Polly Want a Somnogram?
Activity 3E

Objectives:
Students will be able to:

◆ Analyze a polysomnogram to identify what each line is measuring, i.e. EEG, EKG etc.
◆ Observe a polysomnogram and identify the stage of sleep and/or specific wave patterns, sleep disorders, etc.
◆ Compare labeled polysomnograms of patients with unknown (unlabeled) patient polysomnograms to infer the stage of sleep and/or specific wave patterns and sleep disorders found in the unknowns.

Activity Description:
Students will investigate polysomnogram printouts (used by sleep diagnostic centers) that include multiple measurements such as the EEG (brain waves), EMG (leg movement) and EOG (eye movements) along with other measurements taken while a patient sleeps. Since many different bodily function measurements are recorded on the printout, students will learn to identify each line of a polysomnogram. In activity 3F, they will use their newly found skills to examine several labeled (known) polysomnograms and compare them to unlabeled (unknown) samples in order to complete their analysis.

Activity Background:
During a sleep study, electrodes are placed on the body to collect information about the way our body functions during sleep (See Figure 1 Electrode Placement). All of this information is important in understanding what is happening to our bodies during sleep because all of the major organ systems are affected by sleep.

Figure 1 – Electrode Placement

When all of these measurements are taken during a sleep study, there is a lot of information that needs to be analyzed. It is much easier to keep track of all information if it is placed on one report. The printout that has all of this information in one place is called a polysomnogram.
Explain to students that this looks like a complicated word, but is really made from three simple root words. Poly- means many, somn- means sleep and -gram means graph, record or picture. When put together, these root words mean, loosely, “a printout showing many graphs about sleep”. More precisely, it is a printout gathered to test sleep cycles and stages through the use of continuous recordings of eye movement, electrical activity of muscles, brain waves, heart rhythm, snoring and/or talking, air flow during breathing, breathing rate, blood pressure and blood oxygen and direct observation of the person during sleep. Figure 2, Standard Polysomnogram below is an example of a standard polysomnogram. Notice each section has information about a specific body function. Once trained to read these waves, a sleep specialist can provide a detailed report about what is happening to a person during sleep.

**Figure 2 – Standard Polysomnogram**

1. Left eye movements (EOG electrode)
2. Right eye movements (EOG electrode)
3. Jaw movements & teeth grinding (Chin strap)
4. Brain wave activity (EEG electrodes)
5. Brain wave activity (EEG electrodes)
6. Brain wave activity (EEG electrodes)
7. Brain wave activity (EEG electrodes)
8. Left leg movement (EMG electrode)
9. Right leg movement (EMG electrode)
10. Heart rhythm (EKG electrodes)
11. Heart rhythm (EKG electrodes)
12. Snoring/Talking (Sound monitoring)
13. Breathing (Oral Air Flow)
14. Breathing - Chest expansion and contraction (Thoracic Belt)
15. Breathing - Stomach cavity expansion and contraction (Abdominal Belt)
16. Backup belt (sometimes one and sometimes two are used)
17. Oxygen saturation of blood (Pulse Oximeter)

No measurements taken for lines 13 and 14 on a Standard Polysomnogram
**Activity Materials:**
- Colored Map Pencils or Markers
- Standard Polysomnogram Page
- Visual Polysomnogram Page

**Activity Management Suggestions:**

**Modifications:**
The class can be divided into groups that will become "experts" on a specific type of wave, such as EEG, EOG, EMG, EKG.

**Extensions:**
Contact a Sleep Study Clinic and arrange for a speaker for the class to discuss the career field and sleep issues.

Students, as individuals or groups, can research the four types of brain waves: beta, alpha, theta, and delta, and present their findings to the class.

**Activity References Used:**

**Useful Websites:**
- [www.sleepnet.com](http://www.sleepnet.com)
- [www.nhibi.nih.gov/about/mcsdr](http://www.nhibi.nih.gov/about/mcsdr)  
  (National Center for Sleep Disorders Research)
- [www.sleepfoundation.org](http://www.sleepfoundation.org)  
  (National sleep foundation)
- [www.sleephomepages.org/sleep/syllabus/](http://www.sleephomepages.org/sleep/syllabus/)  
  (an overview of sleep behavior)
- [http://faculty.washington.edu/chudler/sleep.html](http://faculty.washington.edu/chudler/sleep.html)  
  (Neuroscience for kids)
Activity “Administrivia”:

Grade Levels 6-8

Relevant TEKS:

*Middle School Science*

6.2, 7.2, 8.2 (C, D, E)

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

- (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
- (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
- (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

6.3, 7.3, 8.3 (A, B, D)

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
- (B) use models to represent aspects of the natural world such as a model of Earth’s layers;
- (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.

7.12 (B)

(12) Organisms and environments. The student knows that living systems at all levels of organization demonstrate the complementary nature of structure and function. The student is expected to:

- (B) identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems;

7.13 (A)

(13) Organisms and environments. The student knows that a living organism must be able to maintain balance in stable internal conditions in response to external and internal stimuli. The student is expected to:

- (A) investigate how organisms respond to external stimuli found in the environment such as phototropism and fight or flight;

*Biology*

Bio 2 (G, H)

(2) Scientific processes. The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

- (G) analyze, evaluate, make inferences, and predict trends from data; and
- (H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

Bio 3 (A, D)

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
- (D) evaluate the impact of scientific research on society and the environment;

Bio 10 (A, C)

(10) Science concepts. The student knows that biological systems are composed of multiple levels. The student is expected to:

- (A) describe the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals;
- (C) analyze the levels of organization in biological systems and relate the levels to each other and to the whole system.
Bio 11 (A, B)
(11) Science concepts. The student knows that biological systems work to achieve and maintain balance. The student is expected to:

(A) describe the role of internal feedback mechanisms in the maintenance of homeostasis;
(B) investigate and analyze how organisms, populations, and communities respond to external factors;

Physics
Phys 2 (I, J, K, L)
(2) Scientific processes. The student uses a systematic approach to answer scientific laboratory and field investigative questions. The student is expected to:

(I) identify and quantify causes and effects of uncertainties in measured data;
(J) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs;
(K) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports; and
(L) express and manipulate relationships among physical variables quantitatively, including the use of graphs, charts, and equations.

Phys 3 (A, E)
(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
(E) research and describe the connections between physics and future careers; and

Phys 4 (A)
(4) Science concepts. The student knows and applies the laws governing motion in a variety of situations. The student is expected to:

(A) generate and interpret graphs and charts describing different types of motion, including the use of real-time technology such as motion detectors or photogates;

Phys 7 (B, C, F)
(7) Science concepts. The student knows the characteristics and behavior of waves. The student is expected to:

(B) investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationship between wavespeed, frequency, and wavelength;
(C) compare characteristics and behaviors of transverse waves, including electromagnetic waves and the electromagnetic spectrum, and characteristics and behaviors of longitudinal waves, including sound waves;
(F) describe the role of wave characteristics and behaviors in medical and industrial applications.