Students collect data which they use to support their predictions.

2 Nature of Mathematics
A. Patterns and Relationships
Students collect data, create a graph and use this to support predictions about patterns of electrical activity in the body.

6 The Human Organism
C. Basic Functions
(Students are exposed to a cycle of electrical activity in the brain and throughout the body during sleep.)



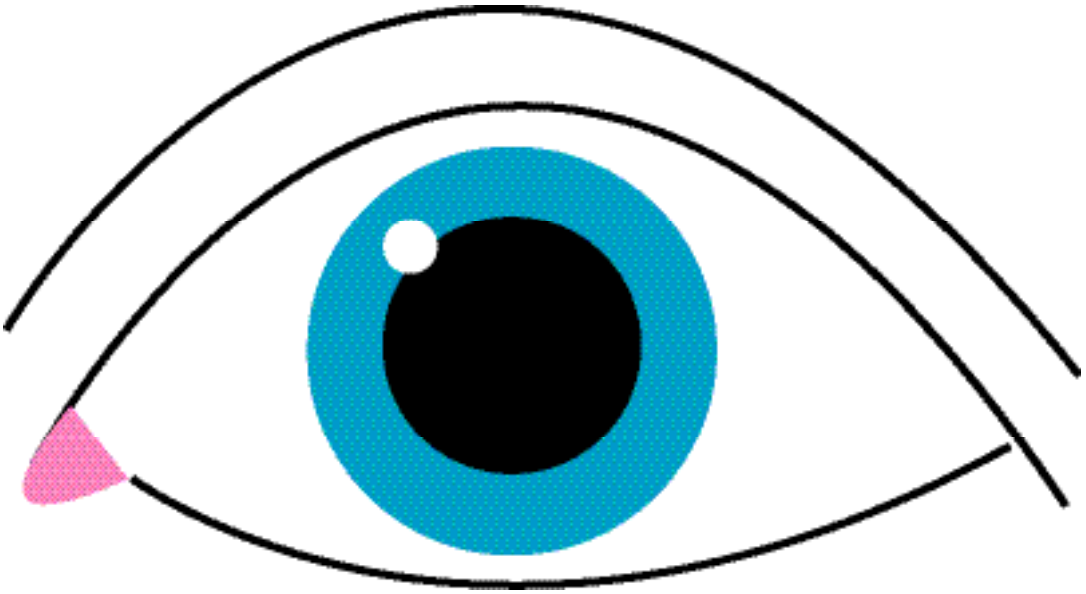
Above: Data Chart with stones. Students record the speed of each rhythm, played by other students, on various musical instruments.

- **Key Cognitive Skills:**
  Observation
  Data collection
  Data interpretation
  Hypothesis

- **Vocabulary Terms:**
  REM Sleep
  Slow Wave Sleep
  Data Collection
  Data Interpretation
  Electrical activity

- **Specific Outcomes:**
  Students learn:
  - Data collection
  - Data interpretation
  - Brain function affects body function
  - Rhythms can be measured in beats.
  - The body has electrical rhythms
  - We dream at specific intervals and for limited amounts of time.
  - The average human has 4-5 periods of rapid eye movement (REM) sleep over an 8 hour period of sleep.
  - REM sleep is characterized by high frequency electrical activity in the brain, rapid eye movement, a fast heartbeat, and skeletal muscle atonia.
  - Slow Wave Sleep is characterized by high activity in skeletal muscle, no eye movement; a slow heartbeat, and low frequency electrical activity in the brain.
  - The dreams we remember occur during REM sleep.

Heart Monitor



Eyes Monitor

Brain Monitor