Coupled Resonant Pendulums

What you will need: string, dowel stick, washers, scissors, and tape.

What to do:

•Cut 3 strings- 2 short and 1 long string.

•Tie the long string to each side of the dowel stick and tape securely.

•Tie the 2 shorter strings to the longer string as shown in the photo, making sure that each string is the same length.

•Tie a nut at the end of each of the short strings. Use tape to secure and prevent motion on the longer string.

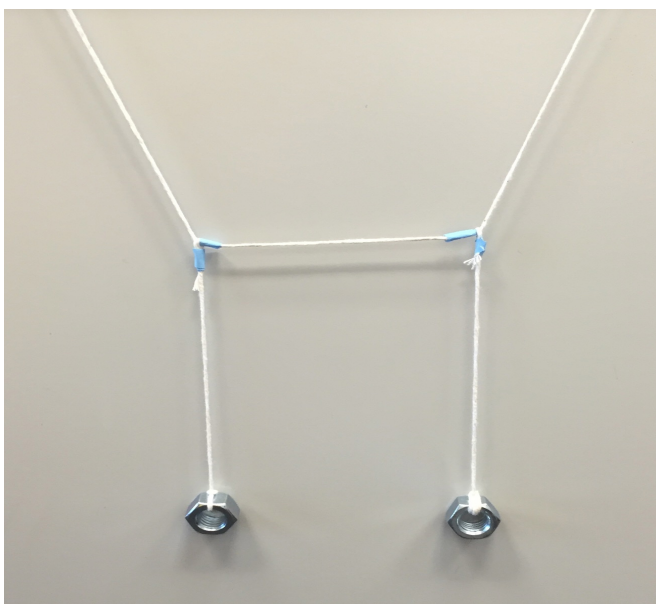
To do and notice:

•Gently pull one pendulum back a short distance and let it go. As it swings back and forth, notice that the other pendulum also begins to move, picking up speed and amplitude with each swing. Notice that the pendulum you originally moved slows down with each swing and eventually stops, leaving the second pendulum briefly swinging by itself. Then the process begins to reverse, and soon the first pendulum is swinging again while the second one is stopped.

•The pendulums repeatedly transfer the motion, energy back and forth between them.

What's going on?

As the first pendulum swings it pulls on the neighbor pendulum making its neighbor swing more. As the initially stopped pendulum's motion builds up, it also pulls on the string, slowly bringing the first pendulum to rest. When the pendulum you started comes to rest, its energy has been completely transferred to the second pendulum, which is swinging.



