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Newton's Cradle
#1379

Warning:

- **Not a toy; use only in a laboratory or educational setting.**
- **California Proposition 65 Warning: This product can expose you to chemicals including lead and nickel, which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.**

Introduction

This classic desk toy and its signature click-clack noise are recognizable all across the globe, but Newton's cradle is more than just a cool novelty decoration. It is also a beautifully simple demonstration of some core concepts of physics and mechanics. With Newton's cradle, you can explore concepts such as the conservation of energy, the conservation of momentum, elastic collisions, and friction.

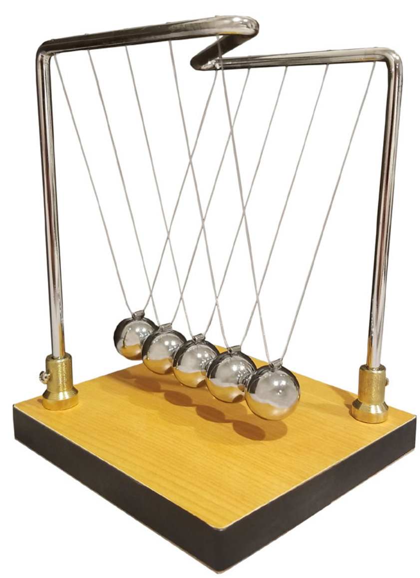
Though Newton neither invented this device nor was he the first to discover the physics it showcases, his greater contribution to physics and his **second law of motion (Force = mass x acceleration)** are the reason his name is used for it. To better understand the mechanics behind your cradle, lets define the principles behind it. The **law of the conservation of energy** states that energy, or the ability to do work, can't be created or destroyed. Similarly, the **law of the conservation of momentum** states that momentum, or the force of an object in motion in one direction, is conserved unless acted upon by an outside force. Another factor at play here is the elasticity of the balls in the cradle. **Elasticity** refers to a material's ability to deform and spring back to it's original shape without losing energy, with a material being considered more elastic the less energy it loses. Finally, friction acts as an ever-present force preventing your cradle from working indefinitely after dropping a ball one single time.

Knowing all of these principles, your cradle works as follows:

- When all balls are at rest, their kinetic (moving) energy and potential energy are zero. When a ball at the end is lifted, it gains potential energy from gravity. When that ball is released, its potential energy is converted into kinetic energy. This energy and the momentum of the ball are what are conserved in this demonstration.

- When the falling ball collides with a ball at rest, its potential and kinetic energy return to zero. The kinetic energy is transferred into the resting ball, which compresses because of its elasticity. This compression stores the potential energy in the ball until it springs back to its original shape and releases kinetic energy into the ball beside it. Energy transfers through each ball down the line in this manner until the ball at the other end raises into the air, falls back down, and begins the whole process again.

- Friction between the air and the balls and between atoms in the balls as they compress eventually slows everything to a halt. Energy is lost in the form of heat and sound because the cradle isn't "ideal" and can't escape outside forces.



How to Use

To hear the signature click-clack that Newton's cradles are famous for and to see its demonstration of simple physics, follow the instructions below.

1. Set your Newton's cradle onto a flat and level surface.

2. With every ball hanging down steadily, grab one ball on either the right or the left side of the cradle, lift it up, and release it.

3. Watch as the ball you drop collides with the remaining four balls. The ball on the opposite end of the cradle will move outward away from the group, and then fall back into the balls in the middle. The balls at either end of the cradle will continue passing energy back and forth between the stationary balls until friction slows the system to a halt.

4. Repeat step 2, but this time lift up two or three balls at a time to start the collisions. You will notice that the amount of balls that move on the opposite side of the cradle is equal to amount of balls you used to start the collisions.