

RAFT IDEAS

Topics: Motion,
Momentum, Amplitude,
Resonance

Materials List

- ✓ Rod, ~ 30 cm (12") long
- ✓ String
- ✓ Three identical items for weights (nuts work well)

This activity can be used to teach:

- Unbalanced forces (CA Science Standards: Grade 8, 2.b, c, d, and e)
- Conservation of Energy and Momentum (CA Science Standards: HS Physics, 2.c and 2.h)

The Magic Pendulum

It Looks Like it's All in Your Mind



This “magic” trick is an entertaining way to introduce the concept of resonance.

Assembly

1. Cut three pieces of string, each with a different length.
2. Tie each piece of string to the rod and add a weight to the bottom of each string

To Do and Notice

1. Introduce the demonstration by telling students that you are imbued with special powers of the mind and that you can make any one of the three pendulums swing while the other two remain at rest.
2. Ask the students to select which of the three pendulums they want you to control.
3. Keep the students focus on your face by adopting a look of grim concentration. Focus all your energy on the pendulum that they selected.
4. As imperceptibly as possible, gently rock the rod until the pendulums start to swing.
5. As the strings begin to move, adjust the timing of your gentle rocking to match the swing of the pendulum that you are trying to get going. Gradually the students will notice that the pendulum they selected is swinging much more than the other.
6. Repeat the trick for effect. Invite a student to try and use their “mental powers” to make the pendulum of their choice swing.

The Science Behind the Activity

This demonstration illustrates the principle of resonance, which states that applying a driving force to an oscillating system at the natural frequency of that system will lead to a large amplitude oscillation. In this case, each of the three length pendulums has a different natural frequency. By timing the gentle rocking (the driving force) to match the frequency of a specific pendulum, each little push on the pendulum occurs just as that pendulum is getting ready to start another round. As a result a large amplitude swing occurs. Since the timing does not match the frequency of the other two pendulums, no noticeable increase in the swing amplitude occurs. This is the same type of phenomena that occurs when you are pushing a child on a swing. As long as the timing of each push coordinates with the timing of the swing, each successive push adds energy to the swing, eventually resulting in a large amplitude swing.

Web Resources (Visit www.raft.net/more for how-to videos and more ideas!)

Try these other resonance activities from the Exploratorium:

- http://www.exploratorium.edu/snacks/coupled_resonant_pendlm.html
- http://www.exploratorium.edu/snacks/resonant_rings.html
- <http://www.exploratorium.edu/snacks/coupledrespend/index.html>