**KE and PE using the Pendulum Lab**

*Objective – to develop a visual concept of the relationship between KE and PE during an object’s motion.*

Main Link: https://phet.colorado.edu/en/simulation/pendulum-lab

INSTRUCTIONS:

**PART I: Setting up and hypothesis**

Go to the PHET Pendulum lab and select “Lab”. If you have never used this application before you might want to play around with the “Intro” and “Energy” screens first.

On the right, leave Length, Mass, Gravity and Friction alone for now. At the bottom left, turn on the ruler and the timer. At the top left, turn on the Energy Graph.

Play with the pendulum and watch how the KE and PE bars change. You might want to change the speed (lower center) to “Slow”.

Make a preliminary statement that describes how these two bars are related to each other and how these relationships change as the pendulum moves through its cycle.

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**PART II: The Experiment**

At the lower center, turn the speed to “Slow”. At the left, drag the ruler to the KE/PE bar graph. Have pencil and paper and prepare to take data.

As the pendulum swings, collect data on time and the height of both KE and PE bars at various locations:

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| --- | --- | --- | --- |
| **Location**  **Of Pendulum Bob** | **Time, in seconds** | **Kinetic Energy,**  **in cm** | **Potential Energy,**  **in cm** |
| Farthest Right |  |  |  |
| Bottom Dead Center |  |  |  |
| Farthest Left |  |  |  |
| Data point of your choice 1 |  |  |  |
| Data point of your choice 2 |  |  |  |
| Data point of your choice 3 |  |  |  |
| Data point of your choice 4 |  |  |  |
|  |  |  |  |
|  |  |  |  |

Make a line graph using Excel, <http://nces.ed.gov/nceskids/createagraph/> or any graphing application of your choice of the KE vs time, and, on the same graph in a different color, PE vs time.

**PART II: Analysis**

1. Was your measure of KE and PE in cm a direct or an indirect measurement of the energy?
2. Look at your graph. If you were to add a third line, representing the sum of KE and PE at any given point, what would it look like?
3. Which law or principle are you demonstrating in #1?
4. Do you think this would hold true if you changed the length of the string? Try it. (just watch the bars to see if your idea if validated, you do not have to graph it)
5. Do you think this would hold true if you changed the mass? Gravity? Try them.
6. At what point is the PE the greatest?
7. At what point is the KE the greatest?
8. At what points is V (velocity) the highest and the lowest?
9. What is the relationship between KE and V?
10. So far we have not dealt with the internal friction of the string. On the right-hand side change the amount of friction (it might take a bit) and watch what happens. If you don’t get an additional red bar you might need to adjust the length or gravity to increase the height of the KE+PE bars.
11. Also you have a 3rd bar – Etotal. What three things make up the total E of the system?
12. What kind of energy is converted to the red bar? Which energy (KE or PE) does it come from?
13. What happens to the motion of the pendulum as the Etotal increases? (Keep this in mind in a few chapters when we get into the 3rd law of thermodynamics).
14. Summary: go back to your original hypothesis in Part I and re-write it if necessary.