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Pendulum Lab

Introduction

In this activity you will investigate how variables affect the motion of a pendulum. You will discover how the period of a simple pendulum depends on the length of the string. You can measure the period using a timer.

A simple pendulum has a mass m (bob) hanging from a string of length l fixed at a pivot point. When displaced to a small initial angle and released, the mass will swing back and forth in periodic motion. **The period is the time it takes to complete one whole swing.**

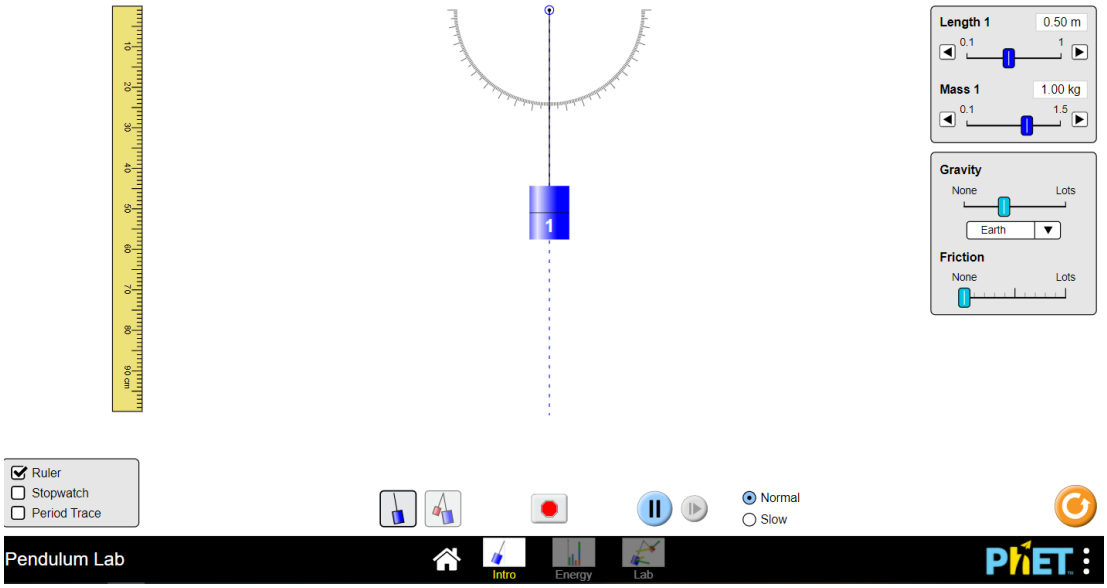
Background Information

One day in the late 1500s, a man named Galileo Galilei was sitting in church when he noticed the lamps hanging from the ceiling were swinging back and forth. Some of the lamps were making great big swings, and others were only making little swings back and forth, but they all went back and forth pretty regularly. Galileo was a curious man, and so he decided to use his heartbeat to measure how long it took the pendulums to swing back and forth. He was very surprised by what he learned. Today, you will repeat Galileo's experiment to learn about pendulums.

Procedure

How to open the simulation:

- Go to the simulation page: tinyurl.com/CHSPendulumLab
- Click the play button and then choose the "Intro" option.
- It will take time to load and then this screen appears:



Aim: Determine how the length of a pendulum affects its period.

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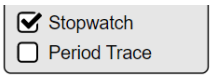
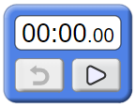
Prediction:

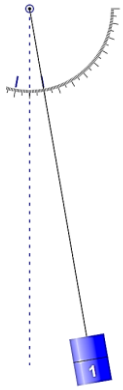
- Does the length of the pendulum affect period of the pendulum? Explain why and how you think so.

Steps:

1. For this activity the mass and angle should stay the same, but the length will change each time. Begin by setting the pendulum length to 1.0 m and the mass to 1.5 kg.
2. Check the stopwatch option 

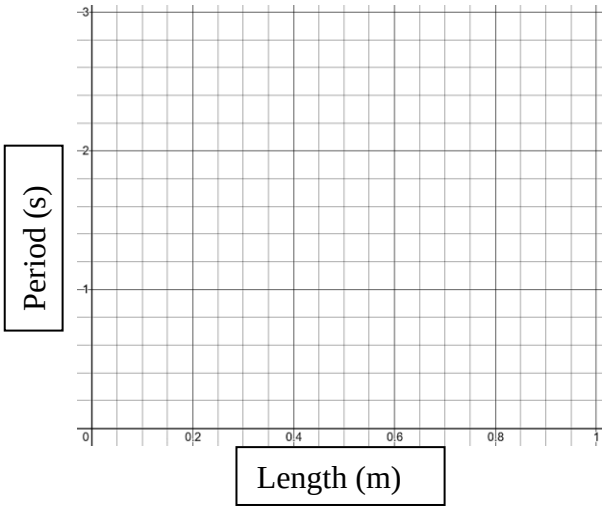
and the stopwatch should appear 

.
3. We are going to use the stopwatch to measure what is know as the period. Watch the following video of me demonstrating first: tinyurl.com/PendulumVideoLab
4. Drag the pendulum so that it is 10 degrees away from the center →
5. Next, let it go and measure the period like I showed in the example video.
6. Click  . Adjust the pendulum to a new length and repeat steps 4 and 5 until your table is complete. Make sure you are always releasing from 10 degrees.
7. Once your table is complete plot your points on the graph. Sketch in the pattern you see.



Length of the Pendulum (m)	Period (s)
1.0	
0.8	
0.6	
0.4	
0.2	
0	

*You may have to guess what the period would be for 0.



Mathematicians and scientists have determined that the formula for the period (T) of a pendulum is $T \approx 2\sqrt{L}$. Open Desmos.com and graph $y = \sqrt{x}$. Does it look similar to your graph? Also graph $y = 2\sqrt{x}$ and write some similarities and differences between it and $y = \sqrt{x}$.

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In general, describe how the period of the pendulum changes (or doesn't) as the length of the pendulum gets shorter.

----------Extension Investigation----------

To study the effects of other factors on the period of the pendulum we are going to alter the two other items we can: the mass of the bob and the angle of drop.

Mass of the Bob

To study how the mass of the bob alters the period of the pendulum, reset the pendulum length to 1.0 m. Now, by always starting the pendulum from 10^{o}, find the period for the following masses and fill in the table.

Mass of the Bob (kg)	Period (s)
1.5	
1	
0.5	
0.1	

Once you have completed the table, answer the following question:
What effect does the mass have on the period?

Angle of Drop

To study how the drop angle alters the period of the pendulum, reset the pendulum length to 1.0 m and the mass to 1.5 kg. Now, drop the pendulum from the various angles and measuring their corresponding periods.

Angle of Drop (degrees)	Period (s)
3	
5	
10	
15	
20	

Once you have completed the table, answer the following question:
What effect does the angle have on the period?

Conclusion: Which of the three factors (length of pendulum, mass of bob, or release angle) has the greatest effect on the period of the pendulum?