Sleepy Reactions
Student Activity 3A

Activity Introduction:
All of us have experienced a time when we could not get to sleep, just look at the number of advertisements for sleep aides! While most of us take these times in stride, sleeplessness can have profound effects on our daily lives. In this activity, we will examine some of the characteristics of sleep and why it is so important to our well-being.

Materials:
- Stopwatch
- Meter stick
- Calculator

Activity Instructions:
Read all directions and check off each instruction as it is completed.

☑ 1. You will work with a partner to measure your reaction time by reading each step and checking it off as it is completed.

☑ 2. One partner will be the Experimenter and the other partner will be the Subject.

☑ 3. You and your partner will perform the following reaction time test. Record your data in the Table on the student data page.

☑ 4. Fold a piece of notebook paper in half, draw a line along the crease and attach the paper to the wall with cellophane tape at a convenient height for you and your partner. (The paper crease should form a horizontal line.)

☑ 5. The Experimenter holds the meter stick with 50 cm mark on line of the paper, zero end of stick down. Be careful to line up the meter stick and the line on the paper exactly on the 50.0 cm mark.

☑ 6. The Subject places thumb and forefinger on either side of ruler, near, but not touching it.

☑ 7. The Experimenter asks to be certain that subject is ready, then within a few seconds releases ruler as cleanly as possible, but should give no hints as to when the meter stick will be released and then drops the meter stick straight down.

☑ 8. The Subject grasps ruler as soon as possible after its release, and holds it against the wall where caught (do not move it once it is caught).

☑ 9. The Experimenter reads the position of the line on the ruler, called the Catch Line, to the nearest tenth of a centimeter.
10. The **Experimenter** will now subtract 50 cm from the reading taken from the meter stick to get the distance the ruler dropped, and records the data in the **Data Table** on the Student Data Page.

11. Repeat at least five times to determine an accurate average. (You will drop the fastest and slowest reaction times.)

12. Convert each distance dropped into milliseconds as required for the reaction time, by using the mathematical formula provided on the Student Data Page.

13. Find the average of the three central reaction time values.

14. You and your partner will now change roles and repeat the entire process so each of you has a chance to measure your reaction time as described.

15. On a piece of paper, write the number of hours you slept last night. (It is important to the results of this activity that you report hours of sleep accurately.)

16. Turn your papers in to your teacher.

17. Your teacher will divide the class into three groups based upon the number of hours of sleep reported.

18. Before going any further, find the average number of hours your group slept by following the instructions on the Student Data Page.

19. Now, calculate the average reaction time for your group.

20. Make a bar graph of the average reaction time for each group in the class.

21. Report your findings to the class.

**Note:** The procedure for measuring reaction time is used with permission from:

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University of Cincinnati Clermont College,
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http://biology.clc.uc.edu/fankhauser/Labs/Anatomy&_Physiology/A&P202/Nervous_System_Physiology/Visual_Reaction.htm

The distance dropped is converted into milliseconds with the following equation:

\[
\text{Reaction Time (milliseconds)} = \sqrt{\frac{2 \times \text{cm dropped}}{980 \text{ cm/sec}^2}} \times 1000 \text{ msec/sec}
\]

**Note:** The symbol \((\sqrt{\cdot})\) which appears in the formula above means to take the square root of the value inside. The square root of a number \(n\) is a positive number that can be multiplied by itself to equal \(n\).

**For example:** 3 is the square root of 9 because \(3 \times 3 = 9\).

**SAMPLE CALCULATIONS:**

1) If the ruler was caught at the 66.0 cm point, the distance dropped would be 16.0 cm
2) 2 times 16.0 cm equals 32 cm
3) 32 cm divided by 980 cm/sec\(^2\) equals 0.03265 seconds\(^2\)
4) The square root of 0.03265 seconds\(^2\) is equal to 0.1807 seconds
5) 0.1807 seconds times 1000 msec/second equals 180 milliseconds reaction time
I. Record your individual results in the following table. Drop the highest and lowest reaction time in the last column by drawing a line through them. Use the remaining three values to calculate your average reaction time in msec.

### Table 1 Data Table

<table>
<thead>
<tr>
<th>Trial</th>
<th>Catch Line (cm)</th>
<th>Subtract 50 cm from “Catch Line” Number</th>
<th>Calculated Reaction Time (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculating the average:

To calculate the average, add up all the numbers from each trial. The sum is then divided by the number of trials.

\[
\text{Average} = \frac{\text{Sum Total}}{5 \text{ trials}}
\]

Use the following equation to calculate the reaction time in msec:

\[
\text{Reaction Time (milliseconds)} = \sqrt{\frac{2 \times \text{cm dropped}}{980 \text{ cm/sec}^2}} \times 1000 \text{ msec/sec}
\]

Record calculations at the top of the next page!
II. Write down the number of minutes you slept for the last three nights in the following table:

<table>
<thead>
<tr>
<th>Night</th>
<th>Number of Hours Slept</th>
<th>Number of Minutes Slept (#Hours x 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

III. Write the average number of minutes you slept over the past three nights on a sheet of paper and hand it to your teacher.
IV. Record the average reaction time for each member of each group in the Class Data Table that follows and calculate the average reaction time for each group.

| Group Member | Group 1 | | Group 2 | | Group 3 | |
|--------------|---------|---|---------|---|---------|
|              | Average Minutes of Sleep | Reaction Time (msec) | Average Minutes of Sleep | Reaction Time (msec) | Average Minutes of Sleep | Reaction Time (msec) |
| 1            |         |   |         |   |         |   |
| 2            |         |   |         |   |         |   |
| 3            |         |   |         |   |         |   |
| 4            |         |   |         |   |         |   |
| 5            |         |   |         |   |         |   |
| 6            |         |   |         |   |         |   |
| 7            |         |   |         |   |         |   |
| 8            |         |   |         |   |         |   |
| 9            |         |   |         |   |         |   |
| 10           |         |   |         |   |         |   |
| 11           |         |   |         |   |         |   |
| 12           |         |   |         |   |         |   |
| 13           |         |   |         |   |         |   |
| 14           |         |   |         |   |         |   |
| 15           |         |   |         |   |         |   |
| Total        |         |   |         |   |         |   |
| Average      |         |   |         |   |         |   |
V. Make a bar graph showing the average reaction time for each group using the graph paper that follows. Be sure to include title, axis, labels, and units.
Results:

1. What does the graph show you about the effect of sleep on your reaction time?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

2. How might these results relate to athletic performance?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

3. How might these results relate to driving?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

4. Based upon what you have read and upon the results of this activity, what do you *think* might happen if a person stayed up three hours past their normal sleep time for two weeks? (Be sure to explain why you think this)
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

5. This activity dealt with the effect of sleep deprivation on reaction time, what other factors might be affected by sleep deprivation?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

Conclusion: Write a statement that explains how sleep affects reaction time.
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__________________________________________________________________________________
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