Welcome to Family Science Night!

How do the length, weight, and swing angle of a pendulum affect its oscillation time?

Have you ever swayed back and forth on a playground swing?
The swing is supported by chains that are attached to fixed points at the top of the swing set. When the swing is raised and released, it moves freely back and forth due to the force of gravity on the swing. The swing continues to oscillate until friction between the air and the swing slows it down and eventually stops.

A pendulum is an object hung from a fixed point that swings freely back and forth under the action of gravity.

Questions to ponder:

- ◊ How does the length of the string affect the pendulum's swing?

- ◊ How does the mass of the washers affect the pendulum's swing?

Materials:
2 Chairs
Yarn
Metal Washers – Identical Size
Masking Tape
Stopwatch
Scissors
Yard Stick/Meter Stick

Examine the materials.
Note the properties of each item.
In five minutes, list as many varied purposes for which the materials could be used.

- ◊ Place the two chairs less than 1 meter apart, back to back.
- ◊ Center the Meter Stick and lay it on the backs of the two chairs.
- ◊ Secure the stick to the chairs.

You can also hang the pendulums from the top, center of a door frame.

Construct 3 pendulums.
Design and conduct an experiment that relates the *length of the swing arm* (string) of a pendulum and the number of swings in *10 seconds*.

The length of the swing arm for the three pendulums should be x, 2x, and 0.5x (where x represents the length of the swing arm).
For example, the length of the swing arm for each of the 3 pendulums might be 10 inches, 20 inches, and 5 inches if x was 10.

Attach 2 washers to the end of the string.

Hang the pendulum from the center of the meter stick. Swings need to be free from obstructions.

Swing the pendulum from the same height (same angle) from the ground, using the same number of washers, for 10 seconds.

Start the stopwatch when you draw back and release the pendulum, simultaneously.

Count the number of complete swings back and forth (oscillations) within 10 seconds.

Perform multiple trials to assure that your results are consistent.

After collecting your data, save each pendulum.

Develop a general statement that relates the variable (length of the string).
The longer the string …
The shorter the string…

Report the average number of swings in 10 seconds for each length.

Investigate:

Number of Swings @ 10 Seconds

Test	Pendulum (0.5x) 5 inches	Pendulum (x) 10 inches	Pendulum (2x) 20 inches
Trial 1			
Trial 2			
Trial 3			
Average			

Observations:

Make any additional predictions and design experiments to further test your predictions.

Test the same pendulums again, increasing the number of washers.

Swing the pendulum from the same height (60-90 degree angle from the ground) for 10 seconds. Count the number of complete swings back and forth (oscillations).

After collecting your data, save each pendulum.

Develop a general statement that relates the variable (mass/washers).
The more washers …
The fewer washers…

Number of Swings @ 10 Seconds

Test	Pendulum (0.5x) 5 inches			Pendulum (x) 10 inches			Pendulum (2x) 20 inches		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
3 Washers									
4 Washers									
5 Washers									

Observations:

Make any additional predictions and design experiments to further test your predictions.

More questions to ponder:

- ◊ Is the movement of the pendulum different when the lengths of the strings are different?

- ◊ Is the movement of the pendulum different when the masses (washers) are different?

The swing of a pendulum led to one of the first accurate timepieces ever developed. There are 3 main factors: the weight hanging on the pendulum, the length of the pendulum, and the distance or angle of the pendulum's swing. Galileo used pendulums extensively in his experiments. He used the pendulum as a timing device, and later it was used in clocks. You can still purchase decorative clocks with pendulums. Pendulums are used to keep time because they take the same amount of time to make every swing.