

Pendulum Pairs

Introduction

A pendulum is anything that can hang and swing back and forth. A swing set on a playground is a pendulum, so are telephone wires in high wind. Pendulums can be used to study many areas of science. For this activity, pendulums will put force on a string that is stretched between two objects. Start with a single pendulum, then explore what happens if two equal pendulums are on the same string.

Think About This

How do swinging containers transfer energy to each other?

Materials

-  Chairs or stools (2)
- String or yarn piece, approx. 30" long (1)
- String or yarn pieces, approx. 10" long (2-3)
- Two identical items that can be tied to the string and swing (empty bottles, washers, pens, small toys, etc.)

Do Ahead of Time

- Cut string into correct lengths
- Tie each end of the 30" string to the chairs or stools at the same height
- Tie a short string to each of the items you found. Make sure that each string is the same length
- Tie the loose end of one of the short strings onto the middle of the longer string
- Make sure that the pendulum can swing without hitting anything. Tie the string shorter if you need to

Directions

Set up a simple pendulum, then test it. Add a second equal pendulum and find out what happens when only one of the pendulums starts swinging. Try different ways of releasing the pendulums.

- 1 Attach one end of a short string to one of the items you have. Tie the other end of the short string to the middle of the long string.
- 2 Gently pull back on the pendulum to lift it a little bit, and let it go. Observe that happens as the pendulum swings.



What did you observe about one pendulum swinging?

Let's think about what might happen if a second pendulum were added to the device. Make a prediction and write it down.

Pendulum Pairs Continued

Hypothesis

IF one pendulum begins to swing,

THEN the second pendulum _____

BECAUSE _____

- 3 Attach a second pendulum to the long horizontal string. Try to put the pendulums at least six (6) inches away from each other so they do not hit. Raise the first pendulum and let it swing. How did your prediction compare to what you observed?
- 4 Draw a picture of what you think is happening.
- 5 Try a different way of making the pendulums move. What happens if both pendulums are pulled and released at the same time in the same direction? What happens if both pendulums are pulled opposite directions and released at the same time? Try it and record what you observe on a chart like the one below.

My pendulums were...	I observed this for Pendulum 1..	I observed this for Pendulum 2..	This makes me wonder...
Released in the same direction at the same time			

My pendulums were...	I observed this for Pendulum 1..	I observed this for Pendulum 2..	This makes me wonder...
Released in the opposite direction at the same time			

- 6 Try making changes. What might happen if the two strings aren't the same length? What might happen if one pendulum is heavier than the other? Make your predictions and test them out.

What's Happening?

As a pendulum attached to a string swings, it pushes and pulls on the string. The force of the pendulum pulling on the string is transferred to the second pendulum. Lightly hold the long string between two fingers while the pendulums swing to feel these forces.

These pendulums show us two of Isaac Newton's Laws of Motion:

Newton's First Law of Motion says that objects will either stay still or keep moving until a force acts on them. One pendulum swinging will keep swinging until gravity slowly stops it. When two pendulums are on a string, the force the swinging pendulum puts on the long string will start the other pendulum moving and eventually stop the first one.

As the pendulum goes back and forth, it is speeding up and slowing down. **Newton's Second Law of Motion** tells us that changes in momentum (speeding up and slowing down) generate force, which we can see as the pendulum pulls on the string.