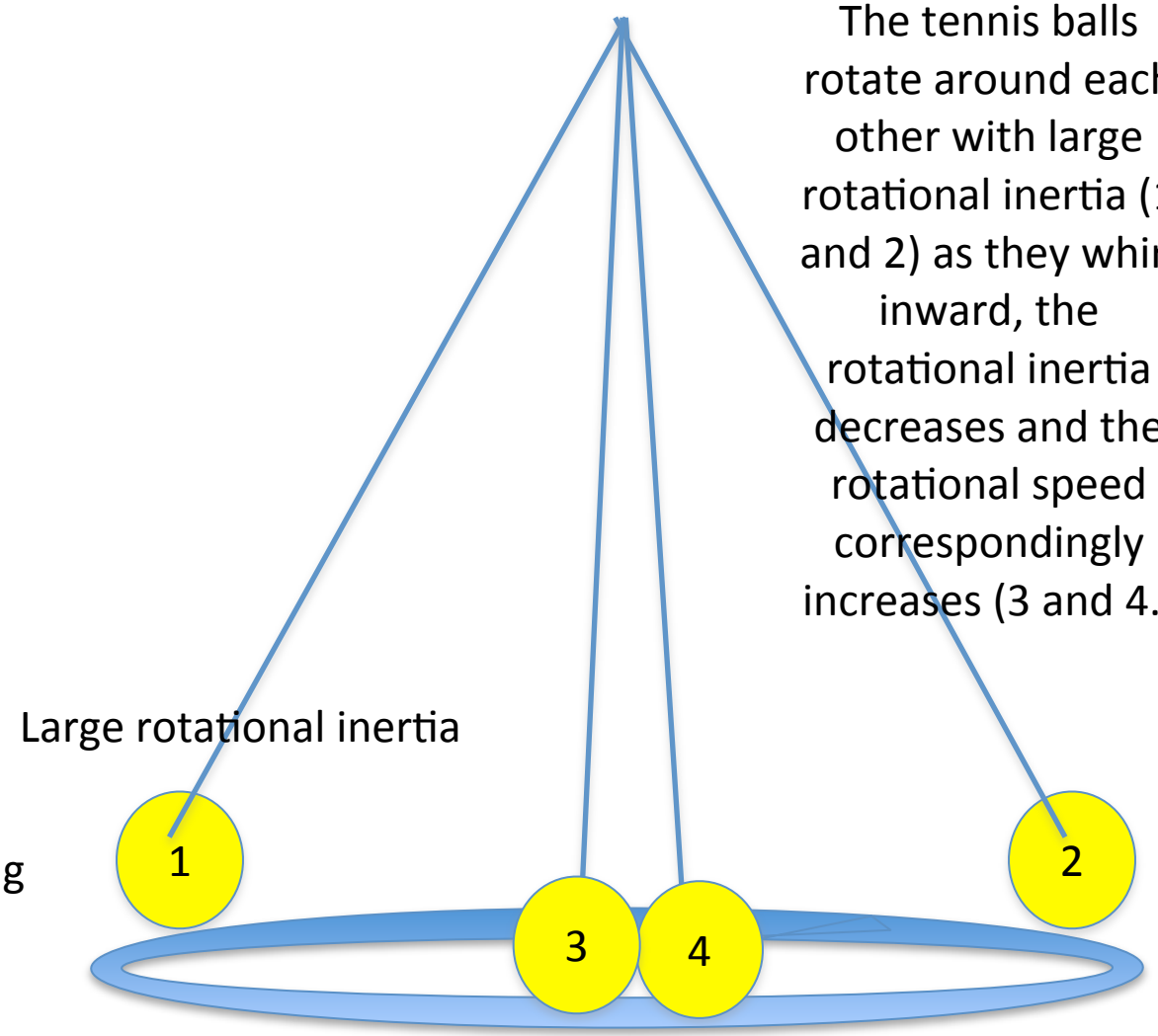
Conservation of Angular Momentum

2 colliding spheres of equal mass

Materials:
String
2 tennis balls
Eye screw (2)

Carefully attach eye screw to each tennis ball
Tie strings to each tennis ball ~ 3 ft long each.
Tie the 2 strings together

To do and notice:
Hold the strings with extended arm and begin each ball in motion rotating around each other.



The tennis balls rotate around each other with large rotational inertia (1 and 2) as they whirl inward, the rotational inertia decreases and the rotational speed correspondingly increases (3 and 4.)

Kathy Holt
LIGO SEC 2016

Pendulum Necklace (snake)

How to calculate the correct LENGTHS:

The longest pendulum on this snack is 38.79 cm (measured to the center of mass of the hexnut) and will swing back and forth 24 times in 30 seconds.

Length	**Number of Back and Forth Swings in 30 seconds**
(L)	(N)
38.79 cm	24

Subsequent lengths can be calculated by using the following formula:

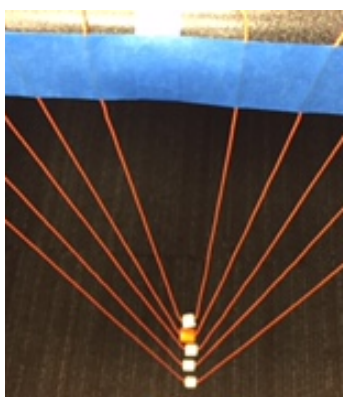
$$L_{n+1} = L_n (N/N + 1)^2$$

For example,

$$L_{25} = L_{24} (24/25)^2$$

$$L_{25} = 35.75 \text{ cm}$$

Length	**Number of Back and Forth Swings in 30 seconds**
(L) cm	(N)
38.79	24
35.75	25
33.05	26
30.65	27
28.50	28



Exploring the relationship between pendulum length and period.

What to do?

1.Cut string 2x's the length, mark both ends with a marker as shown in the diagram. Measure to the center of the mass of the nut.
2.Lay tape on the table sticky side up, use tape on each end to secure tape to table.
3.Place strings with mark at the edge of the tape so that it will hang freely.
4.Place 2nd piece of tape over the 1st to secure strings.
5.Attach the pendulum necklace to the edge of a table or counter.
6.Use a ruler to pull back all the nuts on the string at one time and release.

2106 Kathy Holt
An easier way to make and explore the Pendulum Snake.
LIGO SEC
kholt@ligo-la.caltech.edu