**Activity Introduction:**
You will learn that many measurements are taken during a sleep study, and this makes sense because all of the body’s systems are affected by sleep. How is all of that information collected, interpreted and analyzed? In this activity, you will learn how sleep experts read the “waves” collected when they study someone’s sleeping patterns. You will also be learning how to compare a labeled (known) polysomnogram with an unlabeled (unknown) polysomnogram, much the way scientists compare labeled (known) DNA samples to unlabeled (unknown) DNA samples to look for a match.

**Activity Background:**
During a sleep study, electrodes are placed on the body to collect information about the way our bodies function during sleep (See Figure 1 Electrode Placement). Much information is needed to understand what is happening to our bodies during sleep because all of the major organ systems are affected by sleep.

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 graph that has all of this information in one place is called a polysomnogram. 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 you put all these root words together, the word polysomnogram means, 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. Each line 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 when they sleep.

There are four types of brainwaves: Beta, Alpha, Theta, and Delta. Beta waves are shorter and closer together and they have the highest frequency, 13 to 60 cycles per second, and lowest amplitude. These waves are produced when a person is alert. Delta waves are taller and farther apart, so they have the lowest frequency, up to 4 cycles per second, and the highest amplitude. These waves are produced as a person relaxes and produces slow rolling eye movements. It is important to remember that waves with low energy have low amplitude and high energy waves have high amplitude. Also, high energy waves have shorter frequency while low energy waves have lower frequency. This information will help you interpret the waves on a polysomnogram – higher energy waves will be higher and closer together.
Activity Materials: (Per Student)
- Colored Map Pencils or Markers
- Standard Polysomnogram Page
- The Visual Polysomnogram Page

Activity Instructions:
First, read the background material very carefully and check what you learned by answering the questions that follow. You will create a visual polysomnogram by illustrating the process in each section of the polysomnogram.

☐ 1. List ten measurements that are made during human sleep studies.

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☐ 2. How can Delta brain waves be distinguished from Beta brain waves on an EEG?

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☐ 3. When a person is relaxed and in a deep sleep, which type of brain wave would be produced?

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☐ 4. What is a polysomnogram?

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☐ 5. Making a Visual Polysomnogram Instructions

a. Using Table 1, Standard Polysomnogram Information on next page as a guide, label each section in the Visual Polysomnogram.

b. Color the lines in the Visual Polysomnogram as indicated in the table below (Standard Polysomnogram Information).

c. Next, draw a picture in the box beside each section on the Visual Polysomnogram page included in this activity. Your picture should illustrate clearly what body process each section measures.

d. You will have a unique Visual Polysomnogram when you finish.
### Table 1  Standard Polysomnogram Information

<table>
<thead>
<tr>
<th>#</th>
<th>What this part of the Polysomnogram Measures</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left eye movements (EOG electrode)</td>
<td>Green</td>
</tr>
<tr>
<td>2</td>
<td>Right eye movements (EOG electrode)</td>
<td>Green</td>
</tr>
<tr>
<td>3</td>
<td>Jaw movements &amp; teeth grinding (Chin strap)</td>
<td>Yellow</td>
</tr>
<tr>
<td>4</td>
<td>Brain wave activity (EEG electrodes)</td>
<td>Orange</td>
</tr>
<tr>
<td>5</td>
<td>Brain wave activity (EEG electrodes)</td>
<td>Orange</td>
</tr>
<tr>
<td>6</td>
<td>Brain wave activity (EEG electrodes)</td>
<td>Orange</td>
</tr>
<tr>
<td>7</td>
<td>Brain wave activity (EEG electrodes)</td>
<td>Orange</td>
</tr>
<tr>
<td>8</td>
<td>Left leg movement (EMG electrode)</td>
<td>Blue</td>
</tr>
<tr>
<td>9</td>
<td>Right leg movement (EMG electrode)</td>
<td>Blue</td>
</tr>
<tr>
<td>10</td>
<td>Heart rhythm (EKG electrodes)</td>
<td>Red</td>
</tr>
<tr>
<td>11</td>
<td>Heart rhythm (EKG electrodes)</td>
<td>Red</td>
</tr>
<tr>
<td>12</td>
<td>Snoring/Talking (Sound monitoring)</td>
<td>Purple</td>
</tr>
<tr>
<td>13</td>
<td>Breathing (Oral Air Flow)</td>
<td>Pink</td>
</tr>
<tr>
<td>14</td>
<td>Breathing - Chest expansion and contraction (Thoracic Belt)</td>
<td>Brown</td>
</tr>
<tr>
<td>15</td>
<td>Breathing - Stomach cavity expansion and contraction (Abdominal Belt)</td>
<td>Brown</td>
</tr>
<tr>
<td>16</td>
<td>Backup belt (sometimes one and sometimes two are used)</td>
<td>Aqua</td>
</tr>
<tr>
<td>17</td>
<td>Oxygen saturation of blood (Pulse Oximeter)</td>
<td>Maroon</td>
</tr>
</tbody>
</table>
Figure 3 – Visual Polysomnogram

No measurements taken for lines 13 and 14 on a Standard Polysomnogram
6. Look at the polysomnogram in Figure 4, Drowsy below. It shows measurements taken from a person who is drowsy and about to enter Stage 1 of NREM sleep. Now look at the polysomnogram in Figure 5, below. Figure 4, Drowsy is labeled, so it is a known polysomnogram; Figure 5 ??? is not labeled, so it is an unknown polysomnogram. What do you think might be happening to explain the differences in most areas of the two polysomnograms?
7. Look at the polysomnogram in Figure 6, Stage Awake (Eyes Closed and Eyes Open) below. Which line or lines of the polysomnogram will you be looking at to determine if the eyes are open or closed?

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_____________________________________________________________________________

What evidence do you see in these lines that the person’s eyes are closed?

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Observe the appearance of the lines having to do with left and right eye movements and think about the characteristics of waves you learned about during the Somnosurfin’ activity. How did the lines change when the eyes opened?

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Why does this change indicate that the eyes were open?

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8. Upon completion of a sleep study to determine why you are not able to sleep throughout the night, the sleep specialist tells you that you are grinding your teeth at night and having trouble breathing regularly. By number, which sections of your polysomnogram might indicate these problems?

_____________________________________________________________
_____________________________________________________________

9. How do you think polysomnograms would be used to detect breathing problems while a person is asleep?

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