Pendulum Lab:

Exploration of variables affecting pendulum motion on Earth

Introduction

In this activity you will investigate the physical science of motion and the variables that affect the motion of a pendulum. A pendulum is a mass, or bob, connected to a rod or rope, that experiences simple motion as it swings back and forth.

Before you begin the exploration, indicate which of the following variables you believe may have an affect on the time it takes for a pendulum to have one full swing.

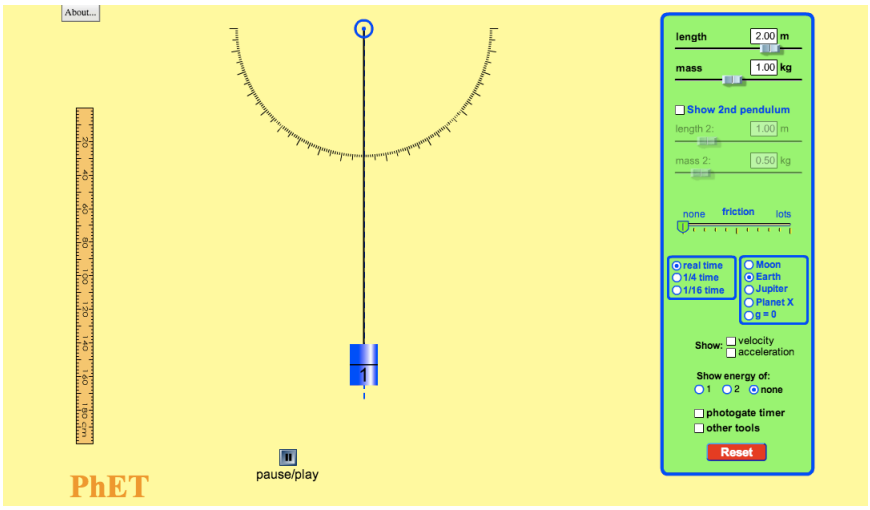
Variable	Yes, it will have an affect	No, it will NOT have an affect
Length of the pendulum rod		
Mass of the bob		
Location of where the pendulum is released		
Friction on the pendulum		

1. Click this link: http://phet.colorado.edu/en/simulation/pendulum-lab

The following screen will appear with the Pendulum Lab simulator:

2. Click **Run Now!**

3. Once the simulator has loaded, the following screen will appear:



Switch between this document and the simulator to complete the activity.

Exploration

1. Use the cursor to raise the pendulum and then let it go.
2. Using the green toolbox adjust the length of the string and the mass of the object.
3. Freely explore adjusting different variables.
4. Try using the photogate timer and other tools.

Questions: The questions below pertain to the conditions on Earth. (Write your prediction in the form of a hypothesis: If (independent variable…), then (dependent variable…).

1. What do you predict the affect that the length of a pendulum rod has on the number of observed swings? Why?

2. What do you predict the affect that the mass of the bob has on the number of observed swings? Why?

3. What do you predict the affect that the location of release has on the number of observed swings? Why?

4. What do you predict the affect that friction has on the number of observed swings? Why?

Explanation

Aim: Students will be able to create rules to describe the affects of independent variables (ie: length of pendulum rod, mass of bob, location where pendulum is released, and friction on pendulum) on the swinging motion of a pendulum.

1a. Test the affect that the length of a pendulum has on the number of observed swings. This experiment is on *Earth* in *real time* with *no friction*. Make sure the other variables remain the same. Adjust the length of the pendulum rod to those in the table below. Using the photogate timer record the time (in seconds) it takes for one full swing. Then count the number of full (round trip) swings for 30 seconds and record the data in the table below.

Controlled Variables: Location of release _____ Mass of bob _____ Friction none

Length of Pendulum Rod (m)	Period of Full Swing (s)	Number of Observed Swings
0.5		
1.0		
1.5		
2.0		
2.5		

1b. How does the length of the pendulum rod affect the number of observed swings? Write your answer as follows: If (independent variable…), then (dependent variable…).

1c. Was your prediction correct? If not, how was it different?

2a. Test the affect that the mass of the bob has on the number of observed swings. This experiment is on *Earth* in *real time* with *no friction*. Make sure the other variables remain the same. Adjust the mass of the bob to those in the table below. Using the photogate timer record the time (in seconds) it takes for one full swing. Then count the number of full (round trip) swings for 30 seconds and record the data in the table below.

Controlled Variables: Location of release _____ Length of pendulum rod _____ Friction none

Mass of bob (kg)	Period of Full Swing (s)	Number of Observed Swings
0.5		
1.0		
1.5		
2.0		

2b. How does the mass of the bob affect the number of observed swings? Write your answer as follows: If (independent variable…), then (dependent variable…).

2c. Was your prediction correct? If not, how was it different?

3a. Test the affect that the location of release has on the number of observed swings. This experiment is on *Earth* in *real time* with *no friction*. Make sure the other variables remain the same. Adjust the location of release to those in the table below. Using the photogate timer record the time (in seconds) it takes for one full swing. Then count the number of full (round trip) swings for 30 seconds and record the data in the table below.

Controlled Variables: Mass of bob _____ Length of pendulum rod _____ Friction none

Location of release (degrees)	Period of Full Swing (s)	Number of Observed Swings
15		
30		
45		
60		
75		

3b. How does the location of release affect the number of observed swings? Write your answer as follows: If (independent variable…), then (dependent variable…).

3c. Was your prediction correct? If not, how was it different?

4a. Test the affect that friction has on the number of observed swings. This experiment is on *Earth* in *real time*. Make sure the other variables remain the same. The friction levels are broken into tenths (0/10 = none, 10/10 = lots). Adjust the amount of friction to those in the table below. Using the photogate timer record the time (in seconds) it takes for one full swing. Then count the number of full (round trip) swings for 30 seconds and record the data in the table below.

Controlled Variables: Location of release _____ Length of pendulum rod _____ Mass of bob _____

Amount of friction	Period of Full Swing (s)	Number of Observed Swings
1/10		
3/10		
5/10		
7/10		
9/10		

4b. How does friction affect the number of observed swings? Write your answer as follows: If (independent variable…), then (dependent variable…).

4c. Was your prediction correct? If not, how was it different?

5. Both the period of full swing and the number of observed swings in a given time are ways to measure the motion of a pendulum. Using the data above, what do you notice about the relationship between the period of full swing and the number of observed swings? Does knowing the period of a full swing help one to predict the number of observed swings?

Application

Complete the table below using your knowledge of variables and their affects on the number of observed swings on *Earth* in *real time* with *no friction*.

Length of Pendulum Rod (m)	Location of Release (degrees)	Mass of Bob (kg)	Period of Full Swing (s)	Number of Observed Swings
0.8			2.0773	13
1.2	15		2.2068	
	60		2.723	11
2.4			3.2319	9

Conclusion

Using your knowledge from the data collections above, explain the conditions in which a pendulum would have the greatest number of observed swings on *Earth* in *real time* with *no friction*. Explain the conditions for the least.

Finished: Congratulations. You are now in the swing of things!