

Topics

Pendulums, Resonance,
Conservation of Energy

Materials

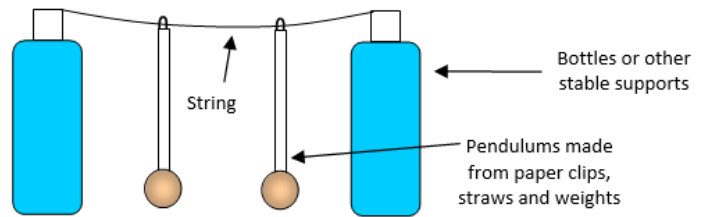
- ✓ Empty bottles or containers with lids
- ✓ Straws
- ✓ Paperclips
- ✓ Weights (washers, binder clips, other)
- ✓ String
- ✓ Tape
- ✓ Scissors
- ✓ Materials to fill bottles (e.g., sand, water, rice, stones)

Learning Standards

NGSS: Forces & Motion,
Conservation of Energy
& Momentum, Effects
of Gravity

Resonant Pendulums

Little Tugs at the Right Time Can Have Big Effects



This magical set-up is remarkable to watch in action and reveals resonance, a fundamental physical behavior of vibrating systems.

To Do and Notice

1. Fill the bottles/containers with weight (e.g. sand, water, rice, etc.).
2. Cut 12" - 18" of string, insert each end of the string into the neck of a bottle and secure the lid. You can also tape the string on top of the lids.
3. Move the bottles apart to keep the string taut.
4. Attach washer, binder clips or other small objects onto one end of each straw. Use tape if needed.
5. Hook 2 paperclips onto the string. Insert one of the paperclips into the non-weighted end of a straw. Repeat for the other straw.
6. Slide the paperclips in or out of the straws until the pendulums are equal lengths. If needed, remove the weights and trim the straws shorter (but make sure they are the same length!). Reattach weights to the straws.
7. Space the pendulums apart by a few inches. Start one pendulum gently swinging. Observe the second pendulum. What happens to each pendulum over time? What happens if you start the pendulums swinging from different heights?
8. Optional: Investigate the effects of changing the string tension, pendulum length, end weights, or adding more pendulums to the system.

The Science Behind the Activity

Every **pendulum** has a natural or **resonant frequency**. This means that it will swing back and forth (**oscillate**) a fixed number of times a second. The frequency varies with changes in the length of the pendulum. When two pendulums are coupled, the pendulum in motion tugs on the string, giving **energy** to the second pendulum to start it swinging. As the first pendulum's energy is transferred, it starts to move less. The energy continues to move between the pendulums until friction and gravity overcome the swinging motion and bring the system to rest (no motion).

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