

INSTRUCTIONAL GUIDE

Contents

- Bouncing Dart
- Pivot rod
- 2 Ring stand collars
- Instructional Guide

Recommended for activities:

- [Ring Stand \(66-4220\)](#)
- [Dynamics Carts \(pair\) \(P3-3530\)](#)



Background

If you fell from a tree limb onto a trampoline, you'd bounce. If you fell into a large pile of leaves, you'd come to rest without bouncing. In which case, if either, is the change in your momentum greater? This activity will help you answer that question. You will compare the changes in momentum in the collision of a "bouncing dart" where bouncing does take place and where it doesn't.

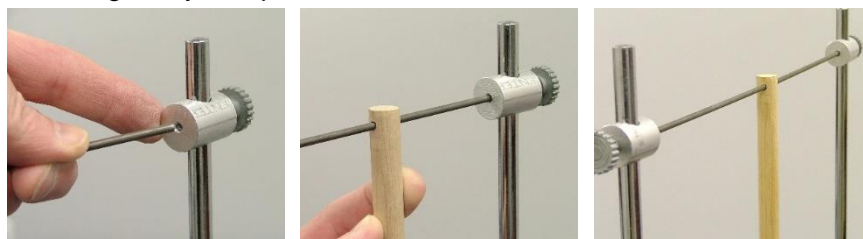
Originally developed for Paul Hewitt's Conceptual Physics, the Bouncing Dart demonstrates the energy transfer that occurs in elastic and inelastic collisions. The dart has an elastic end and an inelastic end. Swing the dart so that it collides with a massive (1kg or more) dynamics cart, and compare the distances the cart moves when hit by the different ends.

Introduction

The dart consists of a thick wooden dowel with a rubber tip on each end. Although the tips look and feel the same, the tips are made of different kinds of rubber. One end acts somewhat like a very bouncy ball. The other end acts somewhat like a lump of clay. They have different elasticities. Bounce each end of the dart on the table and you'll easily see which end is more elastic. In the activity, you'll do the same against the dynamics cart as a pendulum.

Activity

1. Using two ring stands, slide the two-ring stand clamps on to the vertical ring stand rod to approximately the same height. Then insert the thin metal rod into the small hole in one of the clamps. Slide the Bouncing Dart's long vertical dowel onto the rod at the small hole provided, so that it would swing freely at a pendulum.



Slide the other end of the thin rod into its matching hole on the other ring stand clamp. Adjust the clamp positions so that the rod is level, allows the bouncing dart to swing freely as a pendulum and that it is at the right height to strike the middle rear of the dynamics cart at the cart's lowest point.

2. Elevate the dart so that when impact is made, the cart will roll forward a foot or so on a level table or floor when struck by the inelastic end of the dart. Use a meterstick to measure the vertical distance between the release point of the dart and the bottom of its swing. Repeat several times. Record the average stopping distance of the cart.

Vertical distance = _____

Stopping distance (no bouncing) = _____

3. Repeat using the elastic end of the dart. Be sure to release the dart from the *same position* as in Step 2. Note what happens to the dart after it hits the cart. Make sure to release the dart from the same height each time. Repeat several more times to see whether your results are consistent. Record the average stopping distance of the cart.

Stopping distance (with bouncing) = _____

Data Analysis

Define the momentum of the swinging dart before it hits the cart to be positive, so that the momentum in the opposite direction is negative. After the dart bounces off the cart, is its momentum negative or positive?

The dart's momentum after the collision is negative because it is in the opposite direction from the original momentum.

When does the dart have greater momentum—when it bounces off the cart or when it doesn't?

The dart's momentum goes to nearly zero when it does NOT bounce, so its change in momentum is approximately $-mv$. When it bounces in the other direction, its change in momentum has a magnitude of greater than mv .

When does the *cart* undergo the greater change in momentum—when struck by the elastic or inelastic end of the dart?

Momentum is conserved, so when the magnitude of momentum in the dart is greater, the cart's is as well.

Conceptual Physics Lab Manual by Paul G. Hewitt. Pearson Education, Inc. pp.65.

Related Products

Air Puck Physics Kit (P4-2155) Our exclusive Air Puck Physics Kit includes two pucks, inelastic collision kit, and puck launcher.

Economy Air Track (P4-2710) The aluminum precision air track not only comes with an air source and accessories but also includes data-logger and photogates